Developing and Pilot Testing a Population-focused Nutrition Screen Incorporating Social Determinants of Health: An Example from Rural Appalachia, United States

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Abstract

Introduction: Given that nutrition status is directly related to a variety of health outcomes, nutrition screening is a prime focus of public health nutrition practice.
Objectives: The purposes of this pilot study were to develop and pilot test a Rural Adult Nutrition Screen (RANS) that includes criteria addressing social determinants of health and to explore possible applications of the screen development methodology in other settings.
Methods: Mixed-methods research including interviews and survey dissemination was conducted among a rural southern Appalachian population in the United States. Themes identified in the research were used to construct a preliminary rural adult nutrition screen (RANS-1). The RANS-1 was pilot-tested among a sample of community-dwelling rural residents (n = 83), and was revised based on participant, administrator, and nutrition practitioner comments. The revised screen, the RANS, was pilot-tested among a sample of attendees of a free community medical clinic (n = 37). Nutrition risk as determined by the RANS was compared with the Nutrition Triage Score of the Patient-Generated Subjective Global Assessment (PG-SGA), the United States Department of Agriculture 6-item Household Food Security Survey Module (USDA-6), and nutrition assessment performed by a Registered Dietitian Nutritionist who was also credentialed as a Physician Assistant (RDN, PA). Non-parametric statistical tests were used to compare the results of the PG-SGA NTS and the USDA-6 with the RANS regarding "at risk" and "low risk" status.
Results: In this small pilot study, no statistically significant differences were found among either comparative instrument and the RANS in determination of "at risk" and "low risk" status. The RDN, PA's agreement with the RANS was 100%.
Conclusion: This pilot study provides some evidence that the RANS may be used to screen rural, community-dwelling adults for nutrition needs in light of social determinants of health common in rural settings. Further research and formal validation of the RANS are needed in order to establish this tool as a valid nutrition screen for use in the rural community setting. Procedures used to develop the RANS may be applicable to the development of population-specific nutrition screens in other rural and urban populations.

Keywords: Nutrition screening, social determinants of health, rural, rural nutrition care

INTRODUCTION

Given that nutrition status is directly related to a variety of health outcomes, nutrition screening is a prime focus of public health nutrition practice. In a broad sense, the development of a health screening tool (here called "screen" for short) requires a comprehensive understanding of the population of interest, a clear focus on the screen's purpose and parameters, and the existence of comparative standards by which the new screen can be evaluated (Chan, Lim, Ding, Chan, & Lim, 2019; Keating, Sanders, Ngo, Mohapi, & Mandalakas, 2019). Nutrition screens typically consist of a questionnaire or evaluation that, according to a pre-determined scoring scale, may signal the need for a detailed nutritional assessment and/or specific dietary recommendations. Screens are usually intended to be brief, consisting of the minimum number of items needed to determine nutrition risk, and administrable by any trained member of the interdisciplinary care team (Academy of Nutrition and Dietetics Evidence Analysis Library, 2018) . Nutrition screening tools should be characterized by demonstrated practicality, validity, and reliability among the target population of the screen, and should be associated with specific protocols of action based on screening results (Academy of Nutrition and Dietetics Evidence Analysis Library, 2018; Singh & Siahpush, 2014).

Globally, the existence of rural health disparities is well-established in both developed and developing countries (Gutschall, Thompson, & Lawrence, 2018; Kumar & Kumar, 2018; Singh & Siahpush, 2014; Strasser, Kam, & Regalado, 2016). Rural residency is associated with amplified risk factors for nutrition problems. These include but are not limited to financial barriers to obtaining an adequate supply of nutritious food, lack of access to health care, limited opportunities for living wage employment, living situations lacking appropriate equipment for food storage and preparation, transportation challenges, and, in many cases, increased rates of chronic disease and oral health problems compared with urban settings (Ghimire, Kumar Baral, & Callahan, 2017; Gutschall et al., 2018; Zeng et al., 2015). Worldwide, rural residents may be subject to disparities related to limited access to equitable and high-quality nutrition services (Balcha, Phillips, & Trimble, 2018; Gutschall et al., 2018).

