Gerontology & Geriatrics: Research

Open Access

Austin Publishing Group

Research Article

The Nourish Program: Identifying and Implementing Lifestyle Changes to Improve Overall Health While Living in Isolated, Rural Counties

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Received: June 09, 2026
Accepted: June 16, 2026
Published: June 23, 2026

Abstract

Lifestyle changes such as increased physical activity and improved nutrition, along with other changes, may not only avert, but also attenuate, chronic disease. The Nourish program, originally implemented in 2013 and revised in 2023, is designed to recruit middle-aged and older participants in rural areas who are at risk for or have chronic disease, deliver face-to-face or distance-education modules, and collect follow-up surveys to assess planned and sustained lifestyle changes. Seven professionally produced, peer-reviewed modules were designed and delivered on specific topics, e.g., "Eating for Your Eye Health" and "Nourish Your Bones and Joints." Post-module survey results were completed by 108 online plus 69 face-to-face participants. Surveys were analyzed to estimate planned behavior changes for nutrition, physical activity, environmental modifications or 'other' using confidence intervals and x2 tests. Compared to those living with others, participants living alone were more likely to plan to change nutrition, physical activity, environment or 'other'. Participants aged 65 or older were more likely to plan to make changes, and women were more likely to plan to make changes than men across all modules except "Nourish Your Eyes" and "Nourish Your Skin." Participants of Nourish planned to make lifestyle changes to optimize function of body systems and/or prevent or attenuate chronic disease, suggesting the potential influence of the program to promote positive lifestyle changes.

Keywords: Healthy aging; Disease prevention; Nutrition; Physical activity; Behavior change; Rural outreach; Online learning.

Introduction

The vast majority of older adults in the United States have a chronic condition or disease. More precisely, 93% of adults 65 years and older have at least one chronic disease or condition (e.g., heart disease, type 2 diabetes mellitus, cancer, obesity, arthritis, or Alzheimer's disease and dementia), while 79% have two or more [1]. As chronic diseases are leading causes of death in the United States [2] and worldwide [3], their prevention is paramount. Behaviors such as healthful dietary intake [4] and physical activity (PA) [5] are well known for preventing chronic disease. Nonetheless, many older adults in the United States do not meet dietary intake [6] and PA recommendations [7] and strategic innovative solutions are lacking. Targeted interventions are needed to improve diet, PA, and thus health not only later in life, but also earlier in life before the effects of poor lifestyle habits accumulate [8].

Those living in rural America have unique challenges and barriers to achieving healthful dietary intake. While cities offer choices in grocery retailers, the same is not true in rural areas. The average small town or rural community may be limited to only convenience stores for food purchases (e.g., gas stations and dollar stores) where choices are limited to Ultra-Processed Foods (UPF) [9]. Problematically, most UPFs are calorically, but not nutritionally dense [10,11]. Unfortunately, UPFs account for more than 50% of the total energy consumed in the United States [12]. In the rural state of North Dakota (ND), food access is a key issue [13]. A little more than half of its rural population lives 16.1 km (i.e., 10 miles) or more away from a supermarket or grocery store [13,14]. In 25 of 53 counties, all of which are rural, the entire population of that county lives 16.1 km or more away [13,14]. Likely related to this disparity, rates of diabetes and obesity are higher and life expectancy is shorter in rural ND counties [14]. Despite increased obstacles in rural environments [15], nutrition education can improve dietary intake in rural areas [16].

Challenges in achieving adequate PA in rural areas of the United States mirror those of healthful dietary intake. Only one in five rural dwelling residents meet the U.S. Physical Activity Guidelines for Americans [17], a significantly smaller proportion compared to those living in urban areas [18]. This finding applies to ND as well; those living in rural ND counties are less likely to participate in leisure time physical activity [14]. Community-level barriers to PA, namely sparse recreational activity infrastructure (e.g., limited sidewalks and/or biking lanes), play a role in rural and urban disparities in PA [19], but individual-level barriers also exist [20]. Importantly, individual barriers, such as lack of motivation, nescience of how physical inactivity negatively impacts health, and little knowledge of how to participate in PA are the greatest barriers reported by rural populations [21]. Nutrition and PA education can improve health and decrease chronic disease even in isolated areas. *Nourish* is a lifestyle-choice

