

MEAT CONSUMPTION IN RURAL AMERICA: FREQUENT CONSUMPTION REFLECTS
ATTITUDES AND NORMS ASSOCIATED WITH HUNTING AND AGRICULTURAL
LIVESTOCK PRODUCTION

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ABSTRACT

Meat consumption in America exceeds current recommendations and, in rural areas, the custom of hunting and agricultural livestock production may contribute to attitude and norms underlying consumption of meat overall, lean meat and hunted wild game. In the present study, a mixed methods approach applied the Theory of Planned Behavior to explore meat consumption in rural regions. Qualitative, semi-structured interviews were conducted (n=10) and iteratively coded for key themes. Qualitative findings informed the development of an online survey, which measured attitudes, subjective norms, perceived behavioral controls, consumption, and intention to consume meat overall, lean meat, and wild game on sample (n=572) of residents from 12 counties in rural New York State. Consistent with key qualitative themes, survey respondents reported strong, favorable attitudes and beliefs towards meat overall which moderately correlated with higher meat consumption, as well as family norms of daily meat consumption. Survey respondents held strong attitudes towards lean meat, which weakly correlated with consumption, and moderate attitudes towards wild game, which was infrequently consumed. T-tests showed stronger positive attitudes and norms towards meat and higher meat consumption among individuals from households with hunters, as well as individuals with some relationship to agricultural livestock production. This study provides evidence that rural Americans, especially those connected to hunting and livestock production, hold strong positive attitudes towards meat, consistent with family norms, and usually consume it daily. Further, these results suggest a gap between DGA recommendations to consume moderate amounts of mostly lean meat and the beliefs and dietary patterns of rural individuals. Registered dietitian nutritionists and community nutrition educators should approach excess meat consumption among rural clients by suggesting incremental strategies such as portion size reduction rather than promoting vegetarian options.

Future research should explore the relationships of attitudes and family norms with overall dietary quality among rural and urban residents, as well as validate our novel tools to measure wild game consumption.

BIOGRAPHICAL SKETCH

Twila Linville, RDN is a graduate student in the MS program – Dietetics Track in the Division of Nutritional Sciences at Cornell University and will to graduate in August 2019. Prior to enrolling in the MS program, she completed the dietetic internship program at Cornell University in 2018 and received a BS in Dietetics from Kansas State University in Manhattan, KS in May 2017. Her dietetic internship included rotations at the Seneca County Cornell Cooperative Extension in Waterloo, NY working in community nutrition, and at the University of Rochester Medical Center working in clinical nutrition and foodservice management.

During her graduate studies, Twila served as a graduate teaching assistant for two courses: Introduction to Public Health, where she lead student discussion groups and learning activities, and Public Health Nutrition, where she co-led and trained a team of five undergraduate teaching assistants, presented two guest lectures, and mentored students. Twila's research interests lie in food preferences and nutrition beliefs, dietary intake assessment, and the link between dietary patterns and chronic disease. In practice, she is interested in improving quality of life through public health policies and programs which target nutrition-related lifestyle behaviors for chronic disease prevention. Twila is a member of the Academy of Nutrition and Dietetics, the New York Academy of Nutrition and Dietetics, the Public Health/Community Nutrition Practice Group, and the Pediatric Nutrition Practice Group.

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CHAPTER 1

BACKGROUND AND LITERATURE REVIEW

Background

Rural Americans face multiple health disparities, which the National Library of Medicine defines as variations in disease and disability prevalence between socioeconomic and/or geographic groups.¹ Compared to their urban counterparts, in 2017, more rural Americans were obese or overweight (69% vs. 64%),^{2,3} had hyperlipidemia (42% vs. 39%),³ hypertension (38% vs. 33%),³ heart disease (9% vs 7%),³ and diabetes mellitus (12% vs 10%),³ and suffered from multiple chronic diseases (27% vs. 23%).^{3,4} Poor quality dietary patterns, which may involve excessive meat consumption, contribute to the prevalence of obesity and chronic disease.⁵ Currently, little evidence exists about meat consumption among Americans living in rural regions. Thus, understanding of sociocultural factors related to dietary patterns among rural Americans may provide evidence for addressing rural health disparities.

Conflicting nutrition recommendations for meat consumption reflect the mixed evidence about meat consumption and health outcomes. The 2015-2020 Dietary Guidelines for Americans (DGAs) list lean red meat and poultry as healthy protein sources when consumed in moderate amounts – defined as 737 grams per week or 105 grams per day.⁶ The DGAs recommend consuming only lean meats (containing less than 10% total fat and 4.5% saturated fat), given the health risks associated with consuming meat high in saturated fat.⁶ They also recommend limiting processed meat intake to fit within the overall sodium and saturated fat guidelines.⁶ The Scientific Report of the 2015 Dietary Guidelines Advisory Committee – the systematic evidence review which informs the DGAs – provides specific recommendations for maximum amounts of lean red meat (354 grams per week) and poultry (268 grams per week).⁷ However, other expert

sources report differing conclusions from the same evidence. In 2015, the World Health Organization International Agency for Research on Cancer evaluated the evidence for red and processed meat consumption and risk of cancer. In their summary of the evidence, they classified processed meats as carcinogenic to humans and red meat as probably carcinogenic to humans.⁸ However, their conclusions fail to consider the relationship between frequency and amount of red meat and health outcomes, as seen in the scientific literature and reflected in the DGAs, which suggest risk with daily consumption.

Associations between meat consumption, chronic disease and mortality require careful consideration of the conflicting evidence. Some of the mixed epidemiological evidence suggests that red meat intake increases the risk of chronic disease and mortality.^{5,9,10} In 2015, a meta-analysis of 17 cohort studies found a slightly greater risk of all-cause mortality and cardiovascular disease (CVD) mortality with one daily serving of red meat, and with one daily serving of processed meat.¹⁰ However, a smaller body of evidence from randomized controlled trials (RCT) suggests that risk remains constant with moderate meat intake in the context of a healthy diet.¹¹ Also, a comprehensive review of systematic reviews, pooled analyses, and meta-analyses found the highest intakes of red meat were associated with increased risk of chronic disease and cancer in 29 of 52 studies.⁵ The results of the recent meta-analysis of RCTs conflicted with findings from observational studies¹¹, which inconsistently adjusted for likely confounding from overall dietary quality.¹² There are fewer studies of poultry consumption (also referred to as white meat), which suggest poultry does not increase the risk of chronic disease and mortality like red meat.⁹

Meat consumption in America

Meat contributes significant energy and nutrients to dietary intake in the US (40% of protein, 20% of fat, and 15% of energy intake), with the average daily consumption of 110 grams varying by socio-demographic factors.^{13,14} Red meat, which provides significant iron, vitamin B12, and zinc, makes up the largest percentage of total meat consumed (40%), followed by unprocessed poultry (35%) and processed meat (25%).^{7,14} Although meat provides important nutrients, current rates of consumption exceed recommendations with the potential for health ramifications. Data from 2007-2010 showed 60% of Americans consumed more than the DGAs recommendations for total meat with socio-demographic factors linked to higher consumption for some types of meat.⁷ Males exceeded recommendations for total meat by a greater degree than females, and males also consumed more red meat than females, a consistent finding throughout the literature.^{7,15,16} Education level has also been associated with consumption patterns for specific types of meat. In 2003 and 2004, individuals with high school level education or less consumed the highest amounts of total, red, and processed meat, while individuals with higher levels of education (along with higher incomes) consumed more poultry on average.¹³ The limited evidence illustrates the need for more recent estimates of meat consumption in the US that consider key contributing sociodemographic factors.

Few researchers have investigated potential variations in meat consumption between rural and urban regions of the US. One analysis of national data from 1994-1996 showed rural populations consumed more red meat and less poultry than urban populations.¹⁵ Another analysis of national data from the same year found rural Americans consumed more beef and pork when dining out than their urban counterparts.¹⁷ These few, outdated estimates illustrate the need for additional evidence. The associations between higher amounts of meat consumption and chronic disease suggest future research should explore meat consumption in rural populations.

Many rural Americans live near agricultural livestock producers, as evidenced by the concentration of agriculture land, which includes land used for livestock production, in rural regions of the US with only 3% of agricultural land in urban areas.¹⁸ Other industries employ a greater percentage of rural Americans than the agricultural livestock production sector, but this sector is the major target of rural development and provides economic revenue to rural communities.¹⁹ Given the importance of agriculture and livestock production in rural economies and culture, livestock production may influence meat consumption in rural populations.¹⁹ However, to my knowledge, no research has examined this relationship.

For some rural regions of the US, hunting is a cultural norm and wild game may contribute to the typical dietary pattern.²⁰⁻²² Wild game, also called game meat and wild-harvested meat, refers to hunted and wild-caught meat.^{23,24} Although the nutritional content of wild game varies somewhat by region, current literature and the consensus of experts suggests it is a low-fat, nutrient-dense source of protein.^{24,25} Moderate amounts of wild game may be a component of a healthy dietary pattern, but variability by region and season make estimates of consumption difficult to quantify; the scientific literature lacks reliable, precise estimates. A cross-sectional study in Michigan estimated that 20% of the residents consumed venison more than 10 times throughout 2013.²⁵ Prior cross-sectional studies on a sample of avid hunters (n=454) found they consumed 28 grams of venison a day on average with, the 90th percentile consuming at least 167 g/day.^{26,27} For avid hunters and their families, wild game – in particular, venison – may contribute notably to their dietary patterns, but for most individuals in rural areas, the limited estimates suggest that wild game contributes minimally to their overall dietary pattern.

In addition to meat's nutritional contribution to the American diet, it plays a central role in American food culture. Traditionally, meat is served at the center of the plate with side dishes selected as complimentary meal components.^{24,46} Thus, understanding meat consumption requires exploration of its cultural and psychosocial context and importance. In rural America, agricultural livestock production and hunting practices – often localized in rural regions – may influence cultural and psychosocial norms regarding meat consumption, as seen in European counties.²⁸

Conceptual framework

To better understand the complexity of human behavior, Ajzen developed the Theory of Planned Behavior (TPB).^{16,29,30} This theory has been used frequently as a framework to identify explanatory variables in discrete food choices and predict food choice behavior, including meat consumption.³¹ According to this theory, attitudes, subjective norms, and perceived behavioral control predict behavioral intention, which subsequently leads to behavior. This thesis used the TBP as a framework to explore meat consumption in a rural US population (see Figure 1).

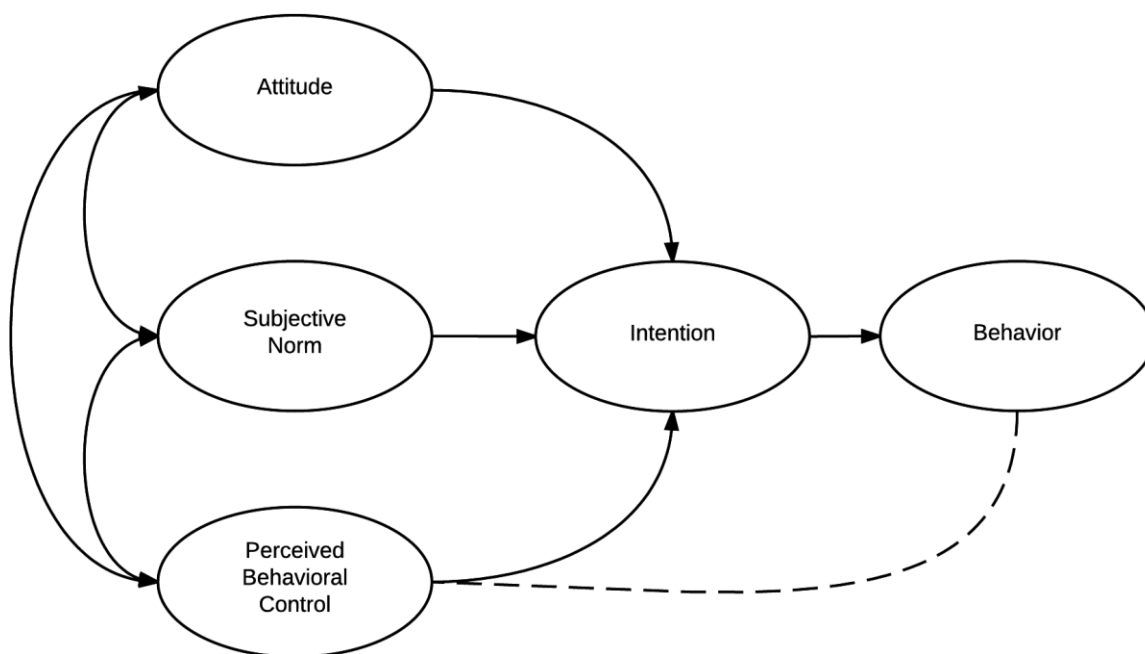


Figure 1: The Theory of Planned Behavior³¹

Although individuals have many beliefs, only a portion of their beliefs may be salient in a given circumstance (such as discrete food choices).³² Attitudes stem from salient beliefs, can be understood as the psychological tendency to negatively or positively evaluate an entity, and can reflect knowledge and preferences.³³ Although attitudes can predict behavior, the TPB posits that they predict behavioral intention more strongly than actual behavior because other variables – like perceived barriers – may prevent individuals from fulfilling their intentions.³² When the TPB has previously been applied to food choice, some individuals possessed ambivalent attitudes towards a food choice.³⁴ For example, they held positive attitudes towards taste and sensory properties but held negative attitudes formed from nutritional knowledge.³⁴ Higher degrees of ambivalence may diminish the influence of attitude on food choice and may strengthen the influence of other variables.^{30,34}

Subjective norms

Another determining construct in TPB, subjective norms represent both the norms of the surrounding community and the individual's motivation to comply with these norms.³² All individuals live surrounded by normative beliefs, but an individual's willingness to comply with these beliefs shares the extent to which norms influence his or her behavior.³¹ When used to predict food choice, some literature suggests that an inverse relationship exists between the predictive powers of individual knowledge and subjective norms – surrounding norms may play a lesser role in individuals with greater nutritional knowledge.³⁴

Perceived behavioral control

The final determinant, perceived behavioral control, includes the concepts of barriers to and self-efficacy for making a food choice. Subjective measures of controls act as a proxy for actual control – an approach investigators utilize for variables like cost and availability which are also difficult to measure directly. Perceived behavioral control reflects the degree to which actual control influences both intention and behavior.^{31,32} Perceived behavioral control can both predict intention and directly exert control on behavior bypassing intention.^{32,35} The other component of perceived behavioral control, self-efficacy, reflects an individual's confidence in performing a behavior - higher confidence increases the likelihood of performing a behavior.^{31,32} Self-efficacy, specifically for food preparation, has been shown to influence food choices.³⁶

REVIEW OF THE LITERATURE

Attitudes and beliefs regarding meat consumption

Understanding American dietary patterns requires an exploration of the underlying beliefs which lead to attitudes in food choice: importance, taste preference, and health.

