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Food choice considerations among American Indians living in rural Oklahoma: The THRIVE study

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Abstract

In rural American Indian (AI) communities, access to affordable, healthy foods is often limited. Understanding AI food choice considerations when selecting foods, such as sensory appeal, cost, or health, is an important yet understudied topic for eliminating persistent AI health disparities.

In partnership with the Chickasaw Nation and Choctaw Nation of Oklahoma, we administered a modified version of the Food Choice Values (FCV) Questionnaire to a cross-sectional sample of 83 AI patrons shopping at tribally-owned convenience stores 3 times per week. The FCV Questionnaire uses 25 items to assess eight FCV subscales related to buying and eating food, including sensory appeal; safety; accessibility; convenience; health/ weight control; organic; tradition; and comfort. We compared mean scores for each FCV subscale by demographic groups using t-tests and ANOVA. We used confirmatory factor analysis (CFA) to examine how well the data from this population fit FCV subscale constructs. We then used cluster analysis, MANOVA, and discriminant analysis to characterize distinct segments of the population based on patterns of FCV endorsement.

Appeal, safety, and access FCVs were most strongly endorsed across the sample. Prioritization of FCVs varied by age, gender, income, and education. Our cluster analysis identified four groups, or segments, each with distinct patterns of FCV endorsement: limited endorsement of any FCVs (23.3%); safety and sensory appeal (32.9%); health/weight control (17.8%); and broad endorsement of FCVs (26.0%). These groups varied by age and employment status.

Findings from this analysis informed the design and implementation of a healthy retail intervention comprised of new healthful foods and beverages, product placement and marketing

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strategies within four tribally-owned and operated convenience stores. Public health interventions aimed at reducing nutrition-related disparities in rural AI populations may benefit from assessing food choice considerations.

Keywords

Food choice values; Cluster analysis; Segmentation; American Indians; Native Americans; Food access

1. Introduction

In rural American Indian (AI) communities, where access to affordable, healthy foods is often limited (Kaufman, Dicken, & Williams, 2014) and socioeconomic nutrition disparities exist, AIs are disproportionately affected by diet-related chronic conditions (Hutchinson & Shin, 2014). A number of initiatives led by tribal health leaders have been implemented to promote and encourage healthy eating (Centers for Disease Control and Prevention, 2013; The Indian Health Service (IHS) Healthy Beverages Action Team, 2013), yet AIs continue to have higher rates of obesity, diabetes, and hypertension compared to the US general population (Hutchinson & Shin, 2014). Individual-level interventions for improving dietary intake have primarily centered upon the values of health and tradition; however, a variety of other factors, such as taste, cost, convenience, and availability, may influence dietary choices (Glanz, Basil, Maibach, Goldberg, & Snyder, 1998). These factors, often referred to as food choice values (FCVs) (Furst, Connors, Bisogni, Sobal, & Falk, 1996; Lysterly & Reeve, 2015) are associated with dietary quality, including weight control and organic FCVs being linked to healthier eating behaviors, while access, convenience, and comfort FCVs are related to unhealthy eating behaviors (Lysterly & Reeve, 2015). Thus, FCVs within AI communities may play a role in understanding individual-level determinants of eating disparities.

Identifying how AI's prioritize FCVs may be especially useful for the tailoring of healthy eating interventions for tribal communities. Research exploring FCVs within AI populations is limited. For example, our studies with Native communities in California found that traditional foods, such as acorn and salmon, were prioritized over types of commercial foods when the traditional foods were readily available (Jernigan, Salvatore, Styne, & Winkleby, 2012). However, within different AI communities or settings, convenience, ease, and price may be more influential than local origin or cultural connections (Stroink & Nelson, 2009).

Determinants of FCV differences within AI communities are unknown, yet may be understood, in part, through Satter's (2007) *Hierarchy of Food Needs Model*. This theoretical model suggests that differences in FCV prioritization, such as those related to access and cost versus health, may partly explain socioeconomic disparities in personal food preferences and dietary intake. Additionally, since food choices are hypothesized to be the result of multiple FCVs that are negotiated and balanced within the context of broader food environments (Furst et al., 1996; Sobal & Bisogni, 2009), healthy eating disparities within a given population may be further explained through audience segmentation, a marketing process that groups consumers according to shared values, beliefs, and attitudes that influence purchasing decisions (Mooi & Sarstedt, 2011). This approach is increasingly being

applied by public health practitioners to inform the development of healthy eating interventions (Carins & Rundle-Thiele, 2014).

Conducted as formative research for the development of a healthy food retail intervention within two rural Oklahoma tribal communities, the present study aimed to identify which FCVs are predominantly reported by AIs as most influential in their food purchasing and eating decisions. We additionally explore the extent to which FCV endorsement varies across sociodemographic characteristics as one potential explanation for socioeconomic nutrition disparities. Finally, we employ audience segmentation techniques to understand how different groups of AI consumers consider multiple FCVs when making food decisions, and whether these clusters differ by sociodemographic characteristics.

