Application of the IMB Model to the Reported Intake of Fruits and Vegetables of Native American Children

Rachel C. Sinley, PhD, MPH, RD, Metropolitan State University of Denver
Julie A. Albrecht, PhD, RD, University of Nebraska-Lincoln

Corresponding Author: Rachel C. Sinley, PhD, MPH RD, Metropolitan State University of Denver, rsinley@msudenver.edu

ABSTRACT
The purpose of this study was to evaluate the applicability of the Information-Motivation-Behavioral Skills (IMB) model to identify variables that are associated with fruit and vegetable intake among Native American children. A cross-sectional study design was employed with a convenience sample of 92 English-speaking caregivers of Native American children between the ages of 2 and 5 from several tribes representing the Midwest, including Omaha, Santee Sioux, Ponca and Winnebago. Caregivers completed an IMB model survey, fruit and vegetable food frequency questionnaire and demographic survey. Multivariate linear regression and path analysis were conducted to assess association between model constructs and fruit and vegetable consumption. Caregiver fruit and vegetable-related behavioral skills were significantly associated with child fruit and vegetable consumption. Caregiver fruit and vegetable-related information was significantly associated with fruit and vegetable related motivation and caregiver fruit and vegetable-related motivation was significantly associated with behavioral skills. Caregiver fruit and vegetable motivation was only associated with child fruit and vegetable consumption via the indirect pathway through behavioral skills.

Keywords: Native American; children; caregivers; IMB model; fruits; vegetables

INTRODUCTION
Native American children experience higher rates of obesity compared to their counterparts in other ethnic groups (Pan et al., 2015). While estimates of childhood overweight and obesity are high among all ethnic groups, rates among Native American children exceed those of all other ethnicities combined (Centers for Disease Control and Prevention, 2012; Holm, Vogeltanz-Holm, Poltavski and McDonald, 2010). Overweight and obese status among Native American children often develops early, with documentation of overweight, obesity and correlating heart-related issues as early as 12 months of age (Lindberg, Adams and Prince, 2012). These issues can often
result in overweight and obese status later in life, as well as premature death from cardiovascular disease (Franks et al., 2010).

The disparity in overweight and obese status among Native American children may result from many overlapping factors, including physical inactivity, a poor food environment and caloric intakes that exceed dietary needs (Halpern, 2007). Native American children have been shown to consume excess sugar (Stroehla, Malcoe and Velie, 2005; LaRowe et al., 2010), inadequate amounts of dairy (Story, Neumark-Sztainer, Resnick and Blum, 1998) and less than recommended amounts of fruits and vegetables (Stroehla, Malcoe and Velie, 2005; Story, Neumark-Sztainer, Resnick and Blum, 1998). Combined with regular physical inactivity (Story, Neumark-Sztainer, Resnick and Blum, 1998), these behaviors can combine to increase Native children’s risk for obesity.

The 2015 Dietary Guidelines for Americans recommends a “shift” to consume more fruit and vegetables across all age groups (United States Department of Agriculture, 2015). The World Health Organization estimates that up to 2.7 million lives could be saved annually if fruit and vegetable consumption increased to a sufficient level of approximately 400 grams (5 servings) daily (World Health Organization, 2005). Adequate consumption of fruits and vegetables is associated with a reduction in the incidence and prevalence of many of the diseases that Native Americans are disproportionately impacted by, including cardiovascular disease (Leenders et al., 2013), diabetes (Cooper et al., 2015) and obesity (Wang, Ge and Popkin, 2003).