Traditionally, meat plays a complex role in food culture and health beliefs, illustrated by its central place in the typical American meal structure.³⁷ These traditions interact with many different underlying beliefs to form the salient attitudes associated with meat consumption.

The importance of meat – its value – varies by socio-demographic characteristics, but few studies have examined differences in meat attitudes across geographic locations.³⁷ Two qualitative studies found rural individuals value meals with meat more than meals without meat.^{38,39} In one study, food insecure, rural respondents described the pleasure of going to the store and buying meat contrasted by the feeling of inadequacy with meatless meals.³⁸ In the context of a hunting community, another qualitative study documented the great importance of meat in comparison with other foods.³⁹ No national study to date has assessed the attitudinal factors influencing meat consumption in rural populations.

Taste preference also plays a fundamental role in meat consumption and results from the interacting quality perceptions of flavor, tenderness, and juiciness.¹⁶ One review of the literature about meat purchasing, which reflects behavioral intention to consume meat, suggested taste preferences are a predominant factor in meat choice.^{37,40} Similarly, a systematic review in 2017 including 24 studies found individuals ranked sensory characteristics highly presuming they ensured better taste.⁴⁰ However, taste preferences often conflicted with nutritional beliefs, because leaner meat often lacked the preferred taste characteristics – juiciness, tenderness, and flavor – provided by fat.^{40,41} Over the past few decades, taste preferences have shifted to leaner meats, but the sensory characteristics from fat remained important.³⁷ The importance of taste appears to vary by type of meat and country, but importance of taste in meat consumption within rural areas of the US is unknown.^{40,42}

Individuals also choose to consume meats based on perceived healthfulness and nutritional beliefs.^{40,43} In 2017, a systematic review of perspectives on beef – the most consumed meat in the US – found health and nutrition to be the 11th most important attribute.⁴⁰ However, the most important attributes included certification, labels, brand information, and visible fat, all of which provided information about the healthfulness of a cut of meat, which suggests that perceived healthfulness also may exert indirect influence.⁴⁰ Attitudes towards the healthfulness of meat appear to vary by socio-demographic factors, but the current body of literature lacks evidence about the presence and strength of these attitudes in rural regions of the US.^{40,43,44}

In rural regions, hunting and agricultural livestock production may shape attitudes towards meat and play a unique role in meat consumption. With the higher prevalence of hunting in rural areas, several researchers have explored attitudes and norms towards hunting and consuming wild game both in rural areas and across the nation.⁴⁵ Two cross-sectional studies found that many rural individuals viewed hunting positively and were more likely to know a hunter personally, which could reinforce positive attitudes towards eating meat.^{21,23} Agricultural livestock production has been documented to influence attitudes about meat in European countries,²⁸ but the scientific literature lacks evidence about the presence and strength of this association in rural America. One qualitative study described how low-income individuals valued beef shared by a local rancher;⁴⁶ however, to my knowledge, other peer-reviewed research in the US does not exist.

Subjective norms regarding meat consumption

The current scientific literature lacks evidence about rural norms for meat consumption. However, several studies provide evidence about norms for healthy eating in rural populations.

Published in 2016, evidence from one cohort of residents (n=245) recruited from community sites in rural Georgia found moderately low social support for healthy eating from family members, co-workers, and fellow church members and did not change from baseline.^{47,48}

Many Americans, both urban and rural, view hunting as an important rural tradition.²¹ Based on cross-sectional studies from 2012 and 2017, individuals are more likely to view hunting for food positively if they know a hunter, suggesting social relationships influence individual perceptions.^{21,23} However, the association between the norm for consuming wild game, an individual's motivation to comply with the norms, and consumption of wild game is not known.

Perceived behavioral control regarding meat consumption

Although individuals may prefer and value certain types of meat, barriers may place constraints on their intentions and subsequent behaviors. Notably, perceptions regarding availability, affordability, and self-efficacy for selection and preparation of meats may alter consumption of meat overall, and specifically lean meat and wild game.

One of the greater perceived barriers may be the limited availability of wild game. Most states in the US – including New York State – prohibit the sale of wild game.⁴⁵ In communities with hunters, wild game sharing can provide a source of wild game for non-hunters but at inconsequential amounts in the context of overall dietary patterns.⁴¹ In 2013, a cross-sectional study found 77% of hunters shared their catch, most often with their families but also with close friends and coworkers.⁴¹ However, individuals without family members or friends who hunt accurately perceived wild game to be largely unavailable.⁴⁹ Even some hunters perceived limited availability as a barrier to consuming wild game due to animal harvest limits, time constraints, hunting costs, and hunting success.⁴⁹

In commercial environments, many individuals perceive meat selection as complex, with many barriers to consuming lean meat. Many individuals have trouble selecting high-quality and healthful products which may indicate low self-efficacy for lean meat selection.^{50,51} To my knowledge, no prior research has examined self-efficacy for the selection of lean meats that meet the fat-content criteria of the DGAs. However, several studies have used subjective terms like minimal visceral fat and marbling, in part because the absolute fat content of meat is difficult to determine.^{41,52} This literature shows a global trend toward selection of, and preference for, lean meats (most frequently documented with red meat) and provides evidence of positive associations between preferences for lean meats and greater importance placed on health.⁵¹⁻⁵⁶ However, no similar studies have been conducted in rural US populations.

Food costs influence consumption patterns to varying degrees with a consistent, inverse association with income.^{16,40} Three qualitative studies of low-income individuals in rural America suggest that price influences both the type of meat consumed (participants in one qualitative study described being able to only afford deli meat)⁵⁷ and amount of meat consumed (another qualitative study documented respondents desired to eat meat but went without it because they could not afford it).^{38,46} These findings align with evidence from stronger study designs presenting quantitative evidence. A systematic review of beef consumption found price ranked second most important behind origin of meat, and that the importance of price was greater at lower income levels.⁴⁰ However, across all income levels, individuals believed that higher prices indicate better quality meats and prioritized perceived quality and taste preferences over price, dependent on the social circumstances of consumption.⁴² Therefore, the precise influence of price is difficult to describe.^{37,42}

Although evidence from one intervention trial linked self-efficacy for cooking with lower fat intake,³⁶ to my knowledge, no prior research has examined the relationship between self-efficacy for cooking meats and consumption. Of note, the most recent Dietary Guidelines Advisory Committee Scientific Report suggested that dietary quality can improve when cooking skills improve and skills develop to modify recipes to decrease saturated fat content in foods (including meats).²⁵ These recommendations highlight the unexplored relationship between meat preparation knowledge, self-efficacy, and the nutritional value of meat consumed by Americans.

Several characteristics of rural regions of the US may alter perceived barriers to choosing the amounts and types of meat consumed. First, in comparison to the national level, the lower median income in rural America may heighten the importance of price in meat consumption.⁶⁸ Second, alternative meat sources from hunting and local agricultural livestock production may alter the primary mechanism for acquiring meat (shopping), thereby negating or reducing barriers of affordability and altering the perceived constraints of availability and affordability. This alternative is consistent with two qualitative studies about rural Americans, who described meat from family members and friends who hunt or farm – often because they could not afford commercial meat.^{39,57} However, to my knowledge, no quantitative evidence exists about the extent individuals share meat, specifically locally raised livestock. Given the distinct characteristics of rural populations, affordability plays an unknown role in influencing their meat consumption. Ultimately, the body of literature for rural regions of the US lacks evidence about alternative meat sources and their potential to reduce the influence of common, perceived barriers to meat consumption.

The subsequent chapter will apply the TPB to explore associations between attitudes, subjective norms, perceived behavioral control, and meat consumption in a rural context. The

study uses a descriptive mixed-methods approach with a sample of rural residents of upstate New York. Chapter three explores theoretical considerations for this research, as well as directions for future research.

REFERENCES

1. Jemal A, Ward EM, Johnson CJ, et al. Health Disparities. Health Services Research Information Central. doi:10.1093/jnci/djx030
2. Barton B, Azam I. *National Healthcare Quality and Disparities Report Chartbook on Rural Health Care*. Rockville, MD; 2017. www.ahrq.gov/research/findings/nhqrd/index.html.
3. Shaw KM, Theis KA, Self-Brown S, Roblin DW, Barker L. Chronic Disease Disparities by County Economic Status and Metropolitan Classification, Behavioral Risk Factor Surveillance System, 2013. *Prev Chronic Dis*. 2016. doi:10.5888/pcd13.160088
4. National Center for Health Statistics. *Health, United States Report 2016: With Chartbook on Long-Term Trends in Health*. Hyattsville (MD); 2017.
5. Fardet A, Boirie Y. Associations between food and beverage groups and major diet-related chronic diseases: An exhaustive review of pooled/meta-analyses and systematic reviews. *Nutr Rev*. 2014. doi:10.1111/nure.12153
6. U.S. Department of Health and Human Services and U.S. Department of Agriculture. *2015 – 2020 Dietary Guidelines for Americans*. Washington, DC; 2015. doi:10.1097/NT.0b013e31826c50af
7. Dietary Guidelines Advisory Committee. *Scientific Report of the 2015 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Health and Human Services and the Secretary of Agriculture*. Washington, DC; 2015. doi:10.1017/CBO9781107415324.004
8. Bouvard R, Loomis D, Guyton KZ, et al. Carcinogenicity of consumption of red and processed meat. *Lancet Oncol*. 2015;16:1599-1600. doi:10.1016/
9. Abete I, Romaguera D, Vieira AR, Lopez De Munain A, Norat T. Association between total, processed, red and white meat consumption and all-cause, CVD and IHD mortality: A meta-analysis of cohort studies. *Br J Nutr*. 2014;112(5):762-775. doi:10.1017/S000711451400124X
10. Wang X, Lin X, Ouyang YY, et al. Red and processed meat consumption and mortality: Dose-response meta-analysis of prospective cohort studies. *Public Health Nutr*. 2015;19(5). doi:10.1017/S1368980015002062
11. O'Connor LE, Kim JE, Campbell WW. Total red meat intake of ≥ 0.5 servings/d does not negatively influence cardiovascular disease risk factors: A systemically searched meta-analysis of randomized controlled trials. *Am J Clin Nutr*. 2017;105(1):57-69. doi:10.3945/ajcn.116.142521
12. Nicklas TA, O'Neil CE, Zhanovec M, Keast DR, Fulgoni VL. Contribution of beef consumption to nutrient intake, diet quality, and food patterns in the diets of the US population. *Meat Sci*. 2012;90(1):152-158. doi:10.1016/j.meatsci.2011.06.021
13. Daniel CR, Cross AJ, Koebnick C, Sinha R. Trends in meat consumption in the United

- States. *Public Health Nutr.* 2011;14(4):575-583. doi:10.1017/S1368980010002077
14. Fehrenbach KS, Righter AC, Santo RE. A critical examination of the available data sources for estimating meat and protein consumption in the USA. *Public Health Nutr.* 2016;19(8):1358-1367. doi:10.1017/S1368980015003055
 15. Guenther PM, Jensen HH. Sociodemographic, Knowledge, and Attitudinal Factors Related to Meat Consumption in the United States. *J Am Diet Assoc.* 2005;105(8):1266-1274. doi:10.1016/j.jada.2005.05.014
 16. Lentz G, Connelly S, Miroso M, Jowett T. Gauging attitudes and behaviours: Meat consumption and potential reduction. *Appetite.* 2018;127:230-241. doi:10.1016/j.appet.2018.04.015
 17. Yen ST, Lin B-H, Davis CG. Consumer knowledge and meat consumption at home and away from home. *Food Prod Compos Consum Heal Public Policy.* 2008;33(6):631-639. doi:10.1016/j.foodpol.2008.02.006
 18. Service USD of ANAS. *Agricultural Statistics 2018.* Washington, DC; 2019. <http://www.nass.usda.gov/>.
 19. Lawley C, Furtan H. The political trade-off between environmental stringency and economic development in rural america. *J Reg Sci.* 2008;48(3):547-566. doi:10.1111/j.1467-9787.2008.00563.x
 20. Lauber TB, Brown TL. *Deer Hunting and Deer Hunting Trends in New York State.* Vol 00-1. Ithaca, NY; 2000. https://www.dec.ny.gov/docs/wildlife_pdf/hdrudeer2000.pdf.
 21. Byrd E, Lee JG, Olynk NJ. Perceptions of hunting and hunters by U.S. respondents. *Animals.* 2017;7(83):1-15. doi:10.3390/ani7110083
 22. Larson LR, Stedman RC, Decker DJ, Siemer WF, Baumer MS. Exploring the Social Habitat for Hunting: Toward a Comprehensive Framework for Understanding Hunter Recruitment and Retention. *Hum Dimens Wildl.* 2014;19(2):105-122. doi:10.1080/10871209.2014.850126
 23. Ljung PE, Riley SJ, Heberlein TA, Ericsson G. Eat prey and love: Game-meat consumption and attitudes toward hunting. *Wildl Soc Bull.* 2012;36(4):669-675. doi:10.1002/wsb.208
 24. Tidball MM, Tidball KG, Curtis P. Ecology of Food and Nutrition The Absence of Wild Game and Fish Species from the USDA National Nutrient Database for Standard Reference: Addressing Information Gaps in Wild Caught Foods. *Ecol Food Nutr.* 2014;53(2):142-148. doi:10.1080/03670244.2013.792077org/10.1080/03670244.2013.792077
 25. Goguen AD, Riley SJ, Organ JF, Rudolph BA. Wild-Harvested Venison Yields and Sharing by Michigan Deer Hunters. *Hum Dimens Wildl.* 2018;23(3):197-212. doi:10.1080/10871209.2017.1409372
 26. Burger J, Gochfeld M. Role of wild game in the diet of recreationists in South Carolina. *J Environ Plan Manag.* 2002;45(1):103-128. doi:10.1080/09640560120100213