2. Methods

2.1. THRIVE study overview

The research presented here was conducted as part of a larger intervention study, The Tribal Health and Resilience in Vulnerable Environments (THRIVE) study, which aimed to improve the food environments of rural AI communities through the development, implementation, and evaluation of “healthy makeovers” in tribally owned and operated convenience stores. The THRIVE study employed a community-based participatory research orientation throughout all phases of its design, and consisted of a tribal-university partnership comprised of the Chickasaw Nation, the Choctaw Nation of Oklahoma, and the University of Oklahoma Health Sciences Center College of Public Health. The THRIVE study was reviewed and approved by the University of Oklahoma Health Sciences Center Institutional Review Board (IRB), the Chickasaw Nation IRB, and the Choctaw Nation of Oklahoma IRB. In accordance with tribal partners' preferences, results are aggregated.

2.2. Study population and recruitment

Data for this phase of the THRIVE study were collected from 83 participants between February and March of 2016. Participants were recruited from within the jurisdictional territories of The Chickasaw Nation and the Choctaw Nation of Oklahoma, which are both located in the southeastern portion of Oklahoma. To be eligible, participants had to be aged at least 18 years, live within the two jurisdictional territories, self-identify as AI or Alaska Native, and shop at tribally-owned convenience stores at least three times per week. Tribal research team members recruited participants through flyers posted at tribally-owned convenience stores and screened participants for eligibility. Participants received a \$20 gift card in compensation for their time, which included completion of the questionnaire and participation in a focus group discussion about foods sold in their community and tribal convenience stores.

2.3. Survey selection, adaption, and administration

The principal investigator, a Choctaw Nation citizen and the senior author of this article, shared the FCV Questionnaire with tribal partners as a potential quantitative measure that could inform the development of the THRIVE healthy eating intervention. This questionnaire, developed by Lyerly and Reeve (2015), built upon earlier FCV research

conducted by Steptoe, Pollard, and Wardle (1995) and may be a useful tool for guiding “intervention and prevention efforts targeting dietary choices” (Lyerly & Reeve, 2015). It uses 25 items to measure eight FCV subscales developed through exploratory factor analysis and confirmed through reliability and validity assessments: convenience, access, tradition, comfort, organic, safety, sensory appeal, and weight control/ health (Lyerly & Reeve, 2015). The FCV Questionnaire was identified as a suitable option since several of its individual FCV subscales previously correlated with desired THRIVE intervention targets such as intake of fruits, vegetables, and sugar-sweetened beverages. Study partners reviewed each item on the FCV Questionnaire and discussed their relevance to the THRIVE intervention. One original FCV Questionnaire item, “Degree to which I can be sure it is not associated with food-borne illness,” was removed because tribal partners felt it was duplicative with the other safety measures. A new item, “Whether it is sold in a tribally-owned or tribally-operated store (e.g., travel plaza/stop)” was added due to the context of the intervention.

The adapted FCV Questionnaire was administered prior to focus group discussions to assess the eight FCV subscales of safety (2 items), convenience (3 items), health/weight control (3 items), comfort (3 items), sensory appeal (3 items), organic (4 items), accessibility (3 items), and culture/traditional (4 items). Participants were asked to indicate, on a five-item Likert scale, how important each of the 25 items representing the eight FCVs was to them: “When deciding what foods to buy or eat on a daily basis, how important are each of the following?” Response options included “not at all” (1), “a little” (2), “moderately” (3), “quite a bit” (4), and “very” (5) with higher scores indicating a stronger endorsement of the FCV. The composite FCV scale and its eight subscales were calculated using the same methods as Lyerly and Reeve (2015), except our safety subscale only included the two safety items, and the culture/traditional subscale included the scores from the added question about tribally-owned stores.

A short socio-demographic survey was also administered at this time, to measure sex, age, marital status, employment, income, and use of federal food assistance programs.

2.4. Statistical analyses

We compared mean FCVs by demographic groups using *t*-tests (two groups) and analysis of variance (three or more groups). Confirmatory factor analysis (CFA) was used to examine how well the data from this population fit the FCV subscale constructs. Then cluster analysis, MANOVA, and discriminant analysis were used to obtain our final characterization of distinct segments of the population based on patterns of FCV endorsements. Cluster and discriminant analyses were conducted using the mean composite score for each FCV. The cluster, MANOVA, and discriminant analyses used only surveys with complete data. Comparison of mean FCVs by demographic groups and CFA were performed in SAS, version 9.4. Cluster analysis and discriminant analysis were performed in SPSS, version 24.

2.5. Confirmatory factor analysis

We used a pre-specified eight-factor confirmatory factor analysis that included subscale scores from all FCV items on our adapted survey. We also ran a second eight-factor pre-

specified confirmatory factor analysis model with a new traditional item (tribally-owned convenience store item) to see whether this item loaded on the traditional subscale.

