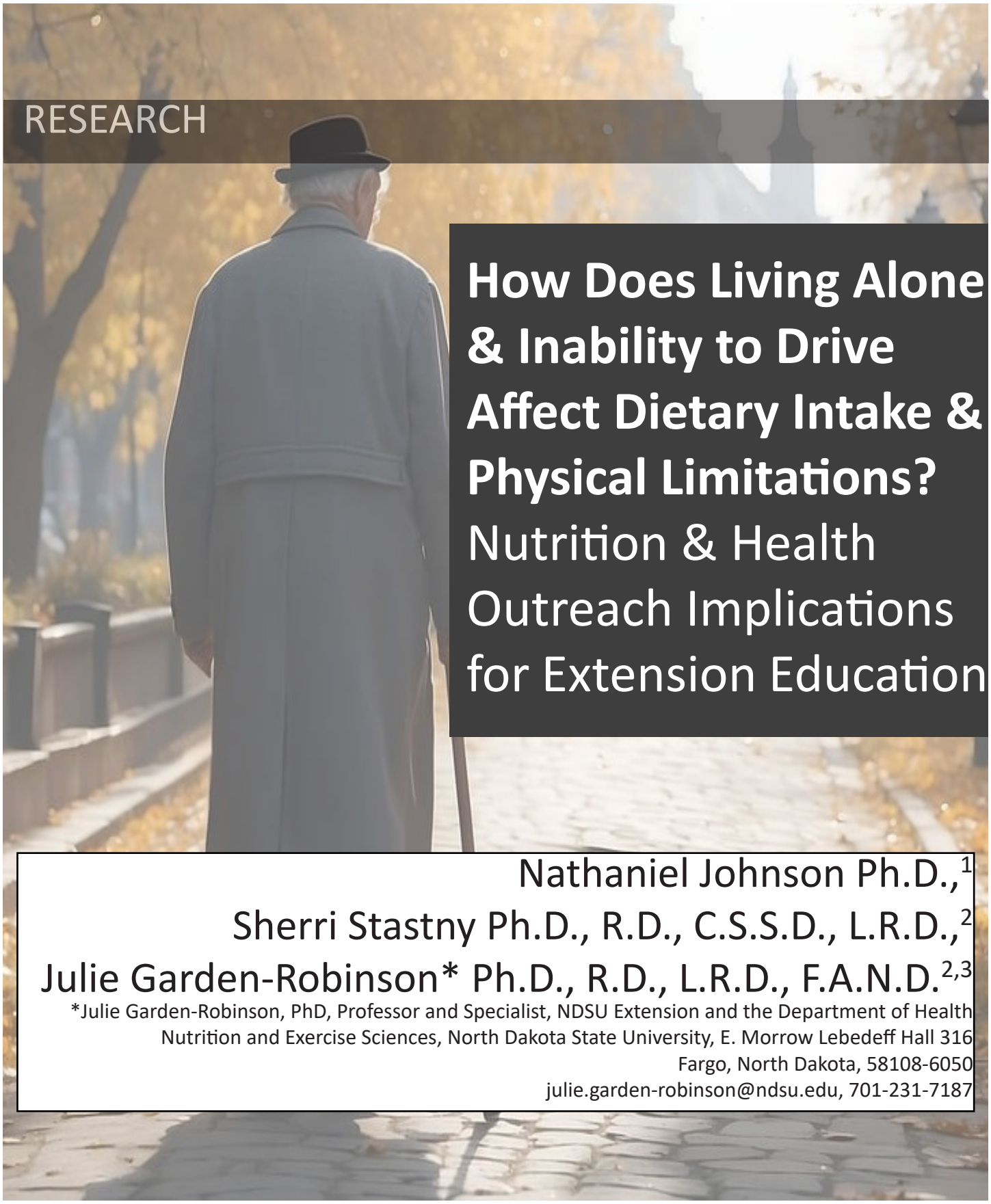

RESEARCH

How Does Living Alone & Inability to Drive Affect Dietary Intake & Physical Limitations?