27. Burger J. Daily consumption of wild fish and game: Exposures of high end recreationists. *Int J Environ Health Res.* 2002;12(4):343-354. doi:10.1080/0960312021000056393
28. Nijland HJ, Aarts N, Van Woerkum CMJ. Exploring the Framing of Animal Farming and Meat Consumption: On the Diversity of Topics Used and Qualitative Patterns in Selected Demographic Contexts. *Animals.* 2018;8(17):1-23. doi:10.3390/ani8020017
29. Graça J, Calheiros MM, Oliveira A. Attached to meat? (Un)Willingness and intentions to adopt a more plant-based diet. *Appetite.* 2015;95:113-125. doi:10.1016/j.appet.2015.06.024
30. Povey R, Wellens B, Conner M. Attitudes towards following meat, vegetarian and vegan diets: An examination of the role of ambivalence. *Appetite.* 2001;37(1):15-26. doi:10.1006/appe.2001.0406
31. Ajzen I. The theory of planned behavior. *Organ Behav Hum Decis Process.* 1991;50(2):179-211. doi:10.1016/0749-5978(91)90020-T
32. Ajzen I. The theory of planned behaviour: Reactions and reflections. *Psychol Heal.* 2011;26(9):1113-1127. doi:10.1080/08870446.2011.613995org/10.1080/08870446.2011.613995
33. Eagly A, Chaiken S. The psychology of attitudes. *Psychol Mark.* 1995;12(5):459-466. doi:10.1002/mar.4220120509
34. Sparks P, Conner M, James R, Shepherd R, Povey R. Ambivalence about health-related behaviours: An exploration in the domain of food choice. *Br J Health Psychol.* 2001;6(1):53-68. doi:10.1348/135910701169052
35. Ajzen I, Fishbein M. Attitude-behavior relations: A theoretical analysis and review of empirical research. *Psychol Bull.* 1977;84(5):888-918. doi:10.1037/0033-2909.84.5.888
36. McGowan L, Pot GK, Stephen AM, et al. The influence of socio-demographic, psychological and knowledge-related variables alongside perceived cooking and food skills abilities in the prediction of diet quality in adults: A nationally representative cross-sectional study. *Int J Behav Nutr Phys Act.* 2016;13(1). doi:10.1186/s12966-016-0440-4
37. Font-i-Furnols M, Guerrero L. Consumer preference, behavior and perception about meat and meat products: An overview. *Meat Sci.* 2014;98(3):361-371. doi:10.1016/J.MEATSCI.2014.06.025
38. Ahluwalia IB, Dodds JM, Baligh M. Social Support and Coping Behaviors of Low-Income Families Experiencing Food Insufficiency in North Carolina. *Heal Educ Behav.* 1998;25(5):599-612. <http://journals.sagepub.com.proxy.library.cornell.edu/doi/pdf/10.1177/109019819802500507>. Accessed July 21, 2018.
39. Smith C, Miller H. Accessing the Food Systems in Urban and Rural Minnesotan Communities. *J Nutr Educ Behav.* 2011;43(6):492-504. doi:10.1016/j.jneb.2011.05.006
40. Henchion MM, McCarthy M, Resconi VC. Beef quality attributes: A systematic review of consumer perspectives. *Meat Sci.* 2017;128:1-7. doi:10.1016/j.meatsci.2017.01.006

41. Wezemaal LV, Caputo V, Nayga RMJ, Chryssochoidis G, Verbeke W. European consumer preferences for beef with nutrition and health claims: A multi-country investigation using discrete choice experiments. *Food Policy*. 2014;44:167-176. doi:<https://dx.doi.org/10.1016/j.foodpol.2013.11.006>
42. Reicks AL, Brooks JC, Garmyn AJ, Thompson LD, Lyford CL, Miller MF. Demographics and beef preferences affect consumer motivation for purchasing fresh beef steaks and roasts. *Meat Sci*. 2011;87(4):403-411. doi:10.1016/j.meatsci.2010.11.018
43. Neff RA, Edwards D, Palmer A, Ramsing R, Righter A, Wolfson J. Reducing meat consumption in the USA: a nationally representative survey of attitudes and behaviours. *Public Health Nutr*. 2018;21(10):1835-1844. doi:10.1017/S1368980017004190
44. Wang Y, Beydoun MA, Caballero B, Gary TL, Lawrence R. Trends and correlates in meat consumption patterns in the US adult population. *Public Health Nutr*. 2010;13(9):1333-1345. doi:10.1017/S1368980010000224
45. U.S. Department of the Interior, U.S. Fish and Wildlife Service, U.S. Department of Commerce, U.S. Census Bureau. 2011 National Survey of Fishing, Hunting, and Wildlife-associated Recreation. *US Census Bur*. 2011:www.census.gov/prod/www/fishing.html. doi:10.3886/ICPSR34699
46. De Marco M, Thorburn S, Kue J. “In a Country as Affluent as America, People Should be Eating”: Experiences With and Perceptions of Food Insecurity Among Rural and Urban Oregonians. *Qual Health Res*. 2009;19(7):2009. doi:10.1177/1049732309338868
47. Haardörfer R, Alcantara I, Addison A, Glanz K, Kegler MC. The impact of home, work, and church environments on fat intake over time among rural residents: A longitudinal observational study. *BMC Public Health*. 2016;16(1). doi:10.1186/s12889-016-2764-z
48. Hermstad AK, Swan DW, Kegler MC, Barnette JK, Glanz K. Individual and environmental correlates of dietary fat intake in rural communities: A structural equation model analysis. *Soc Sci Med*. 2010;71:93-101. doi:10.1016/j.socscimed.2010.03.028
49. Julian KA. From Field to Fork: A Qualitative Investigation of Local Food Consumers’ Attitudes About Membership in Community Supported Agriculture Programs and Food Cooperatives in Southern Michigan and Assessments of Eating Wild Game Meat and Hunting as a Mechanism. 2015.
50. Brunsb K, Bredahl L, Grunert KG, Scholderer J. Consumer perception of the quality of beef resulting from various fattening regimes. *Livest Prod Sci*. 2005;94:83-93. doi:10.1016/j.livprodsci.2004.11.037
51. Wezemaal L Van, Verbeke W, De Barcellos MD, et al. Consumer perceptions of beef healthiness: results from a qualitative study in four European countries. *BMC Public Health*. 2010;10(1). doi:10.1186/1471-2458-10-342
52. Banović M, Chrysochou P, Grunert KG, Rosa PJ, Gamito P. The effect of fat content on visual attention and choice of red meat and differences across gender. *Food Qual Prefer*. 2016;52:42-51. doi:10.1016/j.foodqual.2016.03.017

53. Grunert KG. Future trends and consumer lifestyles with regard to meat consumption. *Meat Sci.* 2006;74(1):149-160. doi:10.1016/j.meatsci.2006.04.016
54. Koistinen L, Pouta E, Heikkilä J, et al. The impact of fat content, production methods and carbon footprint information on consumer preferences for minced meat. *Food Qual Prefer.* 2013;29(2):126-136. doi:10.1016/j.foodqual.2013.03.007
55. Ngapo TM, Braña Varela D, Rubio Lozano MS. Mexican consumers at the point of meat purchase. Beef choice. *Meat Sci.* 2017;134:34-43. doi:10.1016/j.meatsci.2017.07.013
56. McNeill SH. Inclusion of red meat in healthful dietary patterns. *Meat Sci.* 2014;98(3):452-460. doi:10.1016/j.meatsci.2014.06.028
57. Gross J, Rosenberger N. The double binds of getting food among the poor in rural Oregon. *Food, Cult Soc.* 2010;13(1):48-70. doi:10.2752/175174410X12549021368063

CHAPTER 2

MEAT CONSUMPTION IN RURAL AMERICA: FREQUENT CONSUMPTION REFLECTS ATTITUDES AND NORMS ASSOCIATED WITH HUNTING AND AGRICULTURAL LIVESTOCK PRODUCTION

INTRODUCTION

Rural Americans face multiple health disparities, which include higher rates of obesity and chronic diseases, in part a consequence of unhealthy dietary patterns.^{1,2} While lean meat is a good source of essential micronutrients and protein, excessive meat consumption may increase risk of chronic disease, and, therefore, is one potential contributor to rural health disparities.³

Meat consumption patterns may vary by geographic location, but the sociocultural factors underlying this variation are poorly understood.^{4,5} In rural regions of the US, agricultural livestock production and hunting practices, the predominant source of wild game, may play a largely undocumented role in rural meat consumption.⁶⁻⁹ Three cross-sectional studies investigating food access among low-income individuals described the strong preferences and norms for meat in the diet but low consumption due to cost.¹⁰⁻¹² Another small body of literature provides evidence about positive attitudes, norms and perceived behavioral controls for hunting and eating wild game, but estimates of wild game consumption are highly varied by sample characteristics from between 10-13 times per year among the general population¹³ to 28 grams daily among avid hunters.¹⁴ Given the limited evidence regarding meat consumption in rural America, the Theory of Planned Behavior (TPB) was used to frame the current body of literature and investigate the research gaps relating to the attitudes and beliefs, subjective norms and perceived behavioral controls which have been associated with meat consumption in non-rural populations.

OBJECTIVE

This thesis explored knowledge, attitudes, subjective norms, and consumption behaviors regarding meat - with emphasis on meat overall, lean meat and wild game - among residents of rural communities, through application of the TPB. To address this objective, this study investigated three exploratory research questions:

- What are the attitudes and beliefs, norms and behavioral controls regarding meat consumption (overall, lean meats, and wild game) in a rural US population?
- How are attitudes and beliefs, norms and behavioral controls associated with consumption of, and intention to consume, meat in a rural population?
- How are the practices of hunting and agricultural livestock production associated with attitudes and beliefs, norms, behavioral controls, and consumption of meat in a rural population?

METHODS

Design

This cross-sectional study used a mixed-methods design with two phases. During the first phase, the author collected qualitative data using semi-structured, in-depth interviews with a volunteer sample of residents from one rural county in New York State (NYS) to address the first research question. These interviews involved open-ended questions, grounded in the TPB, to explore nutrition beliefs, attitudes towards hunting, subjective norms, and perceived behavioral controls relating to consumption of meat overall, lean meat and wild game. The second phase addressed all research questions, by using qualitative interview findings to inform the

development of an online survey that measured perceptions, prior meat consumption, intention to consume meat, and socio-demographics. The quantitative survey was conducted, using Qualtrics software, from a sample of residents from rural counties in three regions of NYS. Results from analysis of quantitative survey data are the focus of this paper, with supporting evidence provided from qualitative interview findings. This study was exempt from review by the Cornell University Institutional Review Board on the use of Human Subjects in Research.

Setting

This study focused on the 12 rural counties in the central and western NYS. The NYS Department of Environmental Conservation regional classifications were used to define the target area, which included the Central (7), Western Finger Lakes (8), and Western (9) regions (Figure 2).¹⁵ With the target regions, rural counties were selected using the 2013 Urban Influence Codes, which classified rural counties by size of the largest city and proximity to a metro area and defined rural as a code of three or greater.¹⁶ In 2016, rural counties sold three times more hunting licenses per resident than urban counties in NYS.¹⁷ The sampling regions included some counties with notable agricultural livestock production: three ranked in the top five state-wide for the total market value of sold livestock, poultry, and their products, five ranked in the top 20, and 4 ranked in the top 35 (out of 62 counties).¹⁸ Based on the 2010 census, the sampled counties ranged in race and ethnicity from 92-97% white, in median household income from \$US 44,307-\$US 55,459, and in bachelor's degree level of education from 11-24%.¹⁹



Figure 2: New York State Regions¹⁵

Types of meat

This study focused on three categories of meat consumption: meat overall, lean meat, and wild game. Meat overall included any red or white (poultry) meat and excluded fish. Based on qualitative findings, qualitative interview participants perceived the term “lean meat” as ambiguous, so survey questions included the following examples of lean meat: 95% lean ground beef, pork loin with visible fat removed, beef with visible fat removed, 95% fat-free deli meat, and poultry without skin or fat. This definition of the term “lean” was less stringent than the definition in the DGAs (less than 10% total fat and 4.5% saturated fat).²⁰ Wild game, also referred to as game meat or wild-harvested game, was defined as hunted meats, and the survey questions used the following examples: venison, wild turkey, Canada goose, bear, and squirrel.

Phase 1: Qualitative data

Qualitative Sample

In-depth interviews were conducted with a convenience sample of adult residents from one rural county, which was stratified to represent both residents who consumed wild game regularly (defined as eating wild game at least 12 times per year), and who did not consume wild game regularly and did not raise their own meat. A qualitative sample size of 10 participants was deemed adequate, as it was within the range of participants used in other health and nutrition studies.^{21,22} Participants were recruited via an email distributed by the local Cornell Cooperative Extension (CCE) to the general community contact list, and through recruitment flyers, posted in the local CCE building. Participants met the following inclusion criteria: resident of the county, over the age of 18, ate at least one serving (85 grams) of meat per week, and intended to continue eating meat for the next year. The sample was comprised of the first five individuals to respond indicating that they consumed wild game ≥ 12 times per year, and the first five individuals to respond indicating that they consumed wild game < 12 times per year and also did not raise livestock.

Qualitative Measures

I interviewed all participants using in-depth, semi-structured interview questions which explored the constructs of attitudes and beliefs, subjective norms and perceived behavioral control. These questions were informed by Ajzen's guide for constructing a TPB questionnaire²³ and prior literature about wild game consumption.²⁴ The participants shared their perceptions of the nutritional value and importance of meat; taste preferences for meat; value of healthy food; beliefs about hunting; availability of different meats; meat cooking ability; importance of

nutrition labeling; and cost; in addition to their perceptions of family and community norms for hunting, meat, and healthy food (Table 1). The interviews lasted 40 to 50 minutes, allowing for revealing perspectives from participants. Participants also answered closed-choice demographic questions about their gender (Male, Female, Other), age (18-24, 25-30, 30-39, 40-49, 50-59, 60-69, 70+), race and ethnicity (wrote in text box), and household income (\$US 15,000 or less, \$US 15,001-30,000, \$US 30,001-45,000, \$US 45,001-60,000, \$US 60,001 or more).

Table 1: Example Interview Questions

Attitudes and beliefs

1. When considering your general health, how important do you think it is to eat meat?
2. (If you eat wild game) have you ever looked up its nutritional information? Why or why not?
3. How do you define lean meat?
4. When you consider taste, which meat do you think is the tastiest?
5. What makes wild game meats more or less tasty?
6. Do you typically remove the fat from the meat you eat?

Subjective norms

7. Would you like to share your family's views or traditions around hunting and eating wild game?
8. How does your community view hunting and eating wild game?

Perceived behavioral control

9. Do you find it easy or challenging to prepare leaner cuts of meat? Please explain why.
 10. If you wanted to consume more wild game, what would make that easier?
 11. If you wanted to consume more lean meats what would make that easier?
 12. How much does cost influence your choice of meats?
-

Qualitative Analysis

Participant interviews were audio recorded and transcribed verbatim by the principal investigator. All interviews were analyzed using Nvivo 11 qualitative data analysis program.

Prior to the first cycle of coding, a codebook was created based on the TPB and prior literature. During first cycle coding, interviews were structurally coded using provisional codes along with open-ended coding, which was used for new concepts outside of the scope of the provisional codes. Using an iterative process, the researcher updated the codebook and used the code descriptors to identify themes based on constructs from the conceptual framework. During the second cycle coding, the data were coded using the revised codebook to identify the key themes in the interviews.