Few studies have been conducted that investigate factors that predict fruit and vegetable intake among Native American children, or this ethnic group in general. However, researchers have concluded that fruit and vegetable intakes among Native American groups is related to social supports (Story, Neumark-Sztainer, Resnick and Blum, 1998), knowledge (Gittelsohn et al., 2006) and perceptions to healthy eating (Cantrell, 2001). The Information-Motivation-Behavioral Skills (IMB) model addresses these issues within its three constructs. This general model of health behavior change has been used to frame and create theoretically and empirically based health risk reduction interventions. The IMB model focuses on the set of informational, motivational and behavioral skills associated with the successful practice of preventive health-related behaviors (Fisher and Fisher, 1999). The information construct refers to highly relevant knowledge about the health behavior. The motivation construct embodies a range of perceptions related to the behavior, including social and environmental supports and personal attitudes. The behavioral skills construct is based on the concept of self-efficacy, but also takes actual skill level into account (Fisher and Fisher, 1999). The model posits that the information and motivation constructs work together and directly through the behavioral skills construct to impact behavior and that when individuals are well-informed, motivated to act and possess the necessary behavioral skills required to act effectively, they will likely initiate and maintain a health behavior (Fisher and Fisher, 1992). See Figure 1 for a visual representation of the IMB model.
When using the IMB model in the application of a poorly understood health behavior, it has been strongly suggested that researchers first conduct qualitative elicitation research to identify information, motivation and behavioral skills deficits and assets, and then confirm model fit using a quantitative assessment tool (Fisher, Fisher & Harman, 2003). Therefore, this study was a follow up to a qualitative study which explored perceptions held by caregivers and Native American children regarding fruits and vegetables (Sinley and Albrecht, 2015). Results from this research indicate that, in regards to the topic of fruit and vegetable consumption among Native American children, the information construct is comprised of benefits of fruits and vegetables, fruit and vegetable food safety and quality principles of fruits and vegetables. The motivation construct is comprised of social supports (including cultural influences, access and availability), caregiver attitudes and child attitudes regarding fruits and vegetables. Finally, findings from the qualitative research indicated that the behavioral skill construct is comprised of role modeling and cooking self-efficacy, as well as skills to offer fruits and vegetables.

A modified IMB model was developed from this qualitative phase and has been published elsewhere (Sinley and Albrecht, 2015). The purpose of this study was to validate findings from the qualitative phase and evaluate applicability of the IMB model to identify variables that are associated with fruit and vegetable intake in a cross-sectional design using a convenience sample of caregivers of Native American children. The authors hypothesized that caregiver knowledge regarding fruits and vegetables would be positively associated with behavioral skills related to their children’s fruit and vegetable consumption. It was also hypothesized that caregiver motivation toward increasing fruits and vegetables would be positively associated with behavioral skills. Finally, the researchers hypothesized that caregiver behavioral skills would be positively associated with child fruit and vegetable intake. The ultimate goal of this study was to explore and confirm predictors of fruit and vegetable consumption among Native American children, which
then can be used to develop future interventions and potential policy changes among this population.

**METHODS**

**Study Design and Sample**

Data for this study was collected utilizing a convenience sample of English-speaking caregivers of Native American children between the ages of 2 and 5. Primary caregivers were parents or any individual who self-identified as being responsible for providing meals and health care to the child. These inclusion criteria were used to ensure that participants could provide accurate information regarding dietary intakes of the children in question. It was understood that children belonged to one of several tribes representative of the Great Plains, including Omaha, Santee Sioux, Ponca and Winnebago (United States Bureau of Reclamation, 2010), although caregivers did not provide exact information on their child’s tribal affiliation as a part of this study. An IMB model survey, fruit and vegetable food all day screener and demographic survey were collected during health fairs and other community events held at Native American reservations and community centers serving the Native American communities across Nebraska over the course of 6 months in 2015. Written consent was provided by all participants. To be included in the study, participants were required to be the parent or caregiver of a Native American child between the ages of 2 and 5. Caregivers self-administered the survey unless assistance was requested to complete the survey. Surveys took approximately ten minutes for participants to complete. If participants reported having more than one child under their care in this age group, participants were asked to respond to survey questions considering the youngest applicable child. As compensation for completing the surveys, participants received a recipe and activity booklet with ideas for incorporating fruits and vegetables into their child’s diet and a $10 gift card. The researchers estimated a target sample size of 76 to detect medium-sized effects ($r = 0.24-0.36$) in planned path analysis (Cohen, 1992). This research was conducted in accord with prevailing ethical principles and was approved by the University of Nebraska-Lincoln Institutional Review Board and the appropriate tribal officials.