Nutrition & Health Outreach Implications for Extension Education

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Abstract

Older adults have increased nutrient needs, such as calcium and vitamin D, while generally eating less than younger adults, making dietary intake a key factor in healthy aging. In particular, dietary intake is important for maintaining function and preventing disability. Through a nationwide, convenience survey of 1,650 participants, this study aimed to determine the relationships among dietary intake, living alone, motor vehicle use, and/or self-reported physical limitations. Living alone was associated with lower intakes of lean meat ($p = 0.050$), and vegetables ($p = 0.007$). Overall, the results from our study informed the development of an Extension education program for older adult audiences focused on increasing intakes of lean protein and vegetables, as part of a balanced diet, and increasing physical activity.

How Does Living Alone & Inability to Drive Affect Dietary Intake & Physical Limitations? Nutrition & Health Outreach Implications for Extension Education

Muscle mass and strength are key to preventing disability (Beaudart et al., 2017), but unfortunately muscle mass and strength decline with age (Agostini et al., 2023). Although there are variety of reasons muscle mass and strength decline (Agostini et al., 2023), one factor is that older adults produce less muscle protein in response to dietary protein (Moore et al., 2015). As a result, older adults have greater protein needs than younger people (Moore et al., 2015). Recommended levels of protein for older adults have been suggested to be higher than the RDA of 0.8 g per kg of body weight per day at 1.2 g/kg/day (Bauer et al., 2013; Deutz et al., 2014) or 25 to 30 grams of protein at each meal (Paddon-Jones & Rasmussen, 2009) . Dietary protein quantity is not only important but so is dietary protein quality, with higher quality proteins leading to greater net protein balance in older adults (Kim et al., 2018). However, not all high-quality proteins share similar nutrient profiles with many sources of protein also being sources of saturated fat and sodium (Beasley et al., 2020).

Generally, lean and low sodium dietary sources of high-quality protein are non-fat or skim dairy products, eggs, whole, minimally processed lean meats, and soy (Haytowitz et al., 2019; Herreman et al., 2020). This is in contrast to processed meats which are typically high in both saturated fat and sodium (Rohrmann & Linseisen, 2016) while providing less protein. For example, a 100 gram serving of pastrami, processed turkey has 26 grams of protein, 1.4 grams of saturated fat, and 1,120 mg of sodium, whereas an equivalent serving of whole turkey breast provides 30 grams protein, 0.6 grams of saturated fat, and 99 mg of saturated fat. (Haytowitz et al., 2019). In fact, processed but not unprocessed red meat intake is related to increased odds of mortality (Rohrmann & Linseisen, 2016). Thus, selecting the right source of dietary protein is critically important for healthy aging.

Unfortunately, only 50% of older adults in the United States meet FDA protein recommendations (Choi et al., 2021). and some of the top protein sources in older adults' diets come from processed meat, such as cold cuts and cured meats (Beasley et al., 2020). The regular consumption of nutrient-rich foods, containing enough protein, and at least three times per day is hindered by problems that occur with older adults. Common problems include poor dentition, limited resources and ac-

cess to healthy food, decreased vision, taste, and olfactory sense, reduced appetite, and other physical or environmental constraints (e.g., isolation in winter exasperated by inability to drive) (Nieuwenhuizen et al., 2010). Older adults are expected to have a reduced total calorie requirement as a result of a reduced amount of physical activity and resting metabolic rate as attributed to age (Roberts & Rosenberg, 2006). However, there is a point at which a reduction in appetite is indicative of an increased risk of malnutrition. Lack of appetite or decreased food intake in older adults, or the "anorexia of aging" as first described by Morley and Silver in 1988, is a common concern in older populations (Morley & Silver, 1988).

Many older adults live alone and, therefore, do not wish to cook only for themselves, and often lack the social interaction they formerly had at mealtimes when their families were present (Whitelock & Ensaff, 2018), affecting dietary intake (Holmes et al., 2008; Hughes et al., 2004); Isolation, loss of a spouse or divorce, retirement, moving from their long-time family home, side effects from medications (e.g., lack of saliva production), lack of enthusiasm for current living situation, economic hardships, medical problems such as chronic pain, and feelings of diminished power and influence that comes with aging in American culture are obstacles for optimal dietary intake in adults (Landi et al., 2016). These and other stressors detract from motivation to purchase or prepare needed nutrient-rich meals.