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Citation: Knoll K, Stastny S, Garden-Robinson J, Johnson N. The Nourish Program: Identifying and Implementing Lifestyle Changes to Improve Overall Health While Living in Isolated, Rural Counties. Gerontol Geriatr Res. 2026; 12(1): 1113.

education program designed to empower and engage participants to increase healthy lifestyle knowledge, motivate positive behavior change to improve health and lower disease risk among participants. We hypothesized that participants would learn something new from each module that would inform plans to make healthful behavior changes. The project aim was to package educational tactics for adults age 41 and older in rural areas, using an updated distance-delivery programming model and traditional face-to-face delivery.

Materials and methods

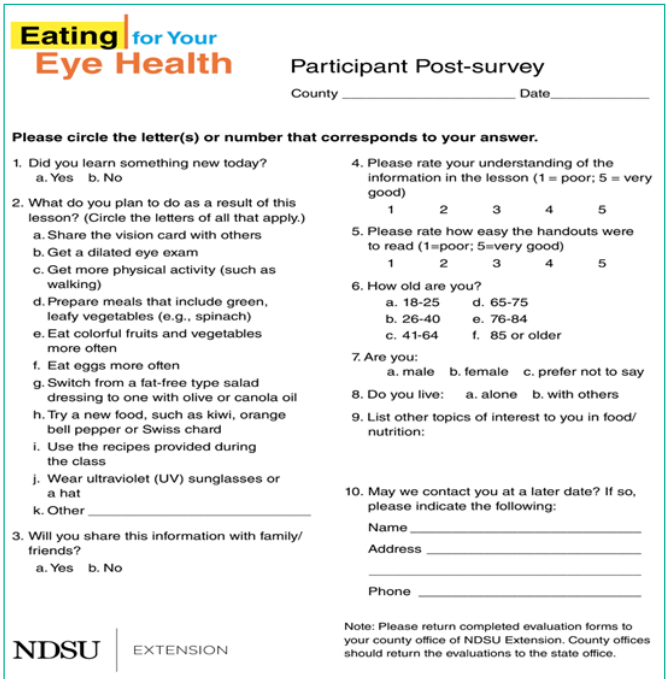
Originally created in 2013, *Nourish* was designed using Self-Determination Theory [22] to prevent and mitigate chronic disease. A decade later, a formative approach was taken to update *Nourish's* format of delivery (uniquely both online asynchronous and face-to-face), content, level of education, and module topics [20,23]. Participant recruitment was delivered by listservs, news columns, and social media portals using a branded image and professionally developed program-specific website. Additionally, county Extension agents assisted in their respective local areas, using existing groups for two face-to-face groups. Any person under the age of 18 was excluded. However, peer-reviewed module content and post-module questionnaires were identical for either delivery method. The program's educational modules are interactive, easy-to-use, and evidence- based. While *Nourish* is intended for adults aged 41 and older living in rural North Dakota, younger people and those living in urban areas can choose to participate as well. Professionally produced, educational modules (e.g., "Nourish Your Bones and Joints," Your Digestive System," "Eating for Your Eye Health," "Nourish Your Heart," "Nourish Your Skin," and "Nourish Your Body with Sleep") were created and recorded by Registered Dietitian Nutritionists (RDN) and are available through the learning platform Moodle™. Each module focuses on a particular body system and presents an overview of its anatomy and physiology, descriptions of common diseases and conditions, and specific healthful behaviors that promote the health of that system. More precisely, modules include websites, infographics and tips from professional organizations, designed and tested recipes, entertaining examples, games, puzzles, voice-over YouTube videos, quizzes, fact sheets (Figure 1) and other resources to engage participants. Modules average about 30-50 minutes to complete. Even though modules were designed to be self-paced and asynchronous, they are adaptable for synchronous presentations and participants are encouraged to complete one module per week to promote adherence to self-identified goals.

To measure program outcomes, participants are asked to complete a post-module survey after each module's content had been viewed. Post-surveys (Figure 2) consist of 10-12 questions about participants' demographic information, acquirement of new knowledge, satisfaction with programming, and planned healthful behavior changes. Surveys for both of the new modules made in 2023 and the old modules made in 2013 are similar, but each survey is customized according to each module's content. These surveys are unvalidated but are standard practice of Extension program assessment.