2.6. Cluster analysis

To separate participants into similar clusters based on FCV sub-scales, we conducted a cluster analysis in multiple steps. First, we conducted a hierarchical cluster analysis using Ward's method to compute an agglomeration matrix showing the mathematical squared Euclidian distance between participants and a dendrogram that maps participants into divergent branches based on similarity of FCV pattern endorsement (Everitt, Landau, Leese, & Stahl, 2011). Additionally, we analyzed the agglomeration results by creating a scree plot using the difference between stepwise coefficients to confirm a final number of clusters in the data. Using the number of specified clusters from the dendrogram, we next performed k-means clustering to assign participants to a cluster. The k-means clustering was repeated several times to confirm the stability of the cluster assignments.

2.7. Discriminant analysis and MANOVA

To determine the accuracy and reliability of our cluster analysis, we conducted discriminant analysis and multivariate analysis of variance (MANOVA). Discriminant analysis is a form of linear modeling used to differentiate group membership through generating functions (Pituch & Stephens, 2016) based on the FCV subscales. In these analyses, we used the generated functions to confirm participant classification from the cluster analysis. Each of the resulting clusters can be described as segments based on patterns of FCV subscale endorsement that illustrate distinct differences between clusters. The MANOVA was used to determine the relative proportion of between-cluster variability explained by each FCV subscale.

3. Results

3.1. Participant demographics

Participant ages ranged between 18 and 75, with an average age of 41.5 years ($SD = 14.9$). A higher proportion of participants were female (72.8%), and one half of the study population was in a relationship (50.8%). The majority were employed (70.0%), and household income was relatively balanced across the earning categories ranging below \$20,000 per year to above \$40,000 per year (Table 1). Most participant incomes (71.3%) supported three or fewer people ($M = 2.9$ people, $SD = 1.72$). One-quarter of participants received SNAP (25.6%) and 14.1% received WIC.

3.2. Confirmatory factor analysis for FCV questionnaire

Both pre-specified seven-factor confirmatory factor analysis (CFA) models had acceptable fits. The CFA model without the tribally-owned item had an acceptable fit that was similar to the Lyerly original scale (Lyerly & Reeve, 2015), $\chi^2 = 354$, $\chi^2/df = 1.58$, CFI = 0.85, TLI = 0.82, RMSEA = 0.090 (90% CI: 0.072, 0.11). The CFA model including the tribally-owned item did not significantly change the fit ($\chi^2 = 393$, $\chi^2/df = 1.59$, CFI = 0.85, TLI = 0.81, RMSEA = 0.091 (90% CI: 0.074, 0.11). Reliability of the composite scale was high (Cronbach's alpha = .90). Based on these results we used the adapted traditional subscale

containing the tribally-owned item for subsequent analyses. The mean endorsement of each FCV subscale for the entire sample are summarized in Table 1. Sensory, safety, accessibility, and convenience were the most strongly endorsed subscales.

3.3. Demographic differences in endorsement of food choice values

When we compared the FCV subscales by participant demographics (Table 1), we identified some differences in the mean endorsement for the FCV subscales of safety, access, organic, tradition, and health/ weight control. We did not identify demographic differences in the mean endorsement of sensory, convenience, and comfort. The mean safety and organic FCV scores were higher among those aged 45 years and older than among younger age groups. The mean access FCV was higher among women than men, while the mean traditional FCV was higher among those in a relationship than among those not in a relationship. We identified more demographic differences for the health/ weight control FCV subscale. Older participants who were employed and earning higher incomes and who were not participating in SNAP or WIC had higher mean FCV scores for the health/weight control FCV subscale.

3.4. Cluster analysis, discriminant analysis, and MANOVA

The cluster analyses used 73 of the 83 patron surveys due to missing data on 10 surveys. After five iterations, the resulting agglomeration schedule, dendrogram, and scree plot indicated four clusters in the data based on patterns of FCV endorsement. Subsequently, four groups were used in the k-means clustering to assign participants to group membership resulting in the following segmented groups: Cluster 1 (n = 17), Cluster 2 (n = 24), Cluster 3 (n = 13), and Cluster 4 (n = 19) (Table 2). Participant assignments to clusters were confirmed with discriminant analysis. The discriminant functions correctly predicted segment classification of 97.3% of participants. Results from the MANOVA also showed significant differences in subscale means across the four clusters, $F(24, 180.42) = 13.891$, $p < .001$. The Wilks' lambda test value was 0.048, indicating that the model explained approximately 95% of the variance. Further review of the test of equality of group means between subscales suggests that the safety FCV subscale explains the greatest proportion of variance between the means of the clusters. After safety, organic, comfort, and health/weight FCV subscales provided similar contributions to the proportion of variance explained, followed by the tradition, sensory, access, and convenience FCV subscales.

3.5. Cluster descriptions

3.5.1. Cluster 1: Limited endorsement of FCVs (23% sample)—This cluster was the least likely to strongly endorse any of the eight FCVs, and endorsement of each FCV was below the total sample mean for that FCV. Only two of the eight FCVs were moderately (averaged > 3) endorsed: sensory ($M = 3.65$, $SD = 0.909$) and accessibility ($M = 3.31$, $SD = 0.939$). This cluster also placed a lower priority on FCV subscales related to safety, health/ weight control, organic, tradition, and comfort.