There is a need for additional nutrition research among rural populations; global researchers have noted not only differences between rural and urban settings but also data gaps resulting from challenges in accessing rural populations, especially in community settings (Balcha et al., 2018; Cesani et al., 2013; Dwyer, Gahche, Weiler, & Arensberg, 2020; Ghimire et al., 2017; Hong, Winichagoon, & Khang, 2020). A nutrition screening tool designed to identify community-dwelling rural adults who may benefit from nutrition education, nutritional management of chronic disease, and/or food assistance services could potentially improve utilization and effectiveness of resources targeted toward rural populations (Gutschall, Marchetti, & Thompson, 2019; Gutschall et al., 2018). Nutrition services offered within the context of rural environments have the potential to ameliorate the impacts of hunger, food insecurity, and chronic disease. Ultimately, such a tool could aid in reducing rural health disparities and improving overall quality of life for rural residents.

Research questions and study purpose

The overall purposes of this pilot study were: 1) to develop a Rural Adult Nutrition Screen (RANS) among a population of rural Appalachian residents in the United States (U.S.), with consideration of criteria addressing social determinants of health; 2) to evaluate the

feasibility of utilizing the RANS to identify rural Appalachian clients who could benefit from nutrition intervention; 3) to determine if there were any significant differences between the results of the RANS and client nutrition risk (classified as 'at risk' or 'not at risk') for: the Patient-Generated Subjective Global Assessment (PG-SGA) Triage score; the USDA U.S. Household Food Security Survey Module: Six-Item Short Form (USDA-6); and assessment of nutrition needs based on clinical examination; and 4) to explore the methods used for developing the RANS to determine if these could be applied to develop population-specific nutrition screens in other rural and urban global settings.

The research questions considered by this study were:

1) Which criteria are indicative of nutrition status, need for nutrition education, and risk for food insecurity in a specific rural adult population?
2) Is there a difference in classification of nutrition risk ('at risk' or 'not at risk') among patients administered both the PG-SGA and the RANS?
3) Is there a difference in classification of food insecurity risk ('at risk' or 'not at risk') among patients administered both the USDA-6 and the RANS?
4) Could the methods used to develop the RANS be used to develop population-focused nutrition screens in other settings?

This research was conducted with approval of the Appalachian State University Institutional Review Board (IRB# 16-0116).

METHODS

Phase 1: Screen Development

The RANS was developed among a rural southern Appalachian population of residents and nutrition practitioners (RDNs) dwelling in the Blue Ridge Mountain region of northwest North Carolina, in the U.S. Appalachia is a cultural region which lies in parts of 13 states along the Appalachian mountain range in the eastern U.S., extending over 1600 km (~1000 miles) from north to south and encompassing about 531,000 sq. km (~205,000 square miles) (The Appalachian Regional Commission, 2020). The region's population in 2010 was approximately 25 million people. Some Appalachian areas have a history of severe poverty. The region is known for its rich cultural traditions and one of the most diverse foodsheds in North America (Renewing America's Traditional Foods Alliance, 2010; Veteto, 2013). Over the past several decades, substantial but uneven economic progress has been made in the region, with the number of counties reporting poverty rates higher than 1.5 times the national U.S. average declining by about 2/3 between 1960 and 2017 (The Appalachian Regional Commission, 2020). Today, Appalachia is home to cities, towns, and communities with successful economies as well as areas – often rural – lacking infrastructure and services (The Appalachian Regional Commission, 2020).

The RANS resulted from an iterative process which involved several stages. An initial questionnaire was developed based on the use of standard qualitative analysis methods to identify themes extracted from field notes from advanced nutrition students completing supervised practice experiences in rural practice settings. Four major themes were identified, including access to nutrition care, sociocultural characteristics such as strong family ties, traditional foods including a heritage of gardening and use of local gathered foods, and health behaviors and beliefs including a definition of health focused on functional ability (Gutschall et al., 2018).