Question 1 asks, "Did you learn something new today?" using a binary response scale (i.e., yes or no) to investigate new knowledge obtainment. Question 3 inquires about the likelihood of participants



Figure 1: An example of a fact sheet from the "Eating for your Eye Health" educational module.



Eating for Your Eye Health

Participant Post-survey

County _____ Date _____

Please circle the letter(s) or number that corresponds to your answer.

1. Did you learn something new today?
   a. Yes b. No
2. What do you plan to do as a result of this lesson? (Circle the letters of all that apply.)
   a. Share the vision card with others
   b. Get a dilated eye exam
   c. Get more physical activity (such as walking)
   d. Prepare meals that include green, leafy vegetables (e.g., spinach)
   e. Eat colorful fruits and vegetables more often
   f. Eat eggs more often
   g. Switch from a fat-free type salad dressing to one with olive or canola oil
   h. Try a new food, such as kiwi, orange bell pepper or Swiss chard
   i. Use the recipes provided during the class
   j. Wear ultraviolet (UV) sunglasses or a hat
   k. Other _____
3. Will you share this information with family/ friends?
   a. Yes b. No
4. Please rate your understanding of the information in the lesson (1 = poor; 5 = very good)
   1 2 3 4 5
5. Please rate how easy the handouts were to read (1=poor; 5=very good)
   1 2 3 4 5
6. How old are you?
   a. 18-25 d. 65-75
   b. 26-40 e. 76-84
   c. 41-64 f. 85 or older
7. Are you:
   a. male b. female c. prefer not to say
8. Do you live: a. alone b. with others
9. List other topics of interest to you in food/ nutrition:
10. May we contact you at a later date? If so, please indicate the following:
    Name _____
    Address _____
    _____
    Phone _____

NDSU EXTENSION

Note: Please return completed evaluation forms to your county office of NDSU Extension. County offices should return the evaluations to the state office.

Figure 2: An example of a post-module survey from the "Eating for your Eye Health" educational module.

sharing their new knowledge with others, again using a binary response scale (i.e., yes or no). Questions 4 and 5 ask participants to rate their perceived understanding of modules and ease of reading provided handouts via 5-point Likert type scales (i.e., 1 = poor to 5 = very good). Questions 6, 7, and 8 collect demographic information (e.g., age, sex, living situation, etc.).

Question 2 asks, "What do you plan to do as a result of this lesson?" and subsequently presents multiple specific behavior changes that coincide with the module-specific content and/or "other." Participants select as many or as few responses as they wish. Examples of specific behavior changes include "switch from cooking with saturated and trans fats to healthy vegetable oils" (from the "Nourish Your Brain with Healthful Foods and Activities" module), "increase my consumption of foods high in soluble fiber, such as dry beans and oatmeal" (from the "Nourish and Exercise Your Heart" module), or "limit caffeine several hours before bedtime" (from the "Nourish Your Body with Sleep" module). While all surveys contain questions related to nutrition/diet, they differ in what other behaviors they assess. Despite questions about specified behavior changes across the surveys being module specific, there are themes shared among them. Therefore, for data analysis and trend identification across modules, selected responses were coded as one of four themes or categories: 1) Change diet (e.g., add more fruits and vegetables, use provided recipes), 2) Increase PA (e.g., increase walking, try new exercise class), 3) Change environment or use devices (e.g., wear a wide-brimmed hat, use sunscreen), or 4) Other. First, three researchers independently, openly coded responses. Researchers then met to compare open codes to generate a closed list of codes. Next, the three researchers independently applied the closed codes to participants' responses. The three researchers met again to compare closed codes. For any items that differed in coding, researchers discussed their rationale, and consensus was reached before final closed code(s) were applied. Participants are allowed to write in their own behavior change, which was coded in one of the aforementioned categories determined by the research team's discretion following the same process of coding. Not all surveys had behavior changes that fit into each category. For example, the "Nourish Your Skin" survey did not provide any behavior changes related to category 2) Increase PA. Additionally, open-ended questions are included in each survey providing participants opportunities to give feedback on each module and offer topics of interest regarding health for future programming. These qualitative responses provide rich data regarding participant experience, engagement, and satisfaction with the program's content. Examples of participant feedback are shown in the results section.