Purpose

This project aimed to develop, implement, and evaluate a survey which was available nationwide to examine the association between aspects of dietary intake and self-reported physical limitations and to investigate the effects of living alone and the ability to operate a motor vehicle on dietary intake. The results from this survey were analyzed and leveraged to develop an evidence-informed Extension nutrition and health program for older adults.

Method

Questionnaire Development & Data Collection

A 79-item, online survey (Qualtrics®) was designed to assess current lifestyle choices among adults aged 50 and older living in the United States. Most items for the survey were borrowed with approval from other surveys, namely the Diabetes Eating Problems Survey – Revised (Markowitz et al., 2010) and the 2021 version of the CDC Behavior Risk Survey (CDC, 2022). After review and approval by the university's Institutional Review Board (#IRB0004482) the survey was administered in spring 2023 and used mixed methods including dichotomous and Likert-type scale questions. The survey was disseminated in e-newsletters, through state news releases, through county-based listservs, through social media (Facebook), and through a nutrition column that appears in 50 newspapers and online. The questionnaire also was made available as a paper copy, and 500 copies were distributed to county Extension offices throughout the state to gather responses from in-person events not related to this project. Participants were offered a chance at winning small prizes for participating.

Statistical Analyses

Descriptive statistics are presented as frequencies and are presented for the entire sample. However, subsequent analyses contained fewer participants as those with missing values or who answered the questions as "Prefer were not to answer" were unable to be included in the analysis due to a lack of information.

To examine the relationship between dietary intake and physical limitations, a mixed linear model controlling for age, sex, race/ethnicity, education, and income, was used. Age, education, income, and dietary intake of lean meats, processed meats, fruits, vegetables, leafy greens, nuts and seeds, and

legumes were entered into the model as ordinal variables, whereas sex (female = 0; male = 1) and race/ethnicity (all other races and ethnicities = 0; non-Hispanic White = 1) were entered as categorical variables. All dietary intake variables were entered into one model to control for other aspects of dietary intake.

To investigate the association between living alone and not being able to drive on dietary intake, mixed linear models controlling for self-reported age, sex, race and ethnicity, education, income, depression, anxiety, pain, sleep, and perceived health were used. Social isolation affects dietary intake (Holmes et al., 2008; Hughes et al., 2004); however, other aspects of health, such as depression are also associated with social isolation (Das Gupta et al., 2020) and with poorer dietary intake (Payne et al., 2012). We sought to control these confounding effects on dietary intake by including self-reported depression, anxiety, pain, sleep, and perceived health in these analyses. Age, education, income, depression, anxiety, pain, sleep, and perceived health were entered as ordinal variables, whereas living alone (lives with other(s) = 0; lives alone = 1), not being able to drive (can drive = 0; cannot drive = 1), sex (female = 0; male) =1) and race/ethnicity (all other races and ethnicities = 0; non-Hispanic white = 1) were considered categorical variables. Only the main effects related to living alone and being unable to operate a motor vehicle alone were investigated, as we did not hypothesize there to be an interaction.

Results

Table 1 provides the demographics for our sample. Most survey participants were ages 50 to 61 years of age (71.6%), male (58%), and non-Hispanic/white (56.8%). Most participants were from North Dakota (35.9%), California (12.0%), Alabama (5.3%), Alaska (4.3%), and Washington (4.2%) with the remaining 38.3% coming from all other states. The majority had an associate's or bachelor's degree (46.5%).

Questions related to the purpose of our project were statistically analyzed. Table 2 details the relationship between dietary intake of lean meats, processed meats, fruits, vegetables, leafy greens, nuts and seeds, and legumes on self-reported physical limitations. A total of 1,645 participants were included, and the model was statistically significant ($R2 = 0.265$; $F = 10.252$; $p < 0.001$). Greater reported intakes of lean meats ($p < 0.001$) and vegetables ($p = 0.002$) were associated with decreased report of physical limitations, whereas greater intake of processed meats was associated with increased report of physical limitations ($p < 0.001$).