The resultant questionnaire consisted of statements based on the themes. Respondents were asked to indicate the degree to which they agreed with each statement, using a 1 – 5 Likert scale with "5" representing the highest agreement and "1" the lowest. Respondents were stratified by resident or practitioner status. Statistical analysis of questionnaire results was performed to identify significant differences between mean scores provided by residents and practitioners. Items with significantly different scores between the two groups were compiled in a draft Rural Adult Nutrition Screen (RANS-1) for field testing with subsequent statistical analysis (Gutschall et al., 2019; Gutschall et al., 2018).

The resulting twenty-question screening tool was administered to participants at various locations including senior centers and a food pantry in two northwest North Carolina counties (N = 83). One county's population was classified as 84.86% rural, and the other county's population was 55.44% rural. Both counties are designated as "rural" by the U.S. Federal Office for Rural Health Policy, and both counties are eligible to participate in the Rural Health Clinics programs operated by the Center for Medicare and Medicaid Services (Rural Health Information Hub, 2020). Medicare and Medicaid are U.S. government health insurance programs for senior adults, persons with disabilities, and low-income persons; the Rural Health Clinics programs are intended to enhance primary care access for rural residents ((Rural Health Information Hub, 2002-2020).

No identifiable participant data were collected. Participants provided informed consent prior to completing the RANS-1 screening tool. All participants spoke English as their primary language. Participants were given a choice of completing the screen themselves or having the screen administered to them by trained, advanced nutrition students under the supervision of faculty members who are RDNs. The screen administrators took notes on questions or terms which seemed problematic or confusing to participants, and were encouraged to provide their own suggestions and comments. Following completion of the screen, participants were asked for comments on the tool, and administrators captured these as written notes. During initial administration, the screen underwent routine editing at intervals for clarity, brevity, and coding of results. Screens were administered either orally by the nutrition students, or were self-completed in writing, according to participant preference.

The results of the initial administration of the tool were analyzed to generate descriptive statistics including age, sex, screening location, and community or assisted living arrangements (IBM Corp, Released 2016). The frequency and proportion (n, %) of risk factors for malnutrition and food insecurity were also analyzed using SPSS software. Demographic characteristics of the participant group are provided in **Table 1.** The RANS-1 with participant responses is found in **Table 2.**

Following initial administration of the RANS-1 tool to 83 participants, qualitative analysis of the development version of the screen was conducted in a two-stage process. First, written feedback via guided questions was collected from university faculty who teach in a rural health-focused academic nutrition department, and rural nutrition practitioners working in area health facilities (n = 12; 7 faculty and 5 practitioners). All feedback participants were credentialed as Registered Dietitians in the U.S., with experience levels ranging from new practitioners (1 – 3 years' experience) to more than 30 years' experience. All of the nutrition faculty participants had extensive past and/or current experience as nutritionists in health care settings. Participants' comments and suggestions were recorded and were used to further review the tool. Second, RANS-1 administrator and participant comments were encouraged and collected during initial administration as previously described; these were also considered during

editing of the tool. Based on feedback comments, the screen questions were revised such that all questions became "true/false", with a "true" answer indicating nutrition risk. Selected written feedback comments are found in **Table 3.**

Table 1. Selected Characteristics of 83 Rurally-located Adults Participating in Initial Development of a Rural Adult Nutrition Screen

Demographic Criterion	**n(%)**
Community living	66(79)
Assisted living	17(21)
Age ≥ 60 years	68(81)
Age < 60 years	15(19)
Female	66(79)
Male	17(21)

Table 2. Summary of "Yes" and "No" Responses from 83 Rurally-located Participants to Questions Included in the Rural Adult Nutrition Screen (Development Version)