Completion of the *Nourish* program was defined as viewing the module content and completing the corresponding post-module survey for at least 6 out of the 7 modules within a three-month period established by Extension. Valid post-survey responses were defined as having six out of the seven questions completed (questions 1, 3-8), with exception of the "Nourish Your Bones and Joints" survey, which requests seven out of eight questions (questions 1, 3, 5-10). Statistical analysis was completed using IBM SPSS Statistics (Version 29.0). The Wilson method for calculating confidence intervals (CI) for proportions was used to analyze demographic data. A Chi-Square Test of Independence assessed influence of age on module selection. Cross tabulations examined relationships between demographics and planned changes.

Results

Participants

From Fall 2023 through Summer 2024, 448 individuals registered to take the *Nourish* program, while completion of the program consisted of 177 participants (108 participants online and 69 participants in-person). The 69 participants in this cohort that completed *Nourish* in-person, were led in groups by Extension agents. Regarding those that completed *Nourish* digitally, 92 participants reported age and 16 did not (1, 54, and 37 participants reported their age in the 18-25, 26-64, and 65-84 age ranges, respectively). Sex was reported by 96 participants (93 females, 3 males) and not reported by 12 participants. Age and sex information was not captured for the participants that completed *Nourish* in-person because demographic information was not systematically linked across program modules within the in-person delivery format (this has since been rectified for future in-person programs). Participants who completed the program, irrespective of delivery format (online or in-person), represented 26 counties across North Dakota.

Among participants with valid post-module surveys (survey inclusion was not contingent upon program completion), the majority were women aged 41–75 years living with others; descriptive demographic characteristics are presented in Table 1.

No significant association is observed between participants' module selection and age range, as assessed by a Chi-Square Test of Independence (p=0.996). To further evaluate potential differences, Odds Ratios (ORs) were calculated comparing younger participants (18–64 years) to older participants (65+ years) for selection of each module (module vs all others). No significant differences were observed across modules, including Bone/Joint (OR=0.95, CI [0.71, 1.27]), Brain (OR=1.29, CI [0.96, 1.72]), Digestive System (OR=1.04,

Table 1: Demographics of participants with valid surveys.

	Valid Surveys (n)	Age (n)						Sex	Living Situation
								% (95% CI)[a]	% (95% CI)*
Module		**18-25**	**26-40**	**41-64**	**65-75**	**76-84**	**85+**	**Women**	**With others**
Bone/Joint	217	6	23	97	71	16	4	88.30%	75.10%
								(83.3, 91.9)	(68.9, 80.4)
Brain	214[§]	6	19	85	75	24	4	90.50%	74.30%
								(85.8, 93.8)	(68.1, 79.7)
Digestive	198	5	23	83	70	14	3	86.20%	79.20%
								(80.7, 90.3)	(73.0, 84.3)
Eyes	256	9	28	110	83	20	6	90.10%	78.40%
								(85.8, 93.2)	(72.9, 83.0)
Heart	216	6	23	97	76	11	3	89.20%	77.60%
								(84.3, 92.7)	(71.6, 82.7)
Skin	187	7	23	78	64	11	4	89.20%	75.60%
								(83.9, 92.9)	(69.0, 81.2)
Sleep	205	6	25	91	70	10	3	87.70%	76.10%
								(82.5, 91.5)	(69.8, 81.4)

Abbreviations: n, number of valid surveys; CI, confidence interval.
•1 missing age response for Brain
[a]3, 3, 2, 3, 3, 2, and 1 missing sex responses for Bone/Joint, Brain, Digestive, Eyes, Heart, Skin, and Sleep, respectively
*1, 1, and 2 missing living situation responses for Digestive, Eyes, and Heart, respectively
Note: Participants were encouraged to complete at least 6 of the 7 modules.

CI [0.77, 1.41]), Eyes (OR=0.98, CI [0.75, 1.28]), Heart (OR=0.94, CI [0.70, 1.25]), Skin (OR=0.96, CI [0.71, 1.31]), and Sleep (OR=0.89, CI [0.66, 1.20]). All 95% confidence intervals included 1, indicating no statistically significant differences in the likelihood of module completion between age groups (Table 2).