3.5.2. Cluster 2: Safety and sensory (33% sample)—Unlike the first cluster, this group strongly endorsed several FCVs (averaging > 4 “quite a bit to very”), including safety ($M = 4.58$, $SD = 0.458$) and sensory appeal ($M = 4.13$, $SD = 0.643$), both of which were also higher than the total sample mean for these FCVs. While not as extreme as the first cluster,

this group also placed a lower priority on FCV subscales related to health/weight control, organic, tradition, and comfort.

3.5.3. Cluster 3: Health and weight control (18% sample)—Unlike clusters 1 and 2, this cluster placed a higher priority on health and weight control ($M = 3.51$, $SD = 0.689$), which was also the FCV most strongly endorsed of all eight; however, this cluster overall did not demonstrate a strong endorsement (> 4) for any of the FCV subscales.

3.5.4. Cluster 4: Broad endorsement of many FCVs (26% sample)—A distinguishing feature of this cluster is the strong endorsement of multiple FCV subscales, including safety, sensory, accessibility, convenience, and health/weight control. Additionally, this cluster demonstrated moderate-level endorsement of organic and traditional values as factors that influence their daily food choices.

3.6. Demographic differences by food choice value cluster assignment

While age, marital status, education employment, income, and government food program use were all significantly associated with mean scores for one or more FCV subscale, only age, $F(3, 66) = 3.95$, $p = .012$, and employment status, $\chi^2(3, N = 71) = 8.2109$, $p = .042$, were significantly associated with cluster assignment (see Table 3). The multiple comparison test (Tukey) found Cluster 1 was significantly younger than Cluster 4. A higher percentage of Cluster 4 (94.4%) were also employed than Cluster 1 (52.9%), Cluster 2 (60.9%), or Cluster 3 (69.2%).

3.6.1. Cluster 1: Limited endorsement of FCVs (23% sample)—This cluster was the youngest in our population, with a mean age of 32.8 ($SD = 10.5$; range: 18–53). This cluster had the highest unemployment rates compared to all other clusters, with nearly one half of the members being unemployed (47.1%). Most of the members in this cluster were single (64.7%) and lacked a college degree (94.1%), but these were not statistically significant differences compared to the other clusters. Again, although not significantly different, this cluster had a higher proportion receiving SNAP (41.2%) or WIC (29.4%) benefits.

3.6.2. Cluster 2: Safety and sensory (33% sample)—This cluster had a wider age range (20–75 years) than the others and the third oldest mean age ($M = 43.8$, $SD = 14.8$). This cluster is the largest ($n = 24$) in our total sample. This cluster had the second highest unemployment rates compared to all other clusters, with over one-third of the members being unemployed (39.1%). However, this cluster also had the highest college completion rates compared to other clusters (34.8%) and had a higher proportion with household incomes above \$40,000 (36.4%), although these were not statistically significant compared with the other clusters.

3.6.3. Cluster 3: Health and weight control (18% sample)—The mean age of this cluster was 37.8 ($SD = 15.4$) and ranged between 19 and 65 years. This cluster had the second highest employment rate compared to other clusters, with slightly over two-thirds of the members being employed (69.2%). Although not statistically significant, this cluster had

a lower proportion of members with a college degree (8.3%) than did Cluster 2 (34.8%) and Cluster 4 (16.7%).

3.6.4. Cluster 4: Broad endorsement of many FCVs (26% sample)—This cluster was the oldest cluster with a mean age of 48.0 (SD = 13.9) and an age range between 24 and 75 years. Unlike the other three clusters that all had high unemployment rates, this cluster was comprised of primarily employed individuals (94.4%). Additionally, this cluster included more members earning household incomes of \$40,000 or above each year (41.2%) and who were in a relationship (66.6%), but these were not statistically significant compared with the other clusters. Although not significantly different than other clusters, very few individuals within this cluster participated in SNAP (10.5%) or WIC (5.3%).

4. Discussion

To our knowledge, this is the first study to explore FCVs among AIs using the FCVs Questionnaire. We identified the predominant FCVs among a sample of AIs living in rural Oklahoma who regularly shop for food at tribally-owned convenience stores. Our results provide additional insight into the potential role of FCVs as one individual-level determinant of eating disparities. Specifically, we found the FCVs of sensory, safety, and access received the strongest endorsement across the entire sample. We also found expression of health/weight, organic, tradition, safety, and access FCVs varied by demographics. Finally, we identified patterns of endorsement across FCVs that allowed us to describe four cluster groups, or segments, within our sample population. These segments differed by age and employment status, but not by income, education, sex, marital status, or food assistance program participation. This study's findings have important implications for the development of healthy eating interventions for AI communities.