Question	**n, %**
1. I am the primary person purchasing and preparing food in my household.	Yes 61, 73% No 22, 26%*
2. I eat most of my meals alone.	Yes 31, 37%* No 52, 62%
3. I hold a high school diploma or a college degree.	Yes 71, 84% No 12, 14%*
4. I have health insurance.	Yes 71, 85% No 12, 14%*
5. I have dental insurance.	Yes 23, 27% No 60, 71%*
6. I have several missing or false teeth.	Yes 51, 61%* No 32, 38%
7. I worry about running out of money to buy food each month.	Yes 20, 24%* No 63, 75%
8. I have access to transportation to get to the grocery store and doctor's appointments.	Yes 80, 95% No 3, 4%*

9. I have a stove and refrigerator.	Yes 82, 98% No 1, 1%*
10. I regularly consume fried foods.	Yes 33, 39%* No 50, 60%
11. I eat five or more servings of fruits and vegetables per day.	Yes 36, 43% No 46, 55%*
12. I regularly drink sugar-sweetened beverages such as sweet tea and regular soda.	Yes 19, 23%* No 64, 76%
13. I eat less than three meals per day.	Yes 25, 30%* No 58, 70%
14. I use tobacco products.	Yes 9, 11%* No 74, 88%
15. I regularly consume more than the recommended servings per day of alcoholic beverages (recommended servings = no more than 2 drinks per day for men; no more than one drink per day for women)	Yes 1, 1%* No 82, 98%
16. I have one or more chronic diseases such as obesity, diabetes, or high blood pressure.	Yes 54, 64%* No 29, 35%
17. I have received nutrition education in the past.	Yes 53, 63% No 30, 36%*
18. I see a physician at least once a year.	Yes 80, 95% No 3, 4%*
19. I usually have a good appetite	Yes 70, 83% No 13, 16%*
20. I usually feel well enough to participate in my usual daily activities.	Yes 77. 92% No 6, 7%*

*Nutrition risk indicated

After reviewing the findings of initial administration and the quantitative and qualitative analysis, the RANS-1 was revised to group the 20 screening items into three categories focused on nutrition therapy, nutrition education, and food insecurity. Initial risk levels based on the number of risk factors identified were set based on the clinical judgment of RDN investigators who were also faculty at the research institution. The developed version of the screen was called the Rural Adult Nutrition Screen (RANS).

Table 3. Selected Examples of Developmental Screen Review Comments Submitted by University Nutrition Faculty and Rural Nutrition Practitioners, With Responses from Investigators

Reviewer Comments	Investigator Responses
"Some of the questions could probably be re-worded to simplify the literacy level. Depending on the county in North Carolina, the average reading level can be around 3-4th grade."	Reading level was assessed to ensure 3rd-4th grade level.
"To make sure my understanding of the screen results is accurate…. the points correlate with "Yes" answers?"	All questions were revised to have "true/false" answers such that a "true" answer indicates risk.
"Given issue of polypharmacy and potential drug-nutrient (and other) interaction, would adding a medication question be of value?"	A medication and supplement usage question was added to the screen.
"My thought is to consider a question on eating out. Or eating out and/or in the homes of friends/family. Fast food is typically an option, no matter how rural the location."	A question on frequency of eating out was added to the screen. "Regular" was defined as "3 or more times per week".

Phase 2: Pilot Evaluation of the RANS

Comparative tools selected for use during the pilot evaluation

The Patient Generated-Subjective Global Assessment tool (PG-SGA) is considered a valid and reliable malnutrition risk assessment tool and is commonly used as a reference standard for identifying malnutrition. (Marshall, Craven, Kelly, & Isenring, 2018; Marshall, Young, Bauer, & Isenring, 2016; Sealy et al., 2018). There is recognition of the need for global utilization of the PG-SGA in order to better track nutrition outcomes, and to support meta-analysis of nutrition data across countries (Jager-Wittenaar & Ottery, 2017; Sealy et al., 2018). Several validated translations of the PG-SGA have been completed to date, using the International Society for Pharmacoeconomics and Outcomes Research ten principles for best practice for translation and cultural adaptation (Wild et al., 2005). Current translations are available for download (PT-Global, 2014).