**Measures**

*Information-Motivation-Behavioral Skills Survey.* Data from focus groups with caregivers and interviews with community stakeholders (Sinley and Albrecht, 2015) were utilized to develop a preliminary IMB model-based fruit and vegetable-focused survey. Direct quotes were used from the population in developing the survey, adding to the validity of the instrument (Creswell and Plano Clark, 2011). Initial items were reviewed by content area experts and pilot tested with a sub-sample of the participant population (n=16). Participants of the pilot test provided feedback on the survey regarding readability and content validity. Piloting procedures included trials of survey administration to establish any participant burden and suitability of the developed instrument for the population. To avoid bias, participants in the pilot phase did not participate in the full administration of the final survey.

Coefficient alpha for the information, motivation and behavioral skills scales from the pilot test were 0.501; 0.711 and 0.865, respectively, indicating a good internal consistency for both motivation and behavioral skills (Creswell, 2005). Items were removed from the information scale to increase coefficient alpha to 0.521. Although this alpha may be considered low by some standards (Creswell, 2005), the knowledge construct gathered information regarding a wide range of fruit and vegetable-related concepts, leading to somewhat heterogeneous survey items. This
survey heterogeneity (in regards to the knowledge construct) was intended by the researchers as these survey items were developed directly from findings from the qualitative formative research (Sinley and Albrecht, 2015). Changes to all sub-scales were made as recommended by participants to increase readability. The final instrument contained 10 information items, 13 motivation items and 14 behavioral skills items using a Likert-type format (a 5-point scale ranging from Strongly Disagree to Strongly Agree). Questions on the information subscale aimed to assess caregiver knowledge of fruits and vegetables (e.g. “Eating fruits and vegetables can prevent diseases such as cancer.”). Questions on the motivation subscale aimed to gauge both child and caregiver attitudes regarding fruits and vegetables (e.g. “I enjoy eating a variety of vegetables.” “My child enjoys eating a variety of vegetables.”). Questions on the behavioral skills subscale were targeted toward understanding caregiver self-efficacy for providing fruits and vegetables (e.g. “Preparing meals with vegetables is easy for me.”). Higher subscale scores reflected higher amounts of accurate information, total motivation and levels of behavioral skills. Coefficient alpha was re-examined after the final survey administration.

Fruit and Vegetable All Day Screener. To assess intake of children’s fruits and vegetables, caregivers completed a fruit and vegetable all day screener (Thompson et al., 2002). The screener was slightly modified for this study, so that participants responded to questions regarding their child’s typical intake as opposed to their own. Participants responded to 27 questions regarding frequency of consumption and portion size consumed of each type of fruit and vegetable throughout the child’s typical day. Researches were on-site while caregivers completed the screener to answer any clarifying questions regarding the screener. Caregivers were asked to recall the child’s typical intake from the last month, first in frequency and then in amount. See Table 1 for an example of a screener question regarding fruit intake. Screeners were scored by expressing each reported frequency as a daily average and assigning fruit and vegetable servings to each portion size category (National Cancer Institute, 2016). Coefficient alpha for the fruit and vegetable screener was examined after the survey administration.

Table 1. Sample All Day Fruit and Vegetable Screener Questions

<table>
<thead>
<tr>
<th>Question</th>
<th>Response Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Think about all the foods your child ate at their morning meal and snacks over the last month. On how many days did your child eat fruit for their morning meal or morning snacks? Count any kind of fruit—fresh, canned, and frozen. Do not count juices.</td>
<td>Never (Go to Question 37), 1-3 days last month, 1-2 days per week, 3-4 days per week, 5-6 days per week, Every day</td>
</tr>
<tr>
<td>1a. When your child ate fruit in the morning, what is the total amount of fruit that they usually ate in a morning?</td>
<td>Less than 1 medium fruit, 1 medium fruit, 2 medium fruits, More than 2 medium fruits</td>
</tr>
<tr>
<td>OR</td>
<td></td>
</tr>
<tr>
<td>Less than ½ cup, About ½ cup, About 1 cup, More than 1 cup</td>
<td></td>
</tr>
</tbody>
</table>
Statistical Analysis