While many AI-specific health interventions often emphasize traditional values as a central component, AI participants in this study did not endorse traditional values as not as strongly as many other FCVs. However, mean endorsement of the original “traditional” FCV subscale were higher in our population than means in the non-AI populations used in the original validation study (Lyerly & Reeve, 2015), including the traditional item ($M = 2.3$ vs. $M = 1.9$), culture item ($M = 2.1$ vs. $M = 1.9$) and similar to childhood item ($M = 2.7$ vs. $M = 2.1$). Weaker endorsement of the traditional FCV among AIs who are not married or in a relationship suggests this demographic group may not be as receptive to healthy eating interventions that emphasize this FCV. However, future studies using the FCV Questionnaire with AI populations should consider whether these items adequately capture tradition or cultural values, as opposed to measuring values for foods eaten as a child or during the holidays.

Health is another FCV commonly promoted by educational materials and related healthy eating interventions, including those developed for AI and non-AI populations. Similar to the Lyerly and Reeve (2015) validation study, the present study's overall sample did not strongly endorse the “health/weight control” FCV as compared with the “sensory”, “safety”, and “access” FCVs. These results suggest that healthy food interventions that incorporate these FCVs may be more effective than those that promote nutritious foods as being healthy.

For interventions that emphasize health as a central FCV, this study's AI population revealed possible differences in item response patterns related to the “health/weight control” and “organic” subscales compared with those in the original FCV Questionnaire validation study. These subtle differences may have important implications when marketing the health and nutrition qualities of a target food. For example, compared to the original validation study, two of the three “health/weight control” FCV subscale items were higher in this study's AI population, including the weight control item ($M = 3.1$ vs. $M = 2.9$) and weight loss item ($M = 3.0$ vs. $M = 2.7$) with no difference for the calories item ($M = 2.9$ vs. $M = 2.9$). Conversely, three of the four “organic” FCV subscale items were lower in this study's AI population, including the additives item ($M = 2.9$ vs. $M = 3.1$), natural item ($M = 2.8$, vs. $M = 3.3$), and vitamin item ($M = 3.0$ vs. $M = 3.2$), with minimal difference for the environmentally-friendly item ($M = 3.0$ vs. $M = 2.9$).

Our findings also lend evidence to support Satter's *Hierarchy of Food Needs Model* (Satter, 2007), which argues that extreme socioeconomic restrictions dampen the expression of higher-level motivations for food choices, such as health promotion or disease prevention, resulting in greater prioritization of values related to obtaining foods that are more easily accessible and acceptable (e.g., taste). AIs in this sample who earn higher incomes and who are employed more strongly endorsed the “health/weight control” FCV compared with those of lower socioeconomic status. Further, those AIs with limited food resources, as indicated by SNAP and WIC participation, also assigned lower priority to the “health/weight control” FCV than did non-participants. Our findings for Cluster 1 and Cluster 4 further suggest FCV operate hierarchically. The overall lack of strong endorsement of any FCV by Cluster 1 suggests socioeconomic restrictions in this segment may be the result of competing priorities in other life domains, such as unemployment, that limit rationalization of food choices beyond meeting immediate food needs. Thus, consumers in this cluster may be less responsive to FCV messaging than may consumers in other clusters. In contrast, Cluster 4 findings further illustrate this model, where choosing foods for “instrumental reasons,” including health and the expression of social values, can only be realized when socioeconomic needs are met. Nearly all of the participants in Cluster 4 were employed, and, although not statistically significant, few participated in food assistance programs. Consumers in this cluster may be the ablest to change their eating behaviors due to having more resources (i.e., employment) and may also be the most responsive to health-related FCV messaging, as indicated by this cluster's strong endorsement of the “health/weight control” FCV.

Collectively, these data suggest that marketing and related health-promotion efforts that emphasize the “health/weight control” FCV may be less effective in promoting healthy food decisions among a large segment of AIs, particularly those of lower socioeconomic status who stand to benefit the most from nutrition interventions. Additionally, the strong endorsement of the “access” FCV in this sample emphasizes the need for multi-level intervention strategies that improve the availability of affordable healthy food options in rural AI communities, which are typically located in food deserts (Kaufman et al., 2014). Further research is needed on how macro, physical, and social determinants limit or encourage the expression or actualization of personal FCVs.

Recent efforts to address AI nutrition disparities include increasing access to healthy foods in tribal communities (Fleischhacker et al., 2012). As noted, findings from this formative research were used to inform the development and evaluation of the THRIVE healthy food retail intervention. For example, the “Sensory” and “Access” FCVs were among the three FCVs receiving the highest mean endorsement of all subscales in our total sample. These FCVs respectively align with “Fresher Choice” and “Value Choice” marketing signage developed to promote healthy food choices by one of the tribal partners. In contrast, the “Health/Weight Control” FCV was not as strongly endorsed across the total sample, but it was strongly endorsed in Cluster 3 and Cluster 4, indicating health-related messaging may be well-received by a segment of customers within this population. Therefore, tribal research partners implemented additional health messaging for targeted foods in the THRIVE study, including “Better Choice”, “Rethink your Drink”, and “Everyday Choice.”