The PG-SGA classifies patients in clinical settings as well-nourished, moderately malnourished, or severely malnourished, indicated by a letter score of A, B, or C, respectively (Ottery, 2005). The PG-SGA also provides a Nutrition Triage Recommendation score based on the points accrued during the assessment, which can be used to support findings of: a) no need for intervention (0 – 1 points); b) need for patient and/or family education by a qualified professional, along with appropriate pharmacological therapy if indicated (2 – 3 points); c) need for prompt nutrition therapy by a dietitian in collaboration with the interdisciplinary team (4 – 8 points); or d) urgent need for symptom therapy and nutrition management; this could

conceivably include food adjustments, nutritional supplements, or enteral/parenteral nutrition therapy (≥ 9 points) (Ottery, 2005).

The PG-SGA has been utilized to perform nutrition assessment in adult populations with conditions including but not limited to cancer, liver cirrhosis, chronic obstructive pulmonary disease, vascular problems and others, as well as in home care, long term care, outpatient, rehabilitation, and palliative care settings (Banning et al., 2020; Berggren, Strang, Orrevall, Ödlund Olin, & Törnkvist, 2019; Carrier et al., 2019; de Oliveira, Abreu, Lima, Aredes, & Wiegert, 2020; de Pinho et al., 2020; Kosters, van den Berg, & van Hamersvelt, 2020; Luong, Kim, Lee, & Carey, 2019; Sealy et al., 2018; ter Beek et al., 2019). The PG-SGA was developed as a clinical tool, and to the best of the authors' knowledge has not specifically been evaluated in rural, community-dwelling adult populations (Berggren et al., 2019). The investigators reasoned that the PG-SGA Nutritional Triage Score, which indicates needs for nutrition education that can often be met in community settings, could be utilized as an appropriate comparative indicator for this pilot study of community-dwelling rural adults (Ottery, 2005).

The USDA-6, a shortened form of the 18-item U.S. Household Food Security Survey Module, is used in screening for food insecurity in community settings in the U.S. Food insecurity has been defined by the U.S. Department of Agriculture Economic Research Service as "…a household-level economic and social condition of limited or uncertain access to adequate food" (United States Department of Agriculture Economic Research Service, 2019). The USDA-6 shows high specificity and sensitivity with minimum bias (Council, 2006; Jones, Ngure, Pelto, & Young, 2013). The USDA-6 is designed to identify households at risk for low and very low food security. The results of the USDA-6 screening can be used to address social determinants of health by documenting risk for food insecurity and needs for food assistance (Council, 2006).

Nutrition assessment performed by a nutrition specialist (for example, a RDN in the U.S.) is used to determine whether or not screening results indicate a nutrition problem (Reber, Gomes, Vasiloglou, Schuetz, & Stanga, 2019). The results of nutrition risk assessment by a nutrition specialist may be compared for congruency with the results of nutrition screens. For these reasons, the investigators decided to use RDN nutrition assessment to triangulate study results.

Pilot evaluation procedures

Graduate dietetics students in the final phases of their educational programs were trained to administer the RANS, the PG-SGA, and the USDA-6 by doctoral-level nutrition faculty. Student training included instruction and practice in administering the nutrition-focused physical examination assessment criteria as required by the PG-SGA. In the clinic, students worked under the direction of an RDN who is also a Physician Assistant (RDN, PA).

After providing informed consent, participating clients completed the PG-SGA, the USDA-6, and the RANS PA (N = 37). Raw scores for each instrument were recorded. Any nutrition needs identified by the screens were immediately addressed by the supervising RDN, PA, who also conducted clinical assessments of each client in conjunction with their medical care at the clinic. Data were collected for each of the three screening tools as well as the RDN, PA's agreement with the RANS results. Data were gathered over a period of 5 weeks.