Table 3 describes the main effects of living alone and an inability to drive a motor vehicle on various aspects of dietary intake while controlling for self-reported age, sex, race and ethnicity, education, income, depression, anxiety, pain, sleep, and perceived health. These analyses included 1,650 participants. The mixed linear models were all statistically significant ($p < 0.001$). Living alone was associated with decreased dietary intake in general, with lower reported intakes of lean meat ($p = 0.050$), processed meat ($p = 0.011$), fruits ($p < 0.001$), vegetables ($p = 0.007$), and nuts and seeds ($p = 0.019$). Not being able to operate a motor vehicle was associated with increased intake of lean meat ($p = 0.025$) and processed meat ($p = 0.001$), and decreased intake of fruit ($p = 0.028$).

Discussion

Overall, the results from our study indicate the nutrition education programs intended to mitigate physical limitations in populations of older adult populations with many members living alone and/or unable to operate a motor vehicle, should focus on increasing intakes of lean protein and vegetables while decreasing intake of processed meats. Our findings, specifically those described in Table 2, show that lean meat and vegetable intakes are inversely related to self-reported disability status, whereas processed meat intake was positively related to disability status. Moreover, our results in Table 3 show that even when controlling for age, sex, education, income, depression, anxiety, pain,

sleep, and perceived health, those who live alone had lower dietary intakes in general compared to those who live with others, reporting lower intakes of lean meat, processed meat, fruits, vegetables, and nuts and seeds. As we found inverse associations between lean meat and vegetable intakes and self-reported disability status, nutrition programs working with older adults who live alone should focus on increasing lean protein and vegetable intakes. Participants who reported being unable to operate a motor vehicle reported increased intake of lean and processed meats and decreased intake of fruits. Thus, nutrition education programs intended to help reduce physical limitations in older adults should focus on increasing the intake of lean proteins and vegetables, while decreasing the intake of processed meats, particularly for those older adults who live alone and cannot drive. Increased food delivery services could benefit this population. Extension educators can use this information to help guide their outreach to similar audiences. Research is continuing to show that older adults have nutritional needs, including protein needs.

Informed by this research, the project team developed or revised Extension materials that can be delivered both as online self-paced modules, and/or as face-to-face presentations to meet the needs of older adult audiences who may have technology available but are unable to drive to a face-to-face class. The content of the online modules was developed based on published nutrition research and national nutrition recommendations. The online modules were designed to be easy to navigate, especially for those with less experience with technology-based delivery. The narrated self-paced modules allow for clicking on images, answering review questions and online surveys to complete a module. The coordinators are available to answer questions and social media (Facebook) and a monthly e-newsletter provided additional information. The face-to-face version of the program includes scripted lesson plans, handouts, PowerPoint slides, hands-on activities, and surveys for delivery in community settings by Extension agents in multiple counties especially in rural areas of the state.

The topics of the classes include nutrition and physical activity concepts related to muscle health, bone health, joint health, brain health, heart health, eye health, and other topics related to aging. Lean protein consumption and fruit and vegetable consumption, which were significant in the research, is a topic of focus in many of these modules, along with other nutrients of concern. Each of the classes also has a component that reminds participants about the importance of physical activity as part of an active lifestyle. A “cooking for one or two” module for online delivery and the associated teaching program for face-to-face delivery are among the next programs to be released. All online and face-to-face participants had the opportunity to receive a prize, a completion certificate, and an opportunity for a gift card if they completed a follow-up interview. This study had limitations. We used a snowball approach and experienced some “robot” takers of the online survey, but those responses were identified and excluded. To avoid excluding people who did not have access to a computer, tablet, or other device, we also made paper copies available of the survey. Although attracting participants to complete long surveys can be challenging, we had more participants than expected. We offered small rewards through prize drawings.

Implications for Extension Professionals

Extension programs, by definition, are based on published research or other evidence-based sources. The current research provided evidence to move forward with the target audience to help participants meet their evolving dietary needs throughout life, based on awareness of current recommendations and personal practices. Improving nutrition and physical activity may help reduce their risk for disability. In addition, the project can introduce other Extension program areas, including gerontology and physical activity. We had an unexpectedly high number of valid responses from throughout the U.S. as a result of creative ap-

proaches to eliciting survey responses.