4.1. Limitations

The data from this study were collected using a convenience sample of AIs who frequently shop at rural tribally-owned convenience stores, and thus may not be representative of all persons or AIs living in rural food environments. Although our analyses confirmed the accuracy and reliability of our four cluster assignments, our small sample size possibly prevented detection of significant differences in demographics between clusters, such as educational or federal food assistance program differences. Thus, larger studies are needed to further explore the relationships between socioeconomic differences in FCVs, as well as differences related to chronic conditions, such as obesity, hypertension, and diabetes, which disproportionately affect AI populations. Finally, the FCV Questionnaire is designed to assess individual-level considerations when buying or eating foods. This scale does not measure other individual-level determinants of AI food decisions, such as food preparation knowledge or confidence (Gittelsohn et al., 2006). While this scale incorporates some aspects of the broader food environment (e.g., accessibility, convenience), it does not assess the overall tribal food environment and how that environment contributes to healthy food access.

5. Conclusion

Interventions designed to improve rural tribal food environments must account for the significant heterogeneity of AI populations within these communities. Segment research, as conducted within this study, may be useful for the tailoring of healthy food messaging as well as to inform comprehensive healthy retail interventions as implemented in the THRIVE study. Additional research is needed to evaluate whether targeted FCV marketing of healthy foods can influence food purchasing decisions within the targeted segment compared with broad health messaging strategies. Further studies that explore expression of FCVs in Native populations, including possible revisions to items that comprise the traditional FCV subscale, and how other factors that comprise tribal food environments, such as access to healthy food options and community norms regarding the consumption of these foods, may play a role in personal food decision making, are needed.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.appet.2018.05.019>.

Table 1
Demographic characteristics of overall sample and endorsement of food choice values by participant characteristics.

	Total sample (n = 83)	Sensory M (SD)	Safety M (SD)	Access M (SD)	Convenience M (SD)	Health/ Wt Control M (SD)	Organic M (SD)	Tradition M (SD)	Comfort M (SD)
Total Sample		3.9 (0.9)	3.9 (1.1)	3.7 (0.8)	3.4 (1.0)	3.0 (1.2)	2.9 (1.0)	2.3 (0.9)	2.2 (1.0)
Age, years¹									
< 30 years	22 (28.2%)	3.9 (0.9)	3.7 (1.1)	3.5 (0.9)	3.2 (0.9)	2.5 (1.0)	2.5 (1.0)	2.0 (0.8)	2.0 (1.1)
31–45 years	27 (34.6%)	3.7 (0.8)	3.6 (1.3)	3.7 (0.9)	3.2 (1.0)	2.8 (1.3)	2.7 (1.2)	2.3 (0.9)	2.1 (1.1)
> 45 years	29 (37.2%)	4.2 (0.8)	4.3 (0.7)	3.9 (0.8)	3.6 (1.0)	3.3 (1.1)	3.3 (0.6)	2.6 (1.0)	2.3 (0.9)
Sex, n (% total)²									
Male	22 (27.2%)	3.8 (0.8)	3.8 (1.3)	3.4 (0.7)	3.1 (0.9)	3.0 (1.0)	2.8 (1.0)	2.1 (0.9)	2.3 (1.1)
Female	59 (72.8%)	4.0 (0.9)	4.0 (1.0)	3.8 (0.9)	3.5 (1.0)	3.0 (1.3)	2.9 (1.0)	2.4 (0.9)	2.2 (1.0)
Marital Status, n (% total)¹									
Married/living with partner	38 (50.8%)	4.0 (0.9)	4.0 (1.2)	3.8 (0.9)	3.5 (1.0)	3.1 (1.1)	3.2 (1.1)	2.6 (0.9)	2.3 (1.0)
Widowed/Divorced/Separated	27 (33.8%)	4.1 (0.7)	4.0 (1.0)	3.7 (0.8)	3.4 (1.2)	3.0 (1.4)	2.8 (0.9)	2.1 (0.9)	2.2 (1.0)
Never Married	13 (16.3%)	3.5 (1.0)	3.4 (1.0)	3.4 (0.9)	3.3 (0.7)	2.7 (0.9)	2.4 (1.1)	1.8 (0.6)	1.8 (1.2)
Education, n (% total)²									
Less than college	65 (82.3%)	3.9 (0.9)	3.9 (1.1)	3.7 (0.9)	3.3 (1.0)	3.0 (1.3)	2.9 (1.1)	2.3 (0.9)	2.2 (1.0)
College or more	14 (17.7%)	4.2 (0.6)	4.2 (1.0)	3.9 (0.7)	3.8 (0.8)	3.0 (1.0)	2.9 (0.7)	2.1 (0.8)	1.8 (0.8)
Employment, n (% total)²									
Working, FT or PT	56 (70.0%)	4.0 (0.8)	4.0 (1.1)	3.8 (0.7)	3.5 (1.0)	3.2 (1.2)	3.0 (1.1)	2.4 (0.9)	2.3 (1.1)
Not working	24 (30.0%)	3.8 (1.0)	3.7 (1.1)	3.5 (1.0)	3.1 (0.9)	2.5 (1.2)	2.7 (1.0)	2.0 (0.7)	1.9 (0.9)
Income, n (%total)¹									
Under \$20,000	27 (34.2%)	4.0 (1.0)	3.8 (1.0)	3.4 (0.8)	3.2 (0.8)	2.7 (1.2)	2.9 (0.8)	2.4 (0.9)	2.4 (1.0)
\$20,000–39,999	27 (34.2%)	3.9 (0.7)	3.7 (1.3)	3.8 (0.9)	3.3 (1.2)	2.9 (1.3)	2.6 (1.2)	2.1 (0.7)	1.8 (0.8)
\$40,000 and above	25 (31.7%)	3.9 (0.9)	4.3 (1.0)	3.9 (0.6)	3.7 (0.9)	3.5 (1.0)	3.3 (1.1)	2.4 (1.0)	2.4 (1.2)
Program Use									
SNAP (% Yes) ²	20 (25.6%)								
No		4.0 (0.9)	4.0 (1.0)	3.7 (0.8)	3.4 (1.1)	3.2 (1.2)	3.0 (1.1)	2.4 (0.9)	2.2 (1.1)
Yes		3.9 (1.0)	3.6 (1.3)	3.7 (1.1)	3.4 (0.8)	2.3 (1.1)	2.7 (1.0)	2.1 (0.8)	2.1 (1.0)