Coefficient alpha was calculated to determine internal consistency of the IMB model survey and Fruit and Vegetable All Day Screener. Multivariate linear regression was conducted to explore the associations between caregiver fruit and vegetable-related information, motivation and behavioral skills and child fruit and vegetable consumption. Path analysis, an extension of multivariate regression analysis which allows for the simultaneous estimation of interrelations between variables, was conducted to estimate parameters for the IMB model. A benefit of using path analysis is that it enables for testing of mediation among the variables and provides estimates of the magnitude, significance and direction of associations between variables as the hypothesized model suggests. Direct associations and standard errors were generated for each pathway. Indirect associations were determined as the product of parameter estimates along a given path. Both standardized and unstandardized coefficients and \( P \) values were calculated. Direct and indirect associations were considered significant at \( P < 0.05 \). Fruit and vegetable consumption was the dependent variable. Path analysis was conducted with fruit and vegetable intakes as separate dependent variables and then with intakes combined. Exogenous independent variables were information and motivation and behavioral skills was the endogenous independent variable. Models were fitted with Mplus (Version 7.11) software (Muthén and Muthén, Los Angeles, California). Chi-square was used as a traditional measure of model fit, as typically reported in path analysis (Cheung and Rensvold, 2002). Descriptive statistics of the demographic variables were determined using the Statistical Package for Social Sciences (Version 19).

RESULTS

Demographics

A total of 92 participants completed the IMB survey, Fruit and Vegetable All Day Screener and demographic survey. As indicated in Table 2, study participants were predominately female and of Native American descent. Approximately one-quarter of participants had a high school diploma and over one-third had attended some college courses at the time of the study. Approximately half of study participants were employed full-time, with the remainder of participants being relatively evenly split between retired (16.7%), student (15.5%), unemployed (11.9%) and part-time (7.1%) working status. The age of study participants ranged from 17 to 87 years with a mean of \( M = 40.4 \) years (s.d. ± 16.3). The number of children that participants cared for ranged from 1.0 to 7.0 with a mean of \( M = 2.5 \) (s.d. ± 1.0). The mean age of children that participants cared for was 6.5 (s.d. ± 4.7) and the mean age of the child eligible for the study and that caregivers reported intake on was 3.7 (s.d. ± 1.5).
Table 2. Demographic Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Percentage&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>77</td>
<td>86.5</td>
</tr>
<tr>
<td>Male</td>
<td>12</td>
<td>13.5</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Native American</td>
<td>90</td>
<td>97.8</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>2.2</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than High School (H.S.)</td>
<td>10</td>
<td>11.1</td>
</tr>
<tr>
<td>Some H.S.</td>
<td>11</td>
<td>12.2</td>
</tr>
<tr>
<td>H.S. Diploma/GED</td>
<td>23</td>
<td>25.6</td>
</tr>
<tr>
<td>Training Beyond H.S.</td>
<td>3</td>
<td>3.3</td>
</tr>
<tr>
<td>Some college</td>
<td>31</td>
<td>34.4</td>
</tr>
<tr>
<td>College grad</td>
<td>11</td>
<td>12.2</td>
</tr>
<tr>
<td>Post-college grad</td>
<td>1</td>
<td>1.1</td>
</tr>
<tr>
<td><strong>Employment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-time</td>
<td>41</td>
<td>48.8</td>
</tr>
<tr>
<td>Part-time</td>
<td>6</td>
<td>7.1</td>
</tr>
<tr>
<td>Retired</td>
<td>14</td>
<td>16.7</td>
</tr>
<tr>
<td>Student</td>
<td>13</td>
<td>15.5</td>
</tr>
<tr>
<td>Unemployed</td>
<td>10</td>
<td>11.9</td>
</tr>
</tbody>
</table>

**Mean**

| Participant age (years)        | 40.4         | 16.3                   |
| Age of all children in care (years) | 6.5   | 4.7                    |
| Age of child eligible for survey (years) | 3.7   | 1.2                    |
| Number of children in care     | 2.5          | 1.0                    |