Phase 2: Quantitative data

Quantitative Sample

CCE offices in the twelve counties were approached for assistance with recruitment of a convenience sample to take a web-based survey. Eight of the CCE offices distributed the survey link via an email or listserv to recipients who had participated in any extension programming, as well as to individuals who had asked to be included on the extension contact list. At one CCE office, no list existed, so CCE posted the survey link on their website. Another CCE office prohibited the use of email for non-programming purposes, so the survey link was included in their local e-newsletter. Two CCE offices within the target regions declined to distribute the survey.

The distribution phase lasted from October to November 2018 and the survey remained open for three weeks after the last distribution date. To minimize selection bias, the recruitment materials did not purposefully recruit meat consumers; instead, it was advertised as a study about food choices and culture in rural NYS. However, the study title disclosed that the study was about meat consumption. The survey sample had the following exclusion criteria: nonresident of

the 12 target counties, employee of CCE or Cornell University, or under age 18. Upon completion of the survey, respondents could enter their name and email into a drawing for three \$100 gift cards in compensation for their time.

Quantitative Measures

Measures of attitudes, subjective norms and perceived behavioral control

This study assessed the TPB constructs of attitudes, subjective norms and perceived behavioral controls, using questions which were structured based on prior TPB investigations.^{25,26} Some constructs were assessed once for an overall measure (e.g. nutrition beliefs about meat, hunting attitudes); and, others were assessed separately for meat overall, lean meat, and wild game (e.g. taste preference, importance, self-efficacy for preparation). Unless otherwise noted, all questions used 7-point Likert-type responses with “strongly disagree” and “strongly agree” as the bottom and top response anchors (Table 2). Scores from Likert-type scales were interpreted as low (1.0 – 2.9), moderate (3.0 – 4.9), and strong (5.0 – 7.0)

Attitudes and beliefs included the domain of healthy eating, and for the categories of meat overall, lean meat and wild game, the domains of nutritional beliefs, importance, and taste preferences (Table 2). Attitudes towards healthy eating were assessed by the question, “In general, how healthy is your overall diet?” with responses: “Poor”, “Fair”, “Good”, “Very good”, and “Excellent.” Under the nutrition beliefs domain, one question assessed perceived importance of meat overall in a healthy diet, and one question assessed the perceived frequency that any meat should be consumed for health with responses: “Never or less than monthly,” “A few times monthly,” “Weekly,” “Multiple times weekly,” “Daily,” and “Multiple times daily.” The midpoint of each response was used to standardize the responses, which were reported as monthly frequencies (for example multiple times weekly converted to 12.85 times per month).

To assess nutrition beliefs about lean meat, three questions of parallel structure assessed the perceived frequency that the three types of lean meat should be consumed for health, reported as a sum of monthly frequencies. One question assessed the same perception for wild game, reported as a monthly frequency. A validated Meat Attachment Questionnaire measured the importance of meat overall, reported as the mean score of the 16 questions, which has been described elsewhere.²⁷ One question assessed the importance of lean meat and another parallel question assessed the importance of wild game. Taste preference for meat overall and wild game were assessed by one question, and for lean meat using the mean score of taste preference for lean poultry and lean red meat. One question measured attitudes towards hunting animals for food.

Subjective norms were assessed for healthy eating and for consuming meat overall, lean meat, and wild game for the family and friend/neighbor domains. For meat overall, lean meat and wild game, subjective norms to eat more were assessed by one measure of norm multiplied by the question that assessed motivation to comply, which had the response anchors “Not at all” and “Very much” on a 7-point scale.²⁸ This result was divided by seven for comparison across variables.

Perceived behavioral control was measured for four domains: affordability, availability, self-efficacy for selection, and self-efficacy for preparation. For perceived affordability of meat overall, self-efficacy for selecting lean meat, and self-efficacy for preparing of lean meat, two questions assessed each domain and were reported as a mean score.

Table 2: Survey Questions for Attitudes and Beliefs, Subjective Norms and Perceived Behavioral Control

Attitudes and beliefs	
Category	Domain

–	Healthy eating	In general, how healthy is your overall diet? ^a
<i>Meat overall</i>	Nutrition beliefs	A healthy diet should include meat.
		How often do you think a healthy diet should include any meat ^b
<i>Lean meat</i>	Taste preference	I enjoy the taste of meat (poultry and red meat)
	Importance	Eating lean meat is important to me
	Taste preference	I like the taste of lean red meat (with little visible fat)
		I like the taste of poultry without the skin (breast meat)
Nutrition beliefs	How often do you think a healthy diet should include lean red meat (low fat: 95% lean ground beef, pork loin) ^b	How often do you think a healthy diet should include low fat processed meat (turkey deli meat, 95% fat-free ham) ^b
		How often do you think a healthy diet should include poultry without skin or fat (breast meat without skin)
	Importance	Eating wild game is an important part of my life
	Taste preference	I enjoy the taste of wild game meat
<i>Wild game</i>	Nutrition beliefs	How often do you think a healthy diet should include wild game meat ^b
	Hunting beliefs	I see little wrong with harvesting animals for their meat as long as the animal is not endangered
Subjective norms		
–	Healthy eating	I feel under pressure from my family to eat a healthy diet
		I feel under pressure from my friends/neighbors to eat a healthy diet
<i>Meat overall</i>	Family	How often does your family/household expect to eat meat? ^b
		My family thinks I should eat more meat
<i>Lean meat</i>	Friends/neighbors	My friends/neighbors think I should eat more meat
	Family	My family thinks I should eat more lean meat
<i>Wild game</i>	Friends/neighbors	My friends/neighbors think I should eat more lean meat
	Family	My friends/neighbors think I should eat more wild game
<i>Motivation</i>	Friends/neighbors	My family thinks I should eat more wild game
	Family	With regards to meat in your diet, how much do you want to do what your family/household think you should?
	Friends/neighbors	With regards to meat in your diet, how much do you want to do what your friends/neighbors think you should?
Perceived behavioral control		
<i>Meat overall</i>	Affordability	Sometimes I cannot afford meat ^c
		Price determines which type and cut of meat I choose ^c
	Preparation	I am confident I can prepare raw meat well

<i>Lean meat</i>	Availability	There are plenty of opportunities for me to get lean (low fat) meat
	Affordability	Eating lean meat would cost too much money ^c
	Selection	I know which meats are low in fat I don't know which cuts of red meat are considered lean (low fat) ^c
	Preparation	I am confident I can prepare raw lean (low fat) meat well Raw meat with less fat is more difficult to prepare ^c
<i>Wild game</i>	Availability	Wild game is readily available to me
	Affordability	Hunting is an affordable way for me to get meat
	Preparation	Wild game is difficult to prepare well ^c

All items are Likert-type scales [from 1-7], unless noted otherwise

^a Response choices ranged from excellent to poor on a 5-point scale

^b Frequency question with six response options

^c Question was reverse coded and recoded for consistency before analysis

Meat consumption

Meat consumption over the past year was measured by four questions from a validated food frequency questionnaire (FFQ), developed by the Nutrition Assessment of Shared Resources of Fred Hutchinson Cancer Research Center.²⁹ These questions assessed consumption of easily recognizable forms of meat: chicken or turkey; hamburger, or other ground meat; processed meat (bacon, sausage, luncheon meat or hot dogs); and beef, pork, ham or lamb. Two questions of parallel structure were developed to assess wild game consumption. One question measured venison consumption, and another question measured other wild game consumption (such as wild turkey, pheasant, or bear). Consumption frequency of meat overall was measured two ways: by the sum of all six monthly frequencies, and by one question asking about consumption of any meat (by itself or within dishes). For all consumption questions, the response scale included nine options ranging from “less than once a month” to “two or more times daily.” To standardize the data, all responses were converted to monthly frequencies using the median point within each response category. For example, the response “three to four times per week” was converted to 8.6 times per month.

For consumption frequencies of once per month or more, the following question asked about the proportion of lean meat consumption of each type of meat (with five response options): “When you ate chicken or turkey, how often did you eat the skin?” (Almost always to never); “How often was the processed meat low-fat, lean or extra lean, such as deli turkey breast or 95% fat-free ham?” (Almost always to never); “When you ate beef, pork, ham or lamb, how often did you eat the fat?” (Almost always to never); “When you ate venison, how often did it contain added fat from other animals?” (Almost always to never); “When you ate other wild game meat, how often did you eat the skin or fat?” (Almost always to never); and “When you ate hamburger or other ground meat, was it usually...” (Select all that apply: regular, lean, extra lean, ground chicken, and ground turkey). The proportion of lean meat was calculated using the following percentages: “Almost always” converted to 100%, “Often” converted to 75%, “Sometimes” converted to 50%, “Rarely” converted to “25%”, and “Never” converted to 0. Total lean meat consumption was calculated using the sum of the proportion of lean meat for all six forms of meat.

Intention to consume meat

Three questions measured intention to consume meat overall, lean meat, and wild game during the subsequent year and were developed using Ajzen’s guidelines for behavioral intention questions, consistent with the TPB.²³ The response choices for these questions were identical to those described above for meat consumption.

Demographics and sample characteristics

Survey respondents indicated if they hunted and if any other household member[s] hunted. Hunting was used to dichotomize the sample by presence any hunters in the household vs. not, which will be referred to as “household hunting status.” If the respondent or a household

member hunted, a follow up question was asked: “How often do you hunt” or “How often does your household members[s] hunt?” with the response categories: “Rarely (Less than once a year),” “Sometimes (2-5 times a year),” “Often (6-12 times a year),” “Very often (more than 12 times a year).” Respondents were asked to “describe your closest relationship to a farm[s] raising animals for food” with five response options: “Currently, I or my family have a farm raising animals for food,” “In the past, I or my family (parents) had a farm that raised animals for food,” “Close friends have a farm that raises animals for food,” “Acquaintances/neighbors have a farm raising animals for food,” and “I have no connections to farms raising animals for food.” Relationship to livestock production was dichotomized into an indicator of any relationship to livestock production vs. no relationship.

Survey respondents answered demographic questions with categorical responses about their gender (Male, Female, or Other), age (18-29, 30-39, 40-49, 50-59, 60-69, or 70+), race and ethnicity (White, non-Hispanic, Black, non-Hispanic, Hispanic or Latino, Asian, Native American or American Indian, Other, or Prefer not to respond), education (Less than high school degree, High school degree or equivalent, Some college, Associate’s degree, Bachelor’s degree, or Graduate or professional degree), household income (\$US 15,000 or less, \$US 15,001-30,000, \$US 30,001-45,000, \$US 45,001-60,000, \$US 60,001-75,000, \$US 75,001-100,000, \$US 100,001+, or I would rather not say), and household size (1-8, or 9+ residents). Respondents entered an estimate of the number of years they lived in a rural area, which was divided by the midpoint of their age range to estimate the percentage of life in a rural area which I assigned to a quartile (Table 3).

Power

Statistical power analysis (alpha = 0.05, beta .80, and effect size= 0.5 standard deviation) suggested that a minimum sample size of 64 respondents from households with hunters and 64 respondents from households without hunters was necessary to test the hypothesis that meat consumption differed between those groups. The survey sample exceeded this minimum and was considered sufficient to answer the research questions.

Quantitative Statistical Analysis

Data were checked for missing values and removed if eligible survey respondents only answered to screener questions (3.4%), or did not respond to questions about gender, age, race and ethnicity, education, and income (12.0%). After those exclusions, 85% of the sample remained. The analytic sample included the remaining 572 cases. Other incomplete responses were retained resulting in up to 3% missing data for some results.

All variables were checked for normality, defined as measures of skewness and kurtosis less than 2.0. To achieve normality across the dataset, all non-normally distributed Likert-type scales were transformed by squaring each response and all monthly frequencies by taking the square root. All transformed variables were converted back into original units before presentation of the results.

To address the first research question, I performed descriptive analysis, calculating the means and standard deviations for the attitudes and beliefs, subjective norms, perceived behavioral controls, meat consumption, and intention to consume meat.

To address the second research question, I used Pearson's correlation coefficients to detect associations between attitudes and beliefs, subjective norms, and perceived behavioral controls and consumption for each category of meat, as well as intention to consume each

category of meat. I considered correlation coefficient from 0.20 to 0.39 to be weak; 0.40 to 0.59 to be moderate; 0.60 to 0.79 to be strong; and 0.80 to 1.0 to be very strong.³⁰

To address the third research question, *T*-tests were used to detect differences in attitudes and beliefs, subjective norms, perceived behavioral controls, and meat consumption by household hunting status and by relationship to livestock production. A chi-squared test was used to detect the association between household hunting status and relationship to livestock production, gender and household hunting status, and gender and relationship to livestock production. The primary investigator performed all statistical analysis in R statistical software (version 1.1.456).

RESULTS

Sample Characteristics

Qualitative interview participants (n=10) were non-Hispanic white, over the age of 30 years, included both genders, and half had incomes over \$US 60,000 (Table 3). Similarly, the survey respondents (n= 572) were primarily non-Hispanic white and between 30 and 69 years, but most were females and two-thirds had incomes over \$US 60,000 (Table 3). Over three-quarters of the survey respondents reported residing in a rural region for at least half of their lives. The majority of the respondents lived in households of two to four persons and half of the survey respondents were the primary person who procured and prepared the meat in their households. Forty-five percent of the respondents indicated that someone within their household hunted, and 44% reported that they currently or previously had a relationship to livestock production. Household hunting status was significantly associated with relationship to livestock production ($p < 0.01$): 59% of households with a hunter also currently or previously had a

relationship to livestock production compared to 36% of households without a hunter (data not shown). Neither household hunting status nor relationship to livestock production were significantly associated with gender. Most respondents (81%) also reported typically cooking meals from basic ingredients, such as raw chicken and vegetables, multiple times a week.