Behavior changes reported via post-module survey

Figure 3 exhibits planned behavior changes by reported demographics using color gradients to indicate frequencies of responses. As mentioned, some modules do not present planned changes for all four themes or categories; hence, there is no data in various rows. Across most modules, individuals who live alone are more likely to indicate plans to change their diet, increase PA, change their environment or use devices, or make other changes compared to those living with others. Women are more likely to indicate planned behavior changes in all categories compared to men in each module with the exceptions of "Eating for Your Eye Health" and "Nourish Your Skin." Individuals 65 years and older are more likely to indicate planned behavior changes compared to individuals 18-64 years old in nearly every module. A majority of reported behavior changes fit into the 'Change Diet' and 'Increase PA' categories, likely because more options are provided in these categories and most modules place a greater emphasis on these categories compared to 'Change Environment and Devices' or 'Other'. "Nourish Your Digestive System" has the greatest proportion of participants indicating plans to make dietary changes (99%), while "Nourish Your Bones and Joints" has the lowest proportion of participants indicating plans to make dietary changes (82%). "Nourish Your Bones and Joints" has the greatest proportion of participants indicating plans to increase PA (88%), while "Nourish Your Digestive System" has the lowest proportion (55%). "Nourish Your Skin" has the greatest proportion of participants indicating plans to change their environment or use devices (78%), while "Nourish Your Digestive System" has the lowest proportion (<1%). "Nourish Your Body with Sleep" has the greatest proportion of participants indicating plans to make other changes (72%), while "Nourish Your Heart" has the lowest proportion (1%).

Table 2: Module selection.

	Chi-Squared p-value	OR (Younger vs older)*	95% CI
Module	0.996		
Bone/Joint		0.95	(0.71, 1.27)
Brain		1.29	(0.96, 1.72)
Digestive		1.04	(0.77, 1.41)
Eyes		0.98	(0.75, 1.28)
Heart		0.94	(0.70, 1.25)
Skin		0.96	(0.71, 1.31)
Sleep		0.89	(0.66, 1.20)

Feedback on program experience

More than 95% of participants rate their understanding of the lessons and the ease of reading materials as "good" or "very good" on a 5-point Likert type scale (1=poor to 5=very good). Over 90% of participants reported that they plan to share the information they learned from the program with family and friends. When given the opportunity to make comments, most participants described the program as both helpful and useful. One participant wrote: *"These modules were a very good review of healthy living. The information was presented well and was up-to-date. I learned something new every module. It was very interesting and well worth my time. Thank you for such a positive experience and all the hard work you put into it."* Another participant wrote: *"There is a good variety of teaching methods in this course, which makes it interesting and adapts well to different learning styles."* Participants recognized the convenience of distance learning that the platform provided. For example, yet another participant wrote:

"I really enjoy learning about these topics. Thank you for making them available online to go at your own pace. I work out of the home, so it is hard for me to make it to [in-person] classes when they are offered."

Nourish provides ideas for actionable behaviors that can enhance optimized function of body systems and/or prevent or attenuate chronic disease. Module content is well-received by participants as indicated by high ratings on the ease of understanding and readability of content, willingness to share information with others, and generally positive feedback from open-response comment sections of post-surveys.