	Total sample (n = 83)	Sensory M (SD)	Safety M (SD)	Access M (SD)	Convenience M (SD)	Health/ Wt Control M (SD)	Organic M (SD)	Tradition M (SD)	Comfort M (SD)
Receiving WIC (% Yes) ²	11 (14.1%)								
No		3.9 (0.9)	4.0 (1.0)	3.8 (0.8)	3.4 (1.0)	3.1 (1.2)	3.0 (1.0)	2.3 (0.9)	2.2 (1.0)
Yes		4.3 (0.6)	3.4 (1.3)	3.4 (1.1)	3.5 (0.8)	2.2 (0.9)	2.5 (1.2)	2.1 (0.8)	2.2 (1.3)

Notes: Possible scores for each food choice value subscale range between 1 and 5, with higher scores indicating a stronger endorsement of that food choice value. Bold denotes $p < .05$ for ¹ANOVA or ²Independent t -test.

Table 2

Endorsement of food choice value items and scales by cluster assignment and total.

	Cluster 1 n = 17 M (SD)	Cluster 2 n = 24 M (SD)	Cluster 3 n = 13 M (SD)	Cluster 4 n = 19 M (SD)	Total Mean (SD)	Wilks' Lambda	F ^b	p
Sensory Appeal	3.65 (.909)	4.13 (.643)	3.36 (.763)	4.61 (.389)	3.9 (0.9)	.684	10.631	< .001
Taste	4.18 (1.07)	4.58 (.50)	3.69 (1.32)	4.68 (.58)	4.3 (1.0)			
Looks	3.41 (1.28)	3.79 (1.10)	3.23 (1.01)	4.68 (.67)	3.8 (1.2)			
Smell	3.35 (1.27)	4.00 (1.22)	3.15 (1.07)	4.47 (.61)	3.8 (1.2)			
Safety	2.62 (.977)	4.58 (.458)	3.42 (.607)	4.71 (.303)	3.9 (1.1)	.325	47.797	< .001
Bacteria/virus	2.71 (1.49)	4.79 (.41)	3.54 (1.20)	4.89 (.32)	4.1 (1.3)			
Care	2.53 (1.46)	4.38 (.71)	3.31 (.63)	4.52 (.61)	3.7 (1.3)			
Accessibility	3.31 (.939)	3.74 (.667)	3.49 (.520)	4.42 (.495)	3.7 (0.8)	.716	9.105	< .001
Close to Home/Work	2.59 (1.23)	3.58 (1.02)	3.62 (.87)	4.63 (.60)	3.6 (1.2)			
Available	3.76 (1.15)	3.33 (1.09)	3.31 (1.03)	4.21 (.92)	3.6 (1.1)			
Value	3.59 (1.18)	4.29 (.95)	3.54 (.78)	4.42 (.77)	4.0 (1.0)			
Convenience	3.00 (.773)	3.14 (.987)	3.18 (.801)	4.19 (.660)	3.4 (1.0)	.737	8.192	< .001
Prepare	3.00 (.94)	3.17 (1.31)	3.08 (1.12)	3.89 (1.15)	3.3 (1.2)			
Prep time	2.94 (.75)	3.04 (1.16)	3.46 (.88)	4.21 (.71)	3.4 (1.1)			
Simple to cook	2.51 (1.23)	3.21 (1.02)	3.0 (.82)	4.47 (.70)	3.5 (1.1)			
Health/Weight Control	1.90 (.724)	2.63 (.970)	3.51 (.689)	4.09 (.874)	3.0 (1.2)	.498	23.147	< .001
Weight control	2.18 (.95)	2.63 (1.06)	3.85 (.80)	4.11 (.99)	3.1 (1.3)			
Weight loss	1.71 (.77)	2.54 (.98)	3.62 (.87)	4.21 (1.08)	3.0 (1.3)			
Calories	1.82 (.81)	2.71 (1.16)	3.08 (1.04)	3.95 (1.13)	2.9 (1.3)			
Organic	1.62 (.638)	2.90 (.827)	3.06 (.410)	3.87 (.642)	2.9 (1.0)	.408	33.431	< .001
Additives	1.47 (.72)	3.08 (1.18)	3.0 (.58)	3.74 (.93)	2.9 (1.3)			
Natural	1.65 (0.70)	2.79 (1.10)	3.0 (.58)	3.68 (.95)	2.8 (1.2)			
Environmentally Friendly	1.82 (1.13)	2.75 (1.22)	3.08 (.49)	3.95 (.85)	3.0 (1.3)			
Vitamins	1.53 (.72)	2.96 (1.12)	3.15 (.80)	4.11 (.74)	3.0 (1.3)			
Tradition	1.59 (.552)	2.10 (.621)	2.42 (.544)	3.20 (.949)	2.3 (0.9)	.573	17.164	< .001
Tradition	1.59 (.87)	1.96 (.86)	2.31 (1.25)	3.26 (1.37)	2.3 (1.3)			