Table 3: Sample Characteristics

Interview participant characteristics		Count	% (n=10)
Gender	Female	6	60
	Male	4	40
Age	30-39	3	30
	40-49	2	20
	50-59	1	10
	60-69	2	20
	70+	2	20
Race	Non-Hispanic, white	10	100
Household income	\$30,001 - \$45,000	2	20
	\$45,001 - \$60,000	2	20
	\$60,000+	5	50
	Prefer not to respond	1	10
Survey respondent characteristics		Count (n = 572)	%
Gender	Female	446	78
	Male	125	21
	Other	1	0
Age	18-29	31	5
	30-39	108	18
	40-49	98	17
	50-59	129	22
	60-69	132	23
	70 +	74	12
Race and ethnicity ^a	Non-Hispanic, white	555	98
	Non-Hispanic, black	3	1
	Hispanic or Latino	2	0
	Asian	1	0
	Native American or American Indian	1	0
	Other	1	0
Education	Less than high school degree	5	1
	High school degree or equivalent	40	7
	Some college	70	12
	Associate's degree	119	21
	Bachelor's degree	157	27

	Graduate or professional degree	181	32
Length of rural residence ^a	Less than 25% of life	43	8
	Between 25% and 50% of life	71	12
	Between 50% and 75% of life	95	17
	More than 75%	362	63
Respondent role in getting meat ^a	“I generally get meat”	283	50
	“I share the responsibility for getting meat”	223	39
	“I do not generally get meat”	65	11
Respondent role in preparing meat	“I am the primary meat preparer”	326	57
	“I share the meat preparation responsibility”	179	31
	“I do not generally prepare meat”	67	12
Respondent cooks meals from basic ingredients	Once a week or less	107	19
	Multiple times week	465	81
Household characteristics			
Income	\$15,000 or less	15	3
	\$15,001 – \$30,000	40	7
	\$30,001 – \$45,000	72	13
	\$45,001 - \$60,000	70	12
	\$60,001 – \$75,000	84	15
	\$75,001 – \$100,000	97	17
	\$100,001 or more	111	19
	Prefer not to respond	83	15
Household size	1 person	69	12
	2 persons	237	41
	3-4 persons	188	33
	5 or more persons	78	14
Hunting in household ^a	No household members hunt	310	54
	At least one household member hunts	260	46
	Respondent hunts	64	11
	Other household member hunts	159	28
	Respondent and other household member(s) hunt	37	7
	Frequency hunt (times/yr)		
	1 time/yr or less	43	17
	Between two and 12 times/yr	140	54
	12 or more times/yr	77	30
	Relationship to livestock production	Currently raise farm animals	144
Previously raised farm animals		118	20
Close friends raise farm animals		70	13
Acquaintances/neighbors raise farm animals		129	23

No connection to farms that raise animals	108	20
-------------------------------------------	-----	----

^a Characteristic missing for 1 to 9 respondents.

What are the attitudes and beliefs, subjective norms, and perceived behavioral controls regarding meat overall, lean meat and wild game?

Among the survey respondents, the most highly rated attitude for meat overall was taste preference (mean score of 6.3 out of 7), followed by the strong belief that a healthy diet should include meat (mean score of 5.6 out of 7) (Table 4). On average, survey respondents held moderate attitudes towards the importance of meat overall. Respondents also believed that meat should be consumed every other day (16.4 times/mo). Consistent with the quantitative survey results, a key theme in the qualitative interview data was the strong taste preference for meat overall, as expressed by one qualitative interview participant: “I am a carnivore and I love my beef.” Among the survey respondents, the mean taste preferences for lean meat was strong, but the perceived frequency that a healthy diet should include meat lean (7.4 times/mo) was less than half that of meat overall. For wild game, the meat taste preference was moderate (4.6 out of 7), and survey respondents reported strong, positive attitudes towards hunting (mean score of 6.2 out of 7).

Survey respondents reported that their families expected to consume meat almost every day (mean 24.7 times/mo). However, subjective norms for consuming more of each meat category were low, at both the family and friend/neighbor levels (the scores ranging from 1.4 to 2.2 out of 7). These results were consistent with a key theme in the qualitative interview data: participants described their families having positive attitudes towards consuming meat and frequently expecting to eat it. One qualitative interview participant explained: “[Meat is] the cornerstone of the meal lots of times. I don't think that anybody would throw a fit if there wasn't

any meat, but it's sort of expected." Qualitative interview participants did not describe strong norms for consuming lean meat.

Survey respondents reported strong self-efficacy for preparing meat overall (6.3 out of 7) and moderate perceived affordability of meat overall (4.2 out of 7). In contrast, the qualitative interviews revealed affordability as a barrier to meat consumption, with one participant in the qualitative interviews stating: "I do think that [meat] is a real expense, especially healthier meats." Similarly, survey respondents perceived lean meat as moderately affordable (4.6 out of 7), but, in the qualitative interviews, affordability as a consistent barrier to consuming lean meat. Interestingly, survey respondents reported wild game as moderately available. However, in the qualitative interviews, a central theme for wild game was the limited availability – discussed by participants from hunting and non-hunting households.

Table 4: Attitudes and Beliefs, Subjective Norms, and Perceived Behavioral Controls Regarding Consumption of Meat Overall, Lean Meat and Wild Game

		Mean (SD) (n=572)
Attitudes and beliefs:		
Heathy eating	Healthiness of overall diet (5-point scale)	3.4 (0.9)
Meat overall	A healthy diet should include meat	5.6 (1.5)
	Importance of meat overall	4.5 (1.3)
	Taste preference for meat ^a	6.3 (3.5)
	Meat consumption for health (times/mo)	16.4 (13.9)
Lean meat	Importance of lean meat	5.0 (1.5)
	Taste preference for lean meat ^a	5.8 (3.4)
	Lean meat consumption for health (times/mo)	7.4 (6.5)
Wild game	Importance of wild game	3.1 (1.9)
	Taste preference for wild game	4.6 (2.0)
	Wild game consumption for health (times/mo) ^b	2.7 (2.3)
Hunting	Attitude towards hunting ^a	6.2 (3.6)
Subjective norms:		
Heathy eating	Family pressure to eat a healthy diet	3.8 (1.7)
	Friends and neighbors pressure to eat a healthy diet	3.2 (1.6)
Meat overall	Family expectation of meat consumption (times/mo)	24.7 (16.1)

	Family norm to eat more meat	1.9	(1.3)
	Friends and neighbors norm to eat more meat	1.4	(1.0)
Lean meat	Family norm to eat more lean meat	2.2	(1.5)
	Friends and neighbors norm to eat more lean meat	1.5	(1.1)
Wild game	Family norm to eat more wild game	1.7	(1.3)
	Friends and neighbors norm to eat wild game	1.4	(1.1)
Perceived behavioral control:			
Meat overall	Affordable	4.2	(1.6)
	Self-efficacy for preparation ^a	6.3	(3.4)
Lean meat	Available	5.5	(1.2)
	Affordable	4.6	(1.6)
	Self-efficacy for selection	5.1	(1.2)
	Self-efficacy for preparation	5.2	(1.1)
Wild game	Available	4.7	(1.9)
	Affordable	4.5	(2.0)
	Self-efficacy for preparation	4.7	(1.7)

All items are Likert-type scales [from 1-7], unless noted otherwise

^a Likert-type scales that were not normally distributed were squared, summarized and summary measures were converted back to original scale units.

^b Frequency measures that were not normally distributed were transformed with square root, summarized, and summary measures were converted back to times/mo.

What is the reported consumption of meat and intention to consume meat?

Respondents reported consuming meat about once per day (24.4 to 37.9 times/mo.; Table 5). Often the meat consumed was lean (22.6 times/mo), but was infrequently wild game (< 1 time/mo). For meat overall and lean meat, consumption appeared higher than intention to consume but were equivalent for wild game.

Table 5: Meat Consumption Frequency and Intention to Consume Meat

	Times per month	
	Mean	(SD)
Meat consumption (past year) (n=572)		
Meat overall (one question)	24.4	(16.3)
Sum of meat overall (six questions)	37.9	(23.7)
Sum of lean meat	22.6	(14.9)
Sum of wild game ^b	0.5	(1.5)
Intention to consume meat (next year)		
Meat overall	21.6	(15.4)
Lean meat ^b	8.6	(2.3)
Wild game ^b	0.6	(1.6)

^b Frequency measures that were not normally distributed were transformed with square root, summarized, and summary measures were converted back to times/mo.

How are attitudes and beliefs, subjective norms, and behavioral controls associated with consumption and intention to consume meat?

Attitudes and beliefs regarding nutrition, importance of meat, and taste preference for meat all had moderate to strong positive correlation with consumption of meat overall (Table 6). Only family expectations for frequency of meat consumption was strongly correlated with overall meat consumption ($r=0.75$ single question). Attitudes, subjective norms, and perceived behavioral controls were weakly correlated with lean meat consumption.

Correlations between attitudes and beliefs, subjective norms, and perceived behavioral controls and intention to consume meat all mirrored the associations with consumption, except when examining intention to consume wild game (Appendix). Attitudes toward the importance of wild game ($r=0.71$) and the belief regarding the frequency of consumption of wild game for health ($r=0.64$) were strongly correlated with intention to consume wild game. Affordability and availability were moderately correlated with intention to consume wild game; in contrast, affordability was weakly correlated to wild game consumption and availability was not correlated to wild game consumption.

Table 6: Correlation between Attitudes and Beliefs, Subjective Norm and Perceived Behavioral Controls, and Meat Consumption Frequency

		Meat overall	Consumption of:		
			Sum of meat overall	Sum of lean meat	Sum of wild game
		(n=572)			
Attitudes and beliefs:					
Heathy eating	Healthfulness of diet	-0.10*	-	-0.07	0.07
			0.17***		
Meat	A healthy diet should include meat	0.43***	0.44***	0.35***	0.22**
	Importance of... ^a	0.53***	0.54***	0.41***	0.70***
	Taste preference for... ^a	0.43***	0.44***	0.32***	0.52***

	Consumption for health of... ^a	0.63***	0.54***	0.36***	0.53***
Hunting	Attitude towards hunting	0.31***	0.33***	0.28***	0.27***
Subjective norms:					
Heathy eating	Family pressure to eat a healthy diet	0.07	0.08	0.05	0.05
	Friends and neighbors pressure to eat a healthy diet	0.07	0.08	0.05	0.03
Meat	Family expectation of consumption	0.75***	0.57***	---	---
	Family norm to eat more... ^a	0.21***	0.25***	0.14***	0.28***
	Friends and neighbors norm to eat more... ^a	0.19***	0.24***	0.11**	0.21***
Perceived behavioral control:					
Meat	...is available ^a	---	---	0.12**	0.45***
	...is affordable ^a	-0.03	-0.06	-0.04	0.47***
	Self-efficacy for selection of... ^a	---	---	0.13**	---
	Self-efficacy for preparation of... ^a	0.30***	0.30***	0.11**	0.30***

^a These attitudes, norms and controls are in reference to the specific type of meat named in the column. For example, the correlation between ‘importance of meat overall’ and consumption was reported in the ‘meat overall’ column; whereas, the correlation between ‘importance of wild game’ and consumption was reported in the wild game consumption column.

Asterisks mark statistically significant differences between groups: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

How are the practices of hunting and agricultural livestock production associated with attitudes and beliefs, subjective norms, and perceived behavioral controls and consumption of meat in a rural population?

Survey respondents’ attitudes and beliefs differed: respondents in households with hunters or with a relationship to livestock production placed greater importance on and preferred the taste of all types of meat, and believed meat was more important in a healthy diet, than did their counterparts (Table 7). Similarly, qualitative interview participants with active roles in acquiring meat reported positive attitudes towards meat, such as, “[wild game] is a little bit more tastier because ... I’m out there working for it,” and “eating meat was part of my everyday life ... Meat will be apart of my daily food consumption.” Notably, the two exceptions were that survey respondents in households with and without relationship to livestock production equally rated the importance of lean meat and the healthfulness of their diets.

Similar to the distinctions in attitudes, subjective norms differed by household hunting status and relationship to livestock production. Survey respondents in households with hunters and those with some relationship to livestock production reported significantly higher frequencies of family expectation for meat consumption than did their counterparts. Consistent with the survey results, qualitative interview participants described strong norms for consuming meat within their families. One qualitative interview participant who hunted explained: “We are a hunting family. My husband, we're both from hunting families. ...like my husband loves the deer heart. ... Everybody has their certain thing they like.” Another qualitative interview participant who had an agricultural background stated: “We had it [meat] virtually every day growing up on the farm. It was just, it was there. And it was always there.” Although some subjective norms towards eating more meat differed significantly by household hunting status and relationship to livestock production, all scores were low.

Some perceived behavioral controls, most notably for wild game, significantly differed by household hunting status and relationship to livestock production. Both survey respondents with a hunter in their household and respondents with some relationship to livestock production had higher self-efficacy for preparing meat overall. Survey respondents with a hunter in their household had strong, positive perceptions of wild game’s availability and affordability; whereas, respondents without hunters in the household had moderate perceptions of wild game’s availability and affordability. This difference was consistent with the qualitative data, as one qualitative interview participant who from a non-hunting household explained: “I guess the real question would be if [wild game] was more available to me.” Qualitative interview participants who were hunters reported similar a similar barrier but to lesser degrees: “a lot of how we determine how much we eat is based on what we were able to harvest.” Additionally, survey

respondents with hunters in their household had higher self-efficacy for preparing wild game than those without hunters.

Table 7: Attitudes and Beliefs, Subjective Norms and Perceived Behavioral Controls by Household Hunting (HH) and Livestock Production

		Hunter in HH, Mean (n=260)	No hunter in HH, Mean (n=310)	Some relationship to livestock production Mean (n=461)	No relationship to livestock production Mean (n=108)
Attitudes and beliefs:					
Heathy eating	Healthfulness of overall diet (5-point scale)	3.4	3.5	3.5	3.3
Meat overall	A healthy diet should include meat	6.0	5.2***	5.7	5.0***
	Importance of meat overall	4.9	4.1***	4.6	4.0***
	Taste preference for meat ^a	6.4	5.2***	6.3	5.9***
	Meat consumption for health (times/mo)	19.9	13.2***	17.4	11.6***
Lean meat	Importance of lean meat	5.3	4.7***	5.0	4.8
	Taste preference for lean meat ^a	36.3	32.3***	5.9	5.6**
	Lean meat consumption for health (times/mo)	8.7	6.3***	7.9	5.4***
Wild game	Importance of wild game	4.1	2.1***	3.3	2.1***
	Taste preference for wild game	5.5	3.8***	4.7	4.0**
	Wild game consumption for health (times/mo) ^b	4.4	1.3***	3.1	1.1***
Hunting	Attitude towards hunting ^a	6.4	5.7***	6.2	5.3
Subjective norms:					
Heathy eating	Family pressure to eat a healthy diet	3.9	3.7	3.9	3.5
	Friends and neighbors pressure to eat a healthy diet	3.3	3.2	3.3	3.0
Meat overall	Family expectation of meat consumption (times/mo)	28.9	21.1***	26.1	18.5***
	Family norm to eat more meat	2.1	1.7***	2.0	1.5***
	Friends and neighbors norm to eat more meat	1.5	1.3	1.5	1.2*
Lean meat	Family norm to eat more lean meat	2.4	2.0**	2.3	1.9**
	Friends and neighbors norm to eat more lean meat	1.6	1.4	1.5	3.1
Wild game	Family norm to eat more wild game	2.2	1.3***	1.9	1.1***

	Friends and neighbors norm to eat wild game	1.7	1.2***	1.5	1.1***
Perceived behavioral control:					
Meat overall	Affordable	4.1	4.3	4.1	4.6*
	Self-efficacy for preparation ^a	6.5	6.2**	6.4	6.0**
Lean meat	Available	5.5	5.5	5.5	5.5
	Affordable	4.5	4.8*	4.6	4.8
	Self-efficacy for selection	5.2	5.1	5.2	5.0
	Self-efficacy for preparation	5.2	5.2	5.2	5.1
Wild game	Available	5.6	3.9***	4.9	3.5***
	Affordable	5.5	3.6***	4.8	3.4***
	Self-efficacy for preparation	5.0	4.4***	4.7	4.6

^a Likert-type scales that were not normally distributed were squared, summarized, and summary measures were converted back to original scale units.