Data Analysis

The numerical PG-SGA Nutrition Triage Score (PG-SGA NTS) was entered into the data set, as well as the raw data score from the USDA 6-item Food Security Module. For the RANS,

each *true* response counted as one positive point, with the total score being the sum of the positive points, with a total possible score of 20. After performing a clinical examination, the supervisor indicated and recorded either agreement or disagreement with the overall results of each participant's RANS.

Prior to data analysis, raw scores from the PG-SGA NTS, USDA-6, and RANS tools were re-coded into *low-risk* and *at-risk* categories. Thus, all well-nourished clients as determined by the PG-SGA were classified as "low risk", while moderately and severely malnourished clients were classified as "at risk". Clients identified as food insecure or very food insecure by the USDA-6 were classified as "at risk", while the remaining clients were classified as "low risk". Based on preliminary data analysis, the "at risk" level for the RANS was set at a raw score ≥7 (out of a total of 20 possible points). The RANS "at risk" level was determined by clinical judgment of the RDN faculty and the RDN, PA preceptor, and roughly aligned with the 11subjects determined to be "at risk" by the PG-SGA.

RESULTS

Non-parametric statistical tests were used to compare the results of the PG-SGA NTS and the USDA-6, respectively, with the RANS regarding "at risk" and "low risk" status. There were no statistically significant differences among either nutrition screening instrument and the RANS in determination of "at risk" and "low risk" categories. Based on the results of clinical examination and nutritional assessment of participants, the RDN, PA's agreement with the RANS was 100%. Based on this initial study, the RANS items were categorized into domains indicating the need for specific nutrition services including nutrition education, nutritional management of chronic disease, and/or amelioration of food insecurity. The final revised version of the Rural Adult Nutrition Screen (RANS) is provided in **Table 4**.

Table 4: Rural Adult Nutrition Screen (RANS), Final Version

Question	True/False (Circle one)		Point Value for 'True'
Nutrition therapy			
1. I take three or more medications each day.	True	False	1
2. I have several missing or false teeth.	True	False	1
3. I drink more than 1 alcoholic drink per day (for women) or 2 alcoholic drinks per day (for men), 3 or more days per week.	True	False	1
4. I have one or more health problems such as: obesity, diabetes, breathing problems, digestive problems, depression or anxiety, pain, or high blood pressure.	True	False	1
5. I use tobacco products.	True	False	1
6. I see a doctor less than one time per year.	True	False	1

7. I do not have health insurance.	True	False	1
8. I often have a poor appetite	True	False	1
9. Often, I do not feel well enough to participate in my normal daily activities.	True	False	1
Nutrition Education			
10. I eat processed, convenience and/or fast foods three or more times per week.	True	False	1
11. I eat less than 3 servings of fruits and/or vegetables per day.	True	False	1
12. I drink sugar-sweetened beverages such as sweet tea and regular soda three or more days per week.	True	False	1
13. I do not know what eating plan to follow for my current state of health (whether I am healthy or not).	True	False	1
14. I have never received nutrition education.	True	False	1
Food Insecurity			
15. I depend on someone else to purchase and prepare food for me.	True	False	1
16. I eat most of my meals alone.	True	False	1
17. I worry about running out of money to buy food each month.	True	False	1
18. I do not have access to reliable transportation to get to the grocery store and doctor's appointments.	True	False	1
19. I do not have equipment to store and prepare food, for example, a refrigerator and stove.	True	False	1
20. I eat less than three meals per day.	True	False	1

Category	**Score (Score 1 point for each 'true' answer.)**
1. Nutrition therapy	**_____ out of 9**
2. Nutrition education	**_____ out of 5**
3. Food insecurity	**_____ out of 6**
Total score	**_____out of 20**

Nutrition risk assessment based on total score:

Risk level	**Total score**
Low risk	**4 or less**
Moderate risk	**5 – 7**
High risk	**> 7**

DISCUSSION

The RANS was developed through an iterative process in which the investigators sought to determine which indicators of nutrition status were important to the study population of rural Appalachian residents and nutrition practitioners. This pilot study sought to develop a nutrition screening tool for a specific population of rural adults that incorporates screening items indicative of social determinants of health, especially those that impact nutrition status in the study setting. The results supported previous reports of common issues impacting nutrition in rural populations, including lack of access to healthy foods and nutrition services, financial barriers, and transportation challenges (Gutschall et al., 2018).