	Cluster 1 n = 17 M (SD)	Cluster 2 n = 24 M (SD)	Cluster 3 n = 13 M (SD)	Cluster 4 n = 19 M (SD)	Total Mean (SD)	Wilks' Lambda	F^b	p
Culture	1.18 (.39)	1.67 (.87)	2.15 (.69)	3.11 (1.29)	2.1 (1.2)			
Tribally-owned convenience store ^a	1.18 (.53)	1.92 (1.14)	2.62 (.77)	3.42 (1.12)	2.3 (1.3)			
Similar to Childhood	2.41 (1.22)	2.88 (1.23)	2.62 (1.04)	3.0 (1.25)	2.7 (1.2)			
Comfort	1.41 (.629)	1.58 (.639)	3.00 (.667)	2.96 (.831)	2.2 (1.0)	.462	26.776	< .001
Relax	1.41 (.71)	1.83 (.96)	3.08 (1.04)	2.95 (1.03)	2.3 (1.2)			
Life events	1.41 (.80)	1.33 (.48)	3.15 (.99)	3.00 (1.15)	2.1 (1.2)			
Stress	1.41 (.80)	1.58 (.78)	2.77 (1.09)	2.95 (.97)	2.2 (1.1)			

Notes: Cluster 1: Limited Endorsement of FCVs; Cluster 2: Safety and Sensory; Cluster 3: Health and Weight Control; Cluster 4: Broad Endorsement of Many FCVs;

^aNot included in original Food Choice Values Questionnaire;

^bMANOVA Test of equality of group means.

Table 3

Demographic differences by clusters.

	Cluster 1 n = 17 (23.3%)*	Cluster 2 n = 24 (32.9%)*	Cluster 3 n = 13 (17.8%)*	Cluster 4 n = 19 (26.0%)*	χ^2	p
Age (M, SD)	32.8 (10.5)*	43.8 (14.8)	38.7 (15.4)	48.0 (13.9)*		0.012
Sex						
Male (n = 19)	4 (23.5)	8 (33.3)	5 (38.5)	2 (11.1)	0.0029 ^a	0.2746
Female (n = 53)	13 (76.5)	16 (66.7)	8 (61.5)	16 (88.9)		
Marital Status					3.4704	0.3246
Married/partner (n = 37)	6 (35.3)	12 (52.2)	7 (53.9)	12 (66.7)		
Single (n = 34)	11 (64.7)	11 (47.8)	6 (46.2)	6 (33.3)		
Education					3.4704 ^a	0.1065
Less than college (n = 57)	16 (94.1)	15 (65.2)	11 (91.7)	15 (83.3)		
Higher Education (n = 13)	1 (5.9)	8 (34.8)	1 (8.3)	3 (16.7)		
Employment					8.2109	0.0418
Working (n = 49)	9 (52.9)	14 (60.9)	9 (69.2)	17 (94.4)		
Not working (n = 22)	8 (47.1)	9 (39.1)	4 (30.8)	1 (5.6)		
Income						
Under \$40,000 (n = 47)	14 (82.4)	14 (63.6)	9 (69.2)	10 (58.8)	2.4732	0.4802
\$40,000 and above (n = 22)	3 (17.7)	8 (36.4)	4 (30.8)	7 (41.2)		
SNAP					5.1350 ^a	0.1966
Yes (n = 16)	7 (41.2)	5 (22.7)	2 (16.7)	2 (10.5)		
No (n = 54)	10 (58.5)	17 (77.3)	10 (83.3)	17 (89.5)		
WIC					5.6339 ^a	0.1934
Yes (n = 9)	5 (29.4)	2 (9.1)	1 (8.3)	1 (5.3)		
No (n = 61)	12 (70.6)	20 (90.9)	11 (91.7)	18 (94.7)		

Notes: Bold denotes $p < .05$; Cluster 1: Limited Endorsement of FCVs; Cluster 2: Safety and Sensory; Cluster 3: Health and Weight Control; Cluster 4: Broad Endorsement of Many FCVs;^aFisher's exact value.