^b Frequency measures that were not normally distributed were transformed with square root, summarized, and summary measures were converted back to times/mo.

Asterisks mark statistically significant differences between groups: *p < 0.05; **p < 0.01; ***p < 0.001

Meat consumption differed by household hunting status and relationship to livestock production (Table 8). Respondents with hunters in the household had significantly higher consumption for every category of meat than respondents without hunters present (p-value <0.001). Similarly, respondents with relationships to livestock production consumed more meat than respondents with no relationship to livestock production (p-value <0.001).

Table 8: Meat Consumption Frequency by Household Hunting (HH) and Livestock Production

	Meat overall	Consumption (times/mo) of:		
		Sum of meat overall	Sum of lean meat	Sum of wild game
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Hunter in HH				
No hunters	21.1 (15.4)***	30.6 (22.8)***	18.4 (14.7)***	0.2 (0.6)***
Hunters	28.4 (16.6)	40.8 (25.9)	23.9 (15.7)	1.3 (1.4)
Relationship to livestock production				
Some relationship	25.9 (16.5)***	40.2 (24.2)***	23.8 (15.1)***	0.7 (1.6)***
No relationship	17.2 (13.4)	28.3 (18.5)	17.5 (12.8)	0.1 (0.8)

Asterisks mark statistically significant differences between groups: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

DISCUSSION

This study provides novel evidence about meat consumption in rural America and its associations with perceptions of healthfulness, cultural norms, and hunting and agricultural livestock production. Overall, strong, favorable attitudes and beliefs towards meat were apparent and moderately associated with higher meat consumption. Perceived family norms of daily meat consumption closely correlated with consumption of meat overall. Rural residents perceived moderate barriers to meat consumption, which were only weakly associated with consumption. Relationships differed when considering meat overall, lean meat, and wild game, and each will be discussed below.

Most notably, however, the presence of hunters within the household and some relationship to agricultural livestock production were both strongly indicative of positive attitudes toward meat, subjective norms that supported meat consumption, greater perceived behavioral control over meat consumption, and higher consumption of meat. These origins may be important context to food choice decisions for rural Americans and will be explored in detail below.

Meat overall

Survey respondents held strong, positive attitudes and beliefs towards meat, which appeared primarily as taste preferences and nutrition beliefs regarding the importance of meat in a healthy diet. Together, the qualitative and quantitative findings consistently showed strong taste preferences for meat; however, in the qualitative interview data, strong taste preferences for meat accompanied great importance of meat, consistent with prior qualitative evidence from

rural, low-income Americans.^{11,31,32} In contrast, the quantitative findings showed that high intrinsic importance of meat was not closely linked to meat consumption. This discrepancy could possibly be due to the abstract nature of the term “importance,” when answering a question when contrast with the more tangible concept of taste preference. In both the qualitative and quantitative results, nutrition beliefs about meat appeared to play a substantial role in consumption. Meat was viewed as an important source of protein in the qualitative interview data. However, this study did not assess perceptions of alternative sources of protein, such as eggs, soy, beans, nuts, and seeds. Other findings from a cross-sectional study of Americans showed a third of the sample believed a healthy diet included meat, suggesting beliefs about the nutritional importance of meat vary greatly across the US.³³

These findings suggest family norms for frequent consumption of meat overall mirror individual consumption. Individual daily meat consumption could explain the finding that respondents did not feel pressure to consume more meat at either the family level or the friends and neighbors level, because this frequency approached the ceiling to the number of times per day that meat can be eaten. Of note, the lack of association between subjective norms and intention to consume meat or meat consumption is consistent with two prior studies.^{34,35} Both studies consider subjective norms more generally as norms of people who are important to the individuals, rather than identifying specific relationships.^{34,35} In contrast, both the qualitative and quantitative findings showed family subjective norms for consuming meat appeared to be stronger than subjective norms at the friends and neighbors level. One study about perceptions of omnivores and vegetarians found subjective norms (a sum of measures of norms at the family, friends, health experts, colleagues and partner levels) the weakest, yet still significant, predictor

of meat consumption.²⁸ Together with this study, my findings suggest that future applications of the TPB to meat consumption should consider the source of subjective norms.

The greatest perceived barrier to consumption was affordability, and while self-efficacy for preparing meat overall was high, neither appeared to be associated with consumption of meat overall. These findings were consistent with prior literature that showed no association between perceived behavioral control and intention to change meat consumption.^{34,35} To my knowledge, this study presents the first evidence supporting a weak relationship between self-efficacy for meat preparation and meat consumption. Of note, my sample included primarily individuals who prepared meals from basic, raw ingredients multiple times a week and had an active role in preparing meat within their household, possibly explaining the strong self-efficacy for preparation and weak correlation to consumption.

Although affordability had the lowest mean score of perceived behavioral controls, it did not appear to hinder meat consumption. This finding was consistent with prior studies, suggesting mixed perceptions about the importance and influence of price on meat consumption.^{36,37} In 2017, a systematic review of consumer perspectives regarding beef consumption showed price was the second most important characteristic (out of 21 characteristics).³⁶ However, another review of perceptions regarding meat overall highlight mixed evidence which was, in part, dependent on income level.¹⁰ Notably, the majority of my sample represented households above the median income level, and, thus, may not have reflected the perceptions of individuals from low-income households.

The average frequency of meat consumption and intention to consume meat in my sample mirrored the high national average of 110 grams per day, which exceeds the recommendations of the Dietary Guidelines Advisory Committee (89 grams per day).^{38,39}

However, the study measured frequency but did not measure serving size, which prevented the collection of precise estimates of the amount of meat consumed, as well as a direct comparison to other studies reporting servings/day or the DGAs recommendations.

Lean meat

Overall, attitudes and beliefs, subjective norms, and perceived behavioral controls appear to have the weakest association with lean meat consumption. These associations reflect similar trends to meat overall but suggest that consuming lean meat is of minimal importance to Americans in rural regions. Although respondents believed a healthy diet includes meat, lean meat did not appear to hold a major role, as the average perception was that lean meat should contribute to less than half of the total meat consumed. These findings contradict other evidence from European counties, which show a preference for leaner meat, associated with nutrition beliefs about the benefits of consuming less fat.^{40,41} This inconsistency illustrates that perceptions regarding the healthfulness of meat may vary greatly by location. Of note, the qualitative interview findings suggested the term lean was ambiguous, with some participants incorrectly describing lean meat as only poultry or white meats. Consequently, in the survey, the term “lean meat” was defined loosely with specific examples of meats. However, inaccurate perceptions about the definition of lean meat and the relatively loose definition of lean meat used in this study could explain the inconsistency between consumption of lean meat and intention. These results cannot be directly compared with other studies reporting servings/day of lean meat or to DGAs recommendations for lean meat consumption.

Other differences regarding lean meat appeared between the qualitative interview findings and the quantitative survey findings. In the qualitative interview data, participants described a lack of knowledge to identify lean meats, especially lean red meats, reflecting low

self-efficacy for selecting lean meat. Furthermore, participants described preparing leaner meat as requiring great self-efficacy, time, and effort, when compared to fattier meat, at times a barrier to consuming lean meat. In contrast, the survey results showed self-efficacy for selecting and preparing lean meat was not a barrier to consumption. Additional research should use objective measures to assess knowledge of lean meat, as well as potential barriers to consumption, because greater self-efficacy for preparing lean meat has the potential to result in lower intakes of saturated fat and improved dietary quality, as suggested by the scientific report of the Dietary Guidelines Scientific Advisory Committee.³

Wild game

Attitudes towards hunting animals for food were positive, consistent with prior evidence.^{8,42} Yet, eating wild game meat appears to hold low importance for rural Americans, even though many rural individuals consume wild game several times per year.⁴³ These findings are consistent with evidence from a recent cross-sectional study about perceptions of hunting that found hunting was viewed as an important rural tradition and acceptable if the animals were hunted for food, not for trophies.⁸

This current estimate of wild game consumption adds to the small body of evidence suggesting that it does not contribute greatly to the dietary pattern of most rural Americans, because it is consumed, on average, less than once per month. In 2018, Goguen *et al* published consistent evidence from Michigan that 40% of residents had consumed venison over the past year (possibly because the majority of hunters share their catch with other households), but only 20% of residents consumed it more than 10 times over the year.¹³ Among hunters, another cross-sectional study assessing wild game consumption in South Carolina reported venison consumption was 5 times per month and that most hunters shared their harvest of wild game

outside of their households.⁴⁴ Overall, the evidence suggests a considerable percentage of rural Americans consume wild game, albeit infrequently enough to meaningfully contribute to their dietary pattern and nutritional status. While this study measured wild game consumption, it did not assess the source of the wild game or how often hunters share their harvest.

Past estimates of wild game consumption have not considered additional meat consumption or used validated measures. To my knowledge, this study developed the first measure of meat consumption which included estimates of wild game and lean meat consumption. Consistent with prior estimates, venison was the largest contributor to wild game consumption in this study (92% of all wild game).^{14,44} Further research is needed to create a validated measure of venison and other wild game consumption.

Stronger attitudes and beliefs and greater perceived behavioral control were associated with intention to consume wild game, rather than past consumption. The qualitative interview findings suggest availability places considerable constraint on wild game consumption; whereas, survey findings suggest availability is only a moderate barrier to wild game consumption. Other qualitative findings from a study of rural Americans in 2015 found limited availability was a major barrier to consuming wild game, especially for individuals who had no interest in hunting.⁴² Possibly, individuals place great importance on wild game, because hunting plays an considerable role and provides them with a consistent source of wild game. Subsequently, because they hunt, they may intend to consume wild game more frequently. The relationship to attitudes may not appear with prior wild game consumption because non-hunters may occasionally receive wild game from hunters, as seen in prior literature.^{13,44} As a result, shared wild game could increase consumption frequency to several times per year among individuals who do not hunt or intend to consume wild game frequently.

Hunting and livestock production

Hunting and livestock production appear to indicate stronger, positive attitudes, beliefs, and subjective norms towards meat consumption and more frequent consumption of meat. Together, the qualitative interview and quantitative survey findings of this study suggest that hunting is closely linked to family norms and that families with hunters take pride in their harvest, associated with a sense of accomplishment from a successful hunt. While individuals from households with hunters may have strong attitudes towards wild game, they also appear to have stronger preferences for all categories of meat (extending beyond wild game), greater importance of meat overall, and stronger beliefs that a healthy diet should include meat. Interestingly, the presence of hunters in a household did not show nutritionally meaningful higher wild game consumption. Rather, the practice of hunting appears to indicate stronger attitudes and beliefs and subjective norms towards meat overall and more frequent consumption of meat overall. Even among households with hunters, my estimates of wild game consumption were lower than those published by 2017 from a sample of avid hunters (1.3 times/mo vs 5 times/mo).⁴⁴ However, potential differences in hunting frequency could explain the discrepancy. In my sample, only a third of the survey respondents with hunters in their household hunted at least twelve times per year, with the majority hunting between one and eleven times per year, limiting the availability of wild game in these households, as suggested by the qualitative findings.

Similar to trends by household hunting status, relationship to livestock production appears to reflect stronger attitudes and subjective norms towards meat. To my knowledge, this is the first quantitative evidence to suggest that closeness to livestock production may influence meat consumption in the US – the closer the relationship to agricultural livestock production, the

greater the frequency of meat consumption for both lean meat and meat overall. Similarly, in 2018, one cross-sectional, qualitative study exploring the perceptions of animal farming and meat consumption in Turkey and the Netherlands found differences in perceptions of livestock production were greatest between rural and urban regions.⁴⁵ Based on qualitative interview data from this study, individuals from rural regions exhibited greater acceptability of livestock production and viewed it as an essential component of to the regional economy and culture, compared to individuals from urban areas. However, the researchers did not explore whether these perceptions were reflected in differential consumption of meat. Further studies are needed compare the attitudes, beliefs, and norms, regarding meat consumption, as well as actual consumption, in rural and urban America.

Together, the qualitative interview and quantitative survey data from this study suggest that active engagement in procuring meat links with greater meat consumption. Notably, differences in attitudes and subjective norms towards meat did not reflect differences in perceptions of healthy eating or subjective norms for healthy eating. Given that nutrition beliefs may be critical factors influencing consumption, it is possible that people with a closer relationship to hunting and livestock production have similar attitudes towards nutrition and dietary quality as other individuals in rural regions. Additional research is needed to provide evidence for the relationship between nutrition beliefs about meat, meat consumption, and overall dietary quality in rural America.

Limitations

There are several limitations to this study which deserve note. First, the sampling method may have biased selection in several ways. In comparison to the target population, the convenience sample was overrepresented individuals with higher education. This may contribute

to minimal bias in estimates of overall meat consumption, as higher education is not associated with frequency of overall meat consumption.³⁸ However, this may bias the estimates of lean meat attitudes towards stronger positive attitudes and greater consumption, which have been associated with higher levels of education.³⁸ The average household income also was above the median household income, which may bias the results of the affordability domain of perceived behavioral control towards the null. I recruited the sample through CCE offices, which promote hunting and provide education for agriculture (such as 4-H). Therefore, the sample may overrepresent individuals with who hunt or may raise livestock, and bias overall estimates of attitudes towards meat overall and wild game upwards. Furthermore, this may limit the generalizability of these findings to rural areas with less hunting and livestock production. The sample also primarily contained individuals who cooked from basic ingredients multiple times a week and have primary or shared roles in acquiring and preparing meat within their household, but typical rural US household purchase meals away from home 5.36 times per week.⁴⁷ This may bias estimates of attitudes which develop through life experiences, as well as estimates of perceived behavioral control for preparing all types of meat.⁴⁸

Second, due to the exploratory nature of this study, the survey only used one to three questions to measure each construct. Further, all measures except importance of meat overall and meat consumption were not from validated questionnaires. To address this limitation, I adapted survey questions from prior studies of food choice based on the TPB. However, confusing questions or incorrect interpretations may have increased measurement error and contributed to some null findings. In addition, the limited number of measures prevented the use of techniques such as confirmatory factor analysis to validate the novel measures. Future

research could test these novel approaches in a more robust data set to perform a validation study.