By exploring social determinants of health - such as the presence of chronic disease, access to health insurance and health providers, food security and financial access to food, fruit and vegetable consumption, oral health, transportation capabilities, and quality of life issues such as frequently eating alone – the investigators suggest that the RANS may provide information on risk factors that the PG-SGA and USDA-6 are not designed to measure. Thus, the RANS specifically seeks to uncover potential risk factors for poor nutrition status that are common among rural populations in the U.S. This study suggests the possibility of a correlation between social determinants of health and clinical indicators of malnutrition.

Nutrition problems may differ in presentation and degree among rural and urban contexts, but the basic issues of poverty, lack of access, and transportation barriers are similar. The authors of this pilot study propose that the process used to develop the RANS may be useful in developing population-specific nutrition screens incorporating consideration of social determinants of health in both rural and urban populations.

This study had several limitations. First, the pilot research was not designed as a validation study. The investigators did not implement a statistical process of determining the screen's validity, sensitivity, specificity, and reliability, and the initial cutoff points for RANS risk were determined based on the investigator's experience and clinical judgment. This was a preliminary study to determine if the RANS should undergo further evaluation. The investigators hope to conduct a formal validation study in the near future. Second, the PG-SGA, to the best of the investigator's knowledge, has not been commonly utilized in community settings and the PG-SGA triage score has not been used in this setting as a comparator. Third, the study population was small, and represented a defined group of rural Appalachian residents in two northwest North Carolina counties. Results may not be generalizable to other rural populations, either in the U.S. or globally.

In this study, bias may exist because participants volunteered to complete the RANS-1 in community settings or the subsequent screenings of the RANS at the free community health clinic. While participating in other programs at the study sites, potential participants were informed of the nutrition screening research. If interested, persons were provided with further information and access to study personnel for questions prior to giving informed consent or declining participation. The individuals who volunteered to participate may be more likely to be interested in health and nutrition than those who did not volunteer, which could result in a sample of healthier individuals with better diets compared to the population as a whole. There was a substantial difference in age between the screen development participants and the screen evaluation participants; however, the lack of significant differences among the validated screens and the RANS suggests that the criteria may be appropriate for rural adult populations in general.

The presence of the RDN, PA as the researcher who supervised the data collection process was a strength and key component of this study. An individual credentialed in the U.S.

as both a Registered Dietitian Nutritionist and Physician Assistant is qualified to perform both comprehensive nutritional assessments as well as medically-focused clinical examinations. The RDN, PA agreed with the results of the RANS for all patients receiving the screen, thus highlighting the potential of the RANS to help identify rural clients who could benefit from nutrition care targeted toward general nutrition education, chronic disease management, and/or amelioration of food insecurity.

CONCLUSIONS

This exploratory pilot study provides some evidence that the RANS may be effective in screening rural, community-dwelling adults for nutrition status in light of social determinants of health common in rural settings. There were no significant differences between the RANS and the PG-SGA screening results in terms of at-risk status, or between the RANS and the USDA-6 regarding risk for food insecurity. There was 100% agreement between the RDN, PA and the RANS results. The RANS was feasible to administer in the free community medical clinic setting. Further research and formal validation of the RANS are needed in order to establish this tool as a valid nutrition screen for use in the rural community setting.

Part of the inherent value of the RANS is that the results are linked to specific nutrition interventions and/or community resources, including nutrition education and food assistance services. Because factors impacting rural and urban nutritional well-being are similar, it may be feasible to use the iterative process described in this paper to develop population-specific nutrition screens considering social determinants of health in both rural and urban settings elsewhere.

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