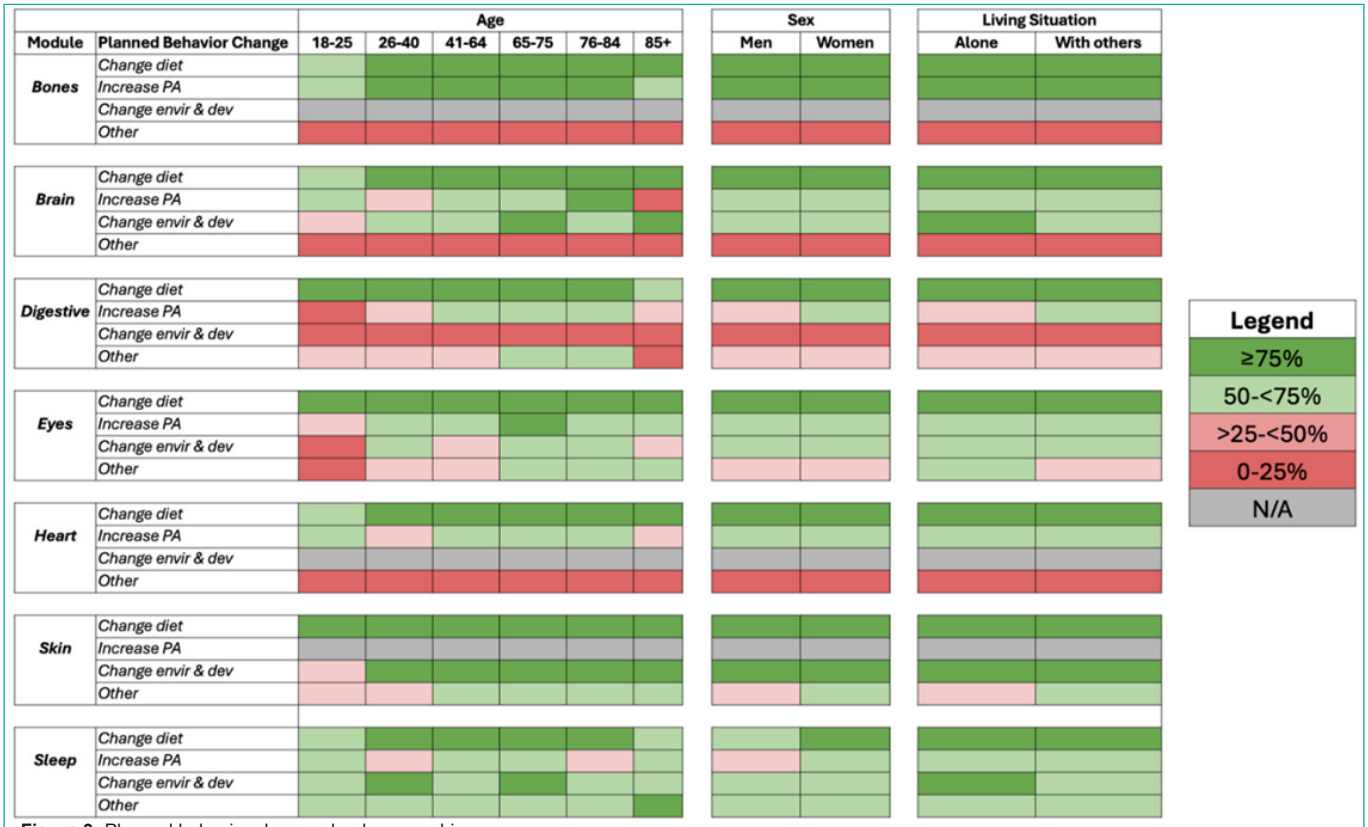


Figure 3: Planned behavior changes by demographics.
Abbreviations: PA: Physical Activity; envir.: Environment; dev.: Devices.
Note: Cross Tabulations; not all modules included all behavioral categories.

Discussion

The primary aim of *Nourish* is to disseminate evidence-based health information that leads to the implementation of incremental lifestyle changes to improve health and prevent or attenuate chronic disease. Although our program was modeled after other large nutrition programs such as Adamski, et al. [24], Nourish uniquely includes curriculum beyond nutrition and PA. In this work, we share results of post-module surveys completed by participants. The major finding of our analyses is that participating in *Nourish* is related to planned behavior changes and motivation to share information with others, regarding their nutrition, PA, alteration of their environment, and/ or other methods to attenuate or prevent chronic disease, i.e., learned something new. Participants are generally positive regarding the convenience of the online asynchronous learning platform available to all adults for no charge.