Third, measuring prior food intake is known to be subject to recall bias.⁴⁶ To address discrepancies in self-reported dietary data, I measured consumption of meat overall by one question and by a sum of six questions assessing the consumption of commonly recognized types of meats, and reported results for assessment of meat consumption via both methods. Both measures behaved identically with regard to the direction of associations, although meat consumption measured by a single question correlated more closely to attitudes, subjective norms and PBCs, than the estimate of meat consumption measured by the sum of six questions.

Finally, the study design and statistical analysis also limit the interpretation of the findings. Due to the cross-sectional design, the results cannot be examined for direction of association between variables or identifying changes in meat consumption. Also, the analytical approach included many statistical tests, which heightened the risk of type one error, but were needed to examine the multiple parts of the theoretical framework, which guided the analytical approach. Notably, the primary findings were highly significant with p -values < 0.001 with low risk of type one error.

Implications

This study has important implications for dietetics practice and public health intervention in rural populations. Because clients place a high value on meat and eat it often, registered dietitian nutritionists and community nutrition educators should assess their rural clients' meat consumption, and, when exceeding the recommendations, advise their rural clients to reduce meat consumption; however, professionals also should recognize that vegetarian and vegan

recipes may not be culturally appropriate or well-received, especially by clients who hunt or work in agricultural livestock production.

The results of this study suggest that hunting and agricultural livestock production may be important factors to consider when investigating attitudes, cultural norms and behaviors in rural regions. Future study designs could compare the attitudes, norms, and PCB regarding meat, as well as meat consumption, of residents in rural regions to residents in urban regions. Future research also could expand upon this work, which estimated frequency of meat consumption, by measuring serving size to contrast meat consumption in rural areas with DGAs. While this study adds novel estimates of the frequency of wild game consumption to the largely inconsistent body of evidence, it also highlights the need for validated tools to measure wild game consumption.^{13,14,44}

Based on the results of the study, rural Americans believe that a healthy diet frequently includes meat, and that less than half of the meat eaten should be lean. These results suggest a gap between the DGA recommendations to consume mostly lean meat and the beliefs and habits of rural individuals. Future research should investigate the nutrition beliefs and knowledge of rural Americans and their overall dietary quality, in order to better understand any gaps in nutrition knowledge that could lead to negative health outcomes.

CONCLUSIONS

In summary, this study found that Americans in rural areas have strong, positive preferences and attitudes towards meat, consistent with subjective norms among households. Foremost, taste preferences and nutrition beliefs were the strongest attitudes and positively correlated with consumption. Household expectations regarding meat consumption closely

correlated with individual meat consumption. In the presence of strong preferences, few barriers may minimally influence meat consumption. In addition, hunting appears to be a commonly accepted practice, but eating wild game may not contribute greatly to overall dietary intake. However, hunting may indicate greater individual value of meat overall and subsequent consumption, extending beyond wild game. Lastly, some relationship to agricultural livestock production appears to indicate stronger taste preferences, nutritional beliefs, and family subjective norms towards meat, and higher meat consumption. These insights provide valuable information for practice and illustrate the need for additional research to understand the dietary patterns of Americans in rural regions.

REFERENCES

1. Shaw KM, Theis KA, Self-Brown S, Roblin DW, Barker L. Chronic Disease Disparities by County Economic Status and Metropolitan Classification, Behavioral Risk Factor Surveillance System, 2013. *Prev Chronic Dis*. 2016. doi:10.5888/pcd13.160088
2. National Center for Health Statistics. *Health, United States Report 2016: With Chartbook on Long-Term Trends in Health*. Hyattsville (MD); 2017.
3. Dietary Guidelines Advisory Committee. *Scientific Report of the 2015 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Health and Human Services and the Secretary of Agriculture*. Washington, DC; 2015. doi:10.1017/CBO9781107415324.004
4. Guenther PM, Jensen HH. Sociodemographic, Knowledge, and Attitudinal Factors Related to Meat Consumption in the United States. *J Am Diet Assoc*. 2005;105(8):1266-1274. doi:10.1016/j.jada.2005.05.014
5. Yen ST, Lin B-H, Davis CG. Consumer knowledge and meat consumption at home and away from home. *Food Prod Compos Consum Heal Public Policy*. 2008;33(6):631-639. doi:10.1016/j.foodpol.2008.02.006
6. Service USD of ANAS. *Agricultural Statistics 2018*. Washington, DC; 2019. <http://www.nass.usda.gov/>.
7. Lauber TB, Brown TL. *Deer Hunting and Deer Hunting Trends in New York State*. Vol 00-1. Ithaca, NY; 2000. https://www.dec.ny.gov/docs/wildlife_pdf/hdrudeer2000.pdf.
8. Byrd E, Lee JG, Olynk NJ. Perceptions of hunting and hunters by U.S. respondents. *Animals*. 2017;7(83):1-15. doi:10.3390/ani7110083
9. Larson LR, Stedman RC, Decker DJ, Siemer WF, Baumer MS. Exploring the Social Habitat for Hunting: Toward a Comprehensive Framework for Understanding Hunter Recruitment and Retention. *Hum Dimens Wildl*. 2014;19(2):105-122. doi:10.1080/10871209.2014.850126
10. Font-i-Furnols M, Guerrero L. Consumer preference, behavior and perception about meat and meat products: An overview. *Meat Sci*. 2014;98(3):361-371. doi:10.1016/J.MEATSCI.2014.06.025
11. Ahluwalia IB, Dodds JM, Baligh M. Social Support and Coping Behaviors of Low-Income Families Experiencing Food Insufficiency in North Carolina. *Heal Educ Behav*. 1998;25(5):599-612. <http://journals.sagepub.com.proxy.library.cornell.edu/doi/pdf/10.1177/109019819802500507>. Accessed July 21, 2018.

12. Smith C, Miller H. Accessing the Food Systems in Urban and Rural Minnesotan Communities. *J Nutr Educ Behav.* 2011;43(6):492-504. doi:10.1016/j.jneb.2011.05.006
13. Goguen AD, Riley SJ, Organ JF, Rudolph BA. Wild-Harvested Venison Yields and Sharing by Michigan Deer Hunters. *Hum Dimens Wildl.* 2018;23(3):197-212. doi:10.1080/10871209.2017.1409372
14. Burger J, Gochfeld M. Role of wild game in the diet of recreationists in South Carolina. *J Environ Plan Manag.* 2002;45(1):103-128. doi:10.1080/09640560120100213
15. Department of Environmental Conservation. Regions. <https://www.dec.ny.gov/about/50230.html>. Accessed March 3, 2017.
16. Parker T. Documentation. United States Department of Agriculture Economic Research Service. <https://www.ers.usda.gov/data-products/urban-influence-codes.aspx>. Published 2018. Accessed March 3, 2019.
17. License Sales by County for Current License Year 2015-2016. 2016. <ftp://ftp.dec.state.ny.us/dfwmr/licsales/>.
18. Farms L. 2012 Census of Agriculture County Profile - Seneca County, New York. *USDA Census Agric.* 2012:1-2.
19. Population Database. United States Census Bureau. https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml?src=bkmk. Published 2010. Accessed March 17, 2019.
20. U.S. Department of Health and Human Services and U.S. Department of Agriculture. *2015 – 2020 Dietary Guidelines for Americans*. Washington, DC; 2015. doi:10.1097/NT.0b013e31826c50af
21. Safman RM, Sobal J. Qualitative sample extensiveness in health education research. *Heal Educ Behav.* 2004;31(1):9-21. doi:10.1177/1090198103259185
22. Sobal J. Sample Extensiveness in Qualitative Nutrition Education Research. *J Nutr Educ.* 2006;33(4):184-192. doi:10.1016/s1499-4046(06)60030-4
23. Ajzen I. Constructing a Theory of Planned Behavior Questionnaire. 2010.
24. Moore M. Eating Locally: How Perceived Motivations and Barriers Influence Consumption of Wild Game and Fish. 2001:30.
25. Verbeke W, Vackier I. Individual determinants of fish consumption: application of the theory of planned behaviour. *Appetite.* 2005;44:67-82. doi:10.1016/j.appet.2004.08.006
26. Armitage CJ, Conner M. Distinguishing perceptions of control from self-efficacy: Predicting consumption of a low-fat diet using the theory of planned behavior. *J Appl Soc Psychol.* 1999;29(1):72-90. doi:10.1111/j.1559-1816.1999.tb01375.x

27. Graça J, Calheiros MM, Oliveira A. Attached to meat? (Un)Willingness and intentions to adopt a more plant-based diet. *Appetite*. 2015;95:113-125. doi:10.1016/j.appet.2015.06.024
28. Povey R, Wellens B, Conner M. Attitudes towards following meat, vegetarian and vegan diets: An examination of the role of ambivalence. *Appetite*. 2001;37(1):15-26. doi:10.1006/appe.2001.0406
29. Center FHCR. Food Frequency Questionnaire. Nutrition Assessment Shared Resource. <https://sharedresources.fredhutch.org/processes/citing-nasr>. Accessed October 4, 2019.
30. Evans J. *Straightforward Statistics for the Behavioral Sciences*. Pacific Grove: Brooks/Cole Publishing; 1996.
31. De Marco M, Thorburn S, Kue J. “In a Country as Affluent as America, People Should be Eating”: Experiences With and Perceptions of Food Insecurity Among Rural and Urban Oregonians. *Qual Health Res*. 2009;19(7):2009. doi:10.1177/1049732309338868
32. Gross J, Rosenberger N. The double binds of getting food among the poor in rural Oregon. *Food, Cult Soc*. 2010;13(1):48-70. doi:10.2752/175174410X12549021368063
33. Neff RA, Edwards D, Palmer A, Ramsing R, Righter A, Wolfson J. Reducing meat consumption in the USA: a nationally representative survey of attitudes and behaviours. *Public Health Nutr*. 2018;21(10):1835-1844. doi:10.1017/S1368980017004190
34. Lentz G, Connelly S, Miroso M, Jowett T. Gauging attitudes and behaviours: Meat consumption and potential reduction. *Appetite*. 2018;127:230-241. doi:10.1016/j.appet.2018.04.015
35. Graça J, Oliveira A, Calheiros MM. Meat, beyond the plate. Data-driven hypotheses for understanding consumer willingness to adopt a more plant-based diet. *Appetite*. 2015. doi:10.1016/j.appet.2015.02.037
36. Henchion MM, McCarthy M, Resconi VC. Beef quality attributes: A systematic review of consumer perspectives. *Meat Sci*. 2017;128:1-7. doi:10.1016/j.meatsci.2017.01.006
37. Reicks AL, Brooks JC, Garmyn AJ, Thompson LD, Lyford CL, Miller MF. Demographics and beef preferences affect consumer motivation for purchasing fresh beef steaks and roasts. *Meat Sci*. 2011;87(4):403-411. doi:10.1016/j.meatsci.2010.11.018
38. Daniel CR, Cross AJ, Koebnick C, Sinha R. Trends in meat consumption in the United States. *Public Health Nutr*. 2011;14(4):575-583. doi:10.1017/S1368980010002077
39. Fehrenbach KS, Righter AC, Santo RE. A critical examination of the available data sources for estimating meat and protein consumption in the USA. *Public Health Nutr*. 2016;19(8):1358-1367. doi:10.1017/S1368980015003055
40. Wezemaal L Van, Verbeke W, De Barcellos MD, et al. Consumer perceptions of beef

- healthiness: results from a qualitative study in four European countries. *BMC Public Health*. 2010;10(1). doi:10.1186/1471-2458-10-342
41. Andrade JC de, Aguiar Sobral L de, Ares G, Deliza R. Understanding consumers' perception of lamb meat using free word association. *Meat Sci*. 2016;117:68-74. doi:10.1016/j.meatsci.2016.02.039
 42. Julian KA. From Field to Fork: A Qualitative Investigation of Local Food Consumers' Attitudes About Membership in Community Supported Agriculture Programs and Food Cooperatives in Southern Michigan and Assessments of Eating Wild Game Meat and Hunting as a Mechanism. 2015.
 43. Goguen AD. Sharing and Consuming Wild Harvested Meat: Providers and Receivers of Venison. *Thesis*. 2015.
 44. Smith JB, Tuberville TD, Beasley JC. Hunting and Game Consumption Patterns of Hunters in South Carolina. *J Fish Wildl Manag*. 2017;9(1):321-329. doi:10.3996/032017-JFWM-028
 45. Nijland HJ, Aarts N, Van Woerkum CMJ. Exploring the Framing of Animal Farming and Meat Consumption: On the Diversity of Topics Used and Qualitative Patterns in Selected Demographic Contexts. *Animals*. 2018;8(17):1-23. doi:10.3390/ani8020017
 46. Naska A, Lagiou A, Lagiou P. Dietary assessment methods in epidemiological research: current state of the art and future prospects. *F1000Research*. 2017;6:926. doi:10.12688/f1000research.10703.1
 47. Todd, J, Scharadin, B. Where Households Get Food in a Typical Week: Findings From USDA's FoodAPS. *EIB*. 2016; 156.
 48. Houwer JD, Thomas S, Baeyens F. Associative Learning of Likes and Dislikes: A Review of 25 Years of Research on Human Evaluative Conditioning. *Psych Bull*. 2001;127(6):853-69. DOI: 10.1037//D033-2909.127.6.853

CHAPTER 3

DISCUSSION

The discussion included in this chapter will explore several topics which lie beyond the scope of the prior chapters. First, I will discuss the classical applications of the TPB to the consumption of different types of meat. Second, I will explore the role and importance of meat consumption perceptions and their origins (i.e. hunting and livestock production). Finally, the chapter will end by framing the findings of this thesis within the context of the global need for environmental sustainability and the consumer demand for convenience in meat consumption.

Interaction between TPB constructs applied to the consumption of different types of meat

The TPB posits that attitudes, subjective norms, and perceived behavioral controls interact to influence behavior. Because of differences in attitudes, subjective norms, and perceived behavioral controls towards meat overall, lean meat and wild game, these constructs and their associations with meat consumption need to be described separately for each type of meat. In this thesis, attitudes towards meat overall were moderately correlated with consumption of meat overall. Other literature from Graça *et al* in 2015 and Lentz *et al* in 2018 investigating attachment and attitudes towards meat to understand individual willingness to reduce meat consumption found positive attitudes and strong attachment to meat (measured via the meat attachment questionnaire) were inversely associated with willingness and intention to reduce meat consumption.^{1,2} This literature is not directly comparable with my results for meat overall but suggests a similar pattern: positive attitudes towards meat link to higher meat consumption. When considering lean meat consumption, respondents reported strong, positive attitudes towards lean meat, but they weakly correlated with consumption. To my knowledge, other

literature has not applied the TPB to lean meat consumption. In contrast to lean meat, attitudes towards wild game (most notably importance and consumption for health) strongly correlated with intention to consume meat.