As we progress with the research through follow-up surveys and interviews, additional Extension programs will be developed into online and face-to-face formats, revised as needed, and implemented based on the participants' feedback and the analysis of additional survey results. The large dataset gathered in this project will allow us to explore further relationships of aging to nutrition and health. The Extension handouts developed are available from www.ag.ndsu.edu/nourish.

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Appendix

Demographics for the sample are displayed in Table 1. A total of 1,788 people completed the survey.

Table 1

Demographics of the total 1,788-person sample.

Age							
	50-55	**56-61**	**62-64**	**65-70**	**71+**		
n	785	495	288	145	74		
%	43.9%	27.7%	16.1%	8.1%	4.1%		
Sex							
	Female	**Male**	**Other**	**Prefer Not to Answer**			
n	720	1,037	22	9			
%	40.3%	58.0%	1.2%	0.5%			
Race and Ethnicity							
	African American	American Indian / Alaska Native	Asian American / Pacific Islander	Hispanic	Non-Hispanic White	Other	
n	255	124	231	142	1016	20	
%	14.3%	6.9%	12.9%	7.9%	56.8%	1.1%	
Education							
	Did not finish high school	High school graduate	Associate's Degree	Bachelor's Degree	Some Graduate School	Post-Graduate Degree	
n	64	359	351	481	97	88	
%	3.6%	20.1%	19.6%	26.9%	5.4%	4.9%	

Household Income							
	$0-24,999	**$25,000-49,999**	**$50,000-74,999**	**$75,000-99,999**	**$100,000-149,999**	**≥$150,000**	**Prefer not to answer**
n	71	377	454	446	230	160	50
%	4.0%	21.1%	25.4%	24.9%	12.9%	2.8%	2.8%
Cohabitation Status							
	Lives Alone	**Lives with a spouse or partner**	**Lives with other persons**				
n	360	1,369	59				
%	20.1%	76.6%	3.3%				
Number in Household							
	1-3	**4-6**	**7+**				
n	810	905	73				
%	45.3%	50.6%	4.1%				
Able to operate a motor vehicle							
	No	**Yes**					
n	268	1520					
%	15.0%	85.0%					

Table 2

The association of dietary intakes of lean meats, processed meats, fruits, vegetables, leafy greens, nuts and seeds, and legumes on disability status when controlling for age, sex, race/ethnicity, education, and income.

Model	β	SE	p
Constant	0.846	0.097	<0.001
Age	0.036	0.011	0.001
Sex (Male =1)	0.015	0.025	0.559
Race/Ethnicity (Non-Hispanic White = 1)	-0.090	0.026	0.001
Education	-0.012	0.009	0.176
Income	-0.044	0.010	<0.001
Lean Meat	-0.041	0.011	<0.001
Processed Meat	0.041	0.010	<0.001
Fruit	-0.001	0.012	0.964
Vegetables	-0.038	0.013	0.002
Leafy Greens	0.017	0.011	0.133
Nuts & Seeds	-0.001	0.011	0.907
Legumes	0.013	0.010	0.195

Table 3

The effects of living alone and an inability to drive a motor vehicle on various aspects of dietary intake while controlling for self-reported age, sex, race and ethnicity, education, income, depression, anxiety, pain, sleep, and perceived health.

		Overall Model			Lives Alone			Cannot Drive	
	R2	F	p	β	SE	p	β	SE	P
Processed Meat	0.078	11.564	<0.001	-0.216	0.085	0.011	0.293	0.092	0.001
Fruit	0.126	19.622	<0.001	-0.282	0.074	<0.001	-0.174	0.079	0.028
Lean Meat	0.078	11.476	<0.001	-0.137	0.070	0.050	0.169	0.075	0.025
Vegetables	0.132	20.702	<0.001	-0.196	0.072	0.007	-0.077	0.077	0.324
Leafy Green	0.117	18.065	<0.001	-0.117	0.078	0.135	0.036	0.084	0.667
Nuts and Seeds	0.061	8.934	<0.001	-0.194	0.083	0.019	-0.060	0.089	0.497
Legumes	0.058	8.326	<0.001	0.117	0.085	0.171	0.071	0.092	0.439