Healthy eating patterns, characterized by intake of fruits, vegetables, whole grains, unsaturated fats, nuts, seeds, legumes, and low-fat dairy with moderate inclusion of lean animal-based protein foods and infrequent intake of UPFs high in trans and saturated fat, sodium, and sugar, featured in *Nourish* are linked to healthy aging [8]. Survey results link the information from the modules to planned behavior change (see Figure 3), such as increased use of fruits and vegetables which are challenging to access in rural areas [13]. For example, 99% of participants that completed the "Nourish Your Digestive System" post-survey made plans to change their diet, and this module had a focus on increased intake of fruits and vegetables. In fact, across all modules, more than three-quarters of participants report that they are planning on eating more fruits and vegetables, and in the six modules that assess PA, more than one-half plan to increase PA. It is imperative to have repeat messaging in curriculum for asynchronous online learning [25], especially for older adults, as the practice reinforces learning. Moreover, a review of interventions to improve nutrition, physical activity and other behavior changes, marked "planned increase in fruit and vegetable consumption" [26] as a key metric to measure improved nutrition, illustrating the impact of *Nourish*.

Nourish was primarily designed as an online educational course, to be completed at one's own chosen pace, although in-person presentations are available in some areas. By offering the program across a variety of modalities, Nourish has greater reach across different age groups, genders, and other demographic factors compared to other more traditional nutrition and physical activity methods [27]. Overall, those that live alone, women, and those aged 65 and older, are most likely to plan behavior changes in nutrition, PA, environment or "other". However, as evidenced by the survey findings, future *Nourish* modules should provide and emphasize more information on PA. First, not all modules contain PA content. Second, although 88% of participants who completed "Bones and Joints" plan to increase PA, only 55% of those completed "Nourish your Digestive System" plan an increase in PA. The program module could easily be updated to include a greater emphasis on PA.

There are limitations to our post-program analysis. The surveys, while standard aspects of Extension program assessment, are unvalidated which may limit the reliability and generalizability of the

findings. Additionally, the surveys assessed only planned behavior change rather than actual behavior change. Not all participants who registered for the course finished at least six modules, and not all participants completed the post-survey for each module. Thus, only a portion of participants are included in analyses. Self-selection bias is likely, as those that completed the surveys may have been more satisfied with the program than those that chose to not complete the post-surveys. Social desirability bias is even more likely, as the surveys ask about planned lifestyle changes. Nonetheless data from the post-surveys informs ways to update and improve our curriculum. Our post-program interviews are yet to be analyzed and should give us a deeper understanding of the "whys" and "hows" of the quantitative survey responses described in this work.

Conclusions

Preventing or mitigating chronic disease is critical for improving health and reducing healthcare costs. The major finding in this brief analysis of *Nourish* is that planned behavior changes and motivation to share information with others regarding positive lifestyle changes were reported by those that completed modules. *Nourish* is a free program that provides a framework for chronic disease prevention efforts targeting aging adults in rural areas while remaining applicable and relevant to younger and more urban populations. The program has promoted positive behavior changes regarding health among the participants which has a positive potential for improved health in the rural community, *Nourish* is easily accessible in the virtual format, for which it was primarily designed.

Author declarations

Author contributions

Conceptualization, J.G.R., S.S. and N.J.; Methodology, J.G.R., S.S. and N.J.; Formal Analysis, K.K., N.J., and S.S.; Investigation, N.J., S.S. and K.K.; Resources, J.G.R., S.S. and N.J.; Data Curation, K.K., J.G.R., S.S. and N.J.; Writing—Original Draft Preparation, K.K., N.J., and S.S.; Writing—Review & Editing, J.G.R., S.S. and N.J.; Visualization, K.K., S.S. and N.J.; Supervision, J.G.R., S.S. and N.J..; Project Administration, J.G.R. and S.S.; Funding Acquisition, J.G.R., S.S. and N.J. All authors have read and agreed to the published version of the manuscript.

Funding

This project was supported by a Rural Health and Safety Education program grant from the U.S. Department of Agriculture's National Institute of Food and Agriculture, Grant number NDN04631.

Institutional review board statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board of North Dakota State University, protocol code IRB0004901 dated September 9, 2023.

Informed consent statement

Completion of registration took the participants to an Informed Consent form, approved as part of IRB0004901 dated September 9, 2023.

Data availability statement

Aggregated data is available upon request.

Acknowledgments

We want to acknowledge the support of Ada Erlandson, Extension Associate, Beth Dahl, administrative coordinator, and our many Extension agents and nutrition assistants who assisted with program design, delivery, and participant recruitment and survey collection.

Conflicts of interest

The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

PA: Physical Activity; UPF: Ultra-Processed Food

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