Weak correlations were present between some subjective norms for consuming more meat overall, but the mean scores were low. Interestingly, family expectation for consumption of meat overall strongly correlated with individual consumption, a relationship that has not been considered in prior literature on meat consumption to my knowledge. This finding suggests family norms may be the main source of subjective norms regarding meat consumption for rural individuals. Two prior studies, not specific to rural regions of the US, from Graça *et al* and Lentz *et al* found no link between subjective norms and meat consumption,^{1,2} while another cross-sectional study found a weak association.³ When generally considering discrete food choice, one systematic review and meta-analysis of studies applying the TPB to food choice found subjective norms had the weakest association to behavior of all the TPB constructs. For lean meat, the lack of associations between subjective norms for lean meat and consumption aligns with prior literature, not specific to lean meat, that has not shown a relationship between subjective norms and consumption.^{1,2} This thesis showed low subjective norms to consume more wild game and the subjective norms weakly correlated with consumption, even though wild game consumption was relatively infrequent (0.5 times/mo) and could plausibly increase in frequency.

Most domains of perceived behavioral control had weak or no association with intention to consume and consumption of meat overall and lean meat. On the other hand, for wild game, the perceived behavioral control domains of availability and affordability moderately correlated with consumption. Prior studies from Graça *et al* and Lentz *et al* investigating attitudes and attachment towards meat to understand individual willingness to reduce meat consumption

defined perceived behavioral control as confidence and ability to reduce or change meat consumption and did not assess barriers to continuing current meat consumption.

Understanding the interaction between attitudes, subjective norms and perceived behavioral control may further explain differences in the behaviors of consuming specific types of meat. While a plausible relationship between attitudes and perceived behavioral control may exist in the context of meat consumption, their relationship to subjective norms is more uncertain. The current literature suggests a relationship between an individual's strength of attitude towards meat and degree of perceived behavioral control. This suggests a plausible relationship between stronger attitudes towards meat and greater perceived behavioral control in the context of meat consumption overall. Although prior literature has not applied TPB to wild game consumption, in the quantitative survey data, a moderate association was present between the importance of wild game and the perceived affordability of hunting wild game (p-value <0.001). When considering attitudes and beliefs towards nutrition, prior literature showed an inverse relationship between perceived nutrition knowledge and subjective norms in food choice and eating behavior.^{4,5} However, to my knowledge, the current body of literature on discrete food choice lacks clear evidence about the relationship between attitudes and subjective norms. It should be noted that all of the studies discussed did not represent individuals with low incomes, which may lower perceived behavioral control. Future research could examine the relationship between subjective norms and attitudes and beliefs among the general population and among individuals with lower incomes.

The TPB vs. the Food Choice Process Model

Classically, the TPB focuses on identifying existing attitudes, subjective norms and perceived behavioral controls that predict behavior but does not aim to identify the origin of these influential constructs, as other theoretical frameworks do. Prior studies applying the TPB have often adjusted regression models for variables that might explain observed variance in these constructs.⁶ This thesis applied the TPB framework to examining meat consumption and generated results which highlight the utility of considering external characteristics, such as hunting practices, to better understand variability in construct and subsequent behavior. With this additional consideration of the origins of attitudes, subjective norms, and perceived behavioral controls, the Food Choice Process Model may give additional insights into my findings and provide a useful framework for future qualitative research in this area.⁷

When considering the TPB, the Food Choice Process Model, and the findings of this thesis, the Food Choice Process Model includes the life course events and experiences construct, which is not a component of the TPB.⁷ This construct, which lies at the foundation of the Food Choice Process Model, encompasses five components (trajectories, transitions, turning points, timing, context), of which trajectories and contexts warrant further discussion in light of my findings. Trajectories include the pathways of people over time, which may explain the consistency between family expectation of meat consumption and later individual meat consumption. The component of context, which is the broader social and physical environment surrounding an individual, also provides insight into my findings. Based on my results, living in the context of livestock production has the potential to shape both individual attitudes towards meat and meat consumption. Of note, my thesis did not directly assess transitions/turning points or timing, but these components suggest additional directions for future researchers to explore.

Livestock production and hunting as an origin of perceptions

My findings suggest that having a relationship to livestock production may influence the traditions and perceptions of an individual. This is consistent with a report from the Pew Commission on Industrial Farm Animal Production which described the history and recent transitions in the role of agricultural livestock production within many rural communities. This report highlighted the essential role of livestock production in rural community norms.⁸ Until the last 30 years, livestock production played a central role in the economic vitality of many rural communities, and although its importance has declined in the past few decades, livestock production still appears to be closely associated with community norms.⁸ Livestock producers employ community residents, rely on local businesses for products and support, and funnel revenue into their local communities.⁸⁻¹⁰ The centrality of livestock production in some rural communities may help to explain positive perceptions and higher consumption of meat among individuals with a relationship to agricultural livestock production.

My findings also suggest an association between hunters in the household and stronger positive attitudes and subjective norms towards meat, in addition to higher meat consumption. The presence of hunters within a household is one potential origin of beliefs. Becoming a hunter has been consistently associated with family support and having a hunter role model.¹¹ This is partly because hunting wild game represents unique values as it demands large amounts of time and energy with harvesting and preparing, in addition to safety risks.¹² A qualitative study exploring the interests of non-hunter local food consumers in initiating hunting found some of the burden of preparing harvested wild game could be transferred to meat processing plants at a cost, but the act of hunting itself required considerable time and preparation, which was a major barrier. Community norms towards hunting also appeared to play a notable role in the initiation

and continuation of hunting.¹¹ This thesis left two gaps for future research considerations regarding rural hunting norms and meat consumption. First, it lacked a measure of social relationships to hunters for individuals in a household without hunters. Second, while it measured individual attitudes towards hunting, it did not assess family or community norms towards hunting. Future research could explore the link between a social relationship with a hunter and perceptions of meat and consumption.

Global environmental sustainability and meat consumption

Scientists nationally and globally have voiced concerns about meat consumption and rising concerns about environmental sustainability. The Dietary Guidelines Advisory Committee illustrated national concerns by reporting their review of the evidence regarding dietary patterns and associations with environmental outcomes, as well as recommendations to lower current meat consumption.¹³ Similarly, the international EAT-Lancet report, published in 2019, highlighted the concerns raised by many scientists and public policy professionals regarding the environmental sustainability of meat consumption.¹⁴ My findings suggest individuals who hunt may place greater importance on including meat frequently in their diet, both wild game and commercially produced meat alike. In light of this finding and overall declines in hunting, more hunting among families with hunters may be a sustainable solution - with additional benefits of wildlife population control and maintenance - to alleviate some of the demand for commercial meat among heavy consumers.^{48,63} Considering these environmental concerns, several prior authors have proposed hunting wild game as an environmentally sustainable alternative source of meat.^{11,15} Further, wild game, as a source of lean protein, could have nutritional benefits to rural Americans.

Consumer demand for convenience in meat consumption

In contrast to long-term concerns of global sustainability, consumer demand within the US and globally has shifted to more convenient food products, and specifically meat products.^{13,16} A review of recent trends in meat consumption discussed this shift and proposed that the recent increase in demand for convenience foods was surrounded by conflicting attitudes.¹⁶ Contemporary attitudes towards meat products placed great importance on ease of preparation; whereas, traditional attitudes towards meat and cooking were associated with negative attitudes towards convenient meat products in which the meat ingredients were less visible. Given the positive attitudes towards meat observed in this thesis, one plausible hypothesis is that individuals with traditional perceptions about fresh meat are less likely to consume convenience meat products. This trend in convenience meat also raises questions regarding family norms for specific types of meat. Future research should consider the influence of convenience on meat consumption overall and specific types of meat, in the context of both households with hunters and other rural American households.

Conclusions

This descriptive study provides novel evidence for strong preferences and frequent consumption of meat in rural regions of the northeast US. Individual consumption appears to closely reflect household expectations, with minimal constraints on behavior from availability and self-efficacy for preparation. Households with hunters appear to have stronger, positive attitudes towards meat and to consume meat more frequently than those without hunters. Interestingly, hunted wild game is one potential source of ecologically sustainable meat, but the

practice to hunting demands considerable time and conflicts with the consumer desire for convenient meat products that are easy and quick to prepare. Similar to hunting, an individual's relationship to agricultural livestock production may translate to considerable differences in meat preferences and consumption. While my thesis answers some questions, my findings introduce additional questions. First, how do the constructs within the TPB interact with one another in explaining meat consumption among rural residents? Understanding how individual attitudes interact with norms may provide further insights into meat consumption, and in situations of excessive meat consumption, may identify barriers to improving dietary quality. Second, would the Food Process Model provide a different framework to explore and understand meat consumption in rural regions, given the considerations of trajectory and context? Although the TPB is one framework through which meat consumption can be understood, the TPB has limitations, and applying the Food Choice Process Model may provide additional insights into rural meat consumption that are beyond the scope of the TPB. Third, does hunting and livestock production play a causal role in perceptions and consumption of meat among rural residents? My findings suggest associations, but the study design limits making causal claims about the practices and attitudes. Finally, what role might hunting and wild game consumption play in the context of national demands for ecological sustainability and consumer convenience? Although hunting provides an ecologically sustainable source of meat, hunting requires considerable time and energy and is not a convenient source of meat. Overall, rural Americans appear to place great importance on frequently including meat overall in their diet consistent with their family norms and greatest among individuals with relationships to livestock producers and hunters, who hold distinctly stronger, positive attitudes towards wild game.

REFERENCES

1. Lentz G, Connelly S, Miroso M, Jowett T. Gauging attitudes and behaviours: Meat consumption and potential reduction. *Appetite*. 2018;127:230-241. doi:10.1016/j.appet.2018.04.015
2. Graça J, Calheiros MM, Oliveira A. Attached to meat? (Un)Willingness and intentions to adopt a more plant-based diet. *Appetite*. 2015;95:113-125. doi:10.1016/j.appet.2015.06.024
3. Carfora V, Caso D, Conner M. Correlational study and randomised controlled trial for understanding and changing red meat consumption: The role of eating identities. *Soc Sci Med*. 2017;175:244-252. doi:10.1016/j.socscimed.2017.01.005
4. Sparks P, Conner M, James R, Shepherd R, Povey R. Ambivalence about health-related behaviours: An exploration in the domain of food choice. *Br J Health Psychol*. 2001;6(1):53-68. doi:10.1348/135910701169052
5. Povey R, Wellens B, Conner M. Attitudes towards following meat, vegetarian and vegan diets: An examination of the role of ambivalence. *Appetite*. 2001;37(1):15-26. doi:10.1006/appe.2001.0406
6. Ajzen I. The theory of planned behaviour: Reactions and reflections. *Psychol Heal*. 2011;26(9):1113-1127. doi:10.1080/08870446.2011.613995org/10.1080/08870446.2011.613995
7. Sobal J, Bisogni CA. Constructing food choice decisions. *Ann Behav Med*. 2009;38(Suppl 1):S37-S46. doi:10.1007/s12160-009-9124-5
8. Pew Charitable Trusts. “Putting Meat on the Table: Industrial Farm Animal Production in America” A Report of the Pew Commission on Industrial Farm Animal Production. Baltimore, MD; 2008.
9. Low SA. Rural Manufacturing at a Glance, 2017 Edition. *Econ Inf Bull*. 2017;177:2013-2018. <https://www.ers.usda.gov/webdocs/publications/84758/eib-177.pdf?v=42962>.
10. Lawley C, Furtan H. The political trade-off between environmental stringency and economic development in rural america. *J Reg Sci*. 2008;48(3):547-566. doi:10.1111/j.1467-9787.2008.00563.x
11. Larson LR, Stedman RC, Decker DJ, Siemer WF, Baumer MS. Exploring the Social Habitat for Hunting: Toward a Comprehensive Framework for Understanding Hunter Recruitment and Retention. *Hum Dimens Wildl*. 2014;19(2):105-122. doi:10.1080/10871209.2014.850126
12. Julian KA. From Field to Fork: A Qualitative Investigation of Local Food Consumers’

Attitudes About Membership in Community Supported Agriculture Programs and Food Cooperatives in Southern Michigan and Assessments of Eating Wild Game Meat and Hunting as a Mechanism. 2015.

13. Dietary Guidelines Advisory Committee. *Scientific Report of the 2015 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Health and Human Services and the Secretary of Agriculture*. Washington, DC; 2015.
doi:10.1017/CBO9781107415324.004
14. Willett W, Rockström J, Loken B, et al. Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems. *Lancet*. 2019;393(10170):447-492. doi:10.1016/S0140-6736(18)31788-4
15. Tidball, Keith. Cornell University. Tidball, Moira. Curtis P. Extending the Locavor Movement to Wild Fish and Game: Questions and Implications. *Nat Sci Educ*. 2013;42:185-189. doi:10.4195/nse.2013.0024
16. Font-i-Furnols M, Guerrero L. Consumer preference, behavior and perception about meat and meat products: An overview. *Meat Sci*. 2014;98(3):361-371.
doi:10.1016/J.MEATSCI.2014.06.025

APPENDIX

Table 9: Correlation between Attitudes and Beliefs, Subjective Norms and Perceived Behavioral Controls, and Intention to Consume Meat

		Intention to consume (times/mo):		
		Meat overall r	Lean meat r	Wild game r
		(n=752)		
Attitudes and beliefs:				
Heathy eating	Healthfulness of diet	-0.06	0.01	0.08
Meat	A healthy diet should include meat	0.41***	0.23***	0.25***
	Importance of... ^a	0.53***	0.44***	0.71***
	Taste preference for... ^a	0.44***	0.34***	0.53***
	Consumption for health of... ^a	0.66***	0.31***	0.57***
Hunting	Attitude towards hunting	0.32***	0.18***	0.28***
Subjective norms:				
Heathy eating	Family pressure to eat a healthy diet	0.04	0.05	0.05
	Friends and neighbors pressure to eat a healthy diet	0.01	-0.02	0.07
Meat	Family expectation of consumption	0.72***	---	---
	Family norm to eat more... ^a	0.17***	0.19***	0.37***
	Friends and neighbors norm to eat more... ^a	0.12**	0.11**	0.28***
Perceived behavioral control:				
Meat	...is available ^a	---	0.18***	0.46***
	...is affordable ^a	0.00	0.06	0.48***
	Self-efficacy for selection of... ^a	---	0.15***	---
	Self-efficacy for preparation of... ^a	0.32***	0.20***	0.32***

^a These attitudes, norms and controls are in reference to the specific type of meat named in the column. For example, the correlation between ‘Importance of meat overall’ and consumption was reported in the ‘meat overall’ column; whereas, the correlation between ‘importance of wild game’ and consumption was reported in the wild game consumption column.

Asterisks mark statistically significant differences between groups: *p < 0.05; **p < 0.01; ***p < 0.001