<sup>a</sup> Individual categories may not sum to 92 due to missing values
<sup>b</sup> Percentage may sum to > 100 due to rounding

IMB Model of Fruit and Vegetable Consumption

In this study, the dependent variable of interest is child fruit and vegetable consumption. The amount of reported daily average fruit consumption (excluding juice) ranged from 0.1 cups to 7.0 cups per day, with a mean of $M = 2.1$ cups (s.d. ± 1.4). The amount of reported daily average vegetable consumption (excluding potatoes and potato products) ranged from 0 cups to 7.0 cups per day with a mean of $M = 2.2$ cups (s.d. ± 1.7). The amount of reported combined fruit and vegetable consumption ranged from 0.3 cups to 9.0 cups per day with a mean of $M = 4.25$ cups (s.d. ± 2.57). Three independent variables were used in this study. The first independent variable was caregiver fruit and vegetable-related knowledge. Scores on the information subscale were
summed with a maximum possible score of 50. The average score on this subscale was \( M = 31.7 \) (s.d. ± 3.9). The second independent variable was caregiver fruit and vegetable-related motivation. Scores on the motivation subscale were summed with a maximum possible score of 65. The average score on this subscale was \( M = 46.0 \) (s.d. ± 16.5). The third independent variable was caregiver fruit and vegetable-related behavioral skills. Scores on the behavioral skills subscale were summed with a maximum possible score of 70. The average score on this subscale was \( M = 55.5 \) (s.d. ± 7.8). Coefficient alpha was found to be 0.519, 0.688 and 0.874 for the information, motivation and behavioral skill subscales, respectively. The low coefficient alpha on the information subscale can be attributed to the heterogeneous nature of the survey items due to the wide range of comments on fruits and vegetables from the qualitative phase of this research (Sinley & Albrecht, 2015). Coefficient alpha for the Fruit and Vegetable All Day Screener was found to be 0.706.

Results of the multivariate linear regression of child fruit and vegetable consumption with caregiver information, motivation and behavioral skills can be found in Table 3. Approximately 18.6% of the variance in child fruit and vegetable consumption can be explained by this model. Figure 2 presents the results of the path analysis and corresponding standardized coefficients. The effect of caregiver behavioral skills on child fruit and vegetable consumption was significant, \( \beta = 0.442, p < 0.05 \). The unstandardized coefficient was 0.295, suggesting that for every 1 point increase on the caregiver behavioral skills subscale, controlling for the other variables, we would expect the corresponding child to consume approximately an additional one-third or more cups of vegetables per day. The effect of caregiver information on caregiver motivation was also significant, with \( \beta = 0.348, p < 0.05 \). The unstandardized coefficient was 0.066, suggesting that each 1 point increase on the caregiver fruit and vegetable-related knowledge subscale results in approximately 0.07 point increase in the caregiver motivation subscale. The effects of caregiver information and caregiver motivation on child fruit and vegetable consumption were both non-significant, with \( \beta = -0.20 \) and \( \beta = -0.006, p > 0.05 \), respectively.

Figure 2. Path analysis between caregiver information, motivation, behavioral skills and child fruit and vegetable consumption with standardized path coefficients. *\( p \leq 0.001 \); ** \( p \leq 0.0001 \).
Table 3. Parameters from multivariate multiple regression predicting child fruit and vegetable intake

<table>
<thead>
<tr>
<th>Predictors</th>
<th>β</th>
<th>B</th>
<th>s.e.</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information</td>
<td>-0.020</td>
<td>0.102</td>
<td>-0.201</td>
<td>0.841</td>
</tr>
<tr>
<td>Motivation</td>
<td>-0.006</td>
<td>0.135</td>
<td>-0.041</td>
<td>0.967</td>
</tr>
<tr>
<td>Behavioral Skills</td>
<td>0.442</td>
<td>0.130</td>
<td>3.402</td>
<td>0.001*</td>
</tr>
<tr>
<td><strong>R²</strong></td>
<td>0.186</td>
<td>0.130</td>
<td>3.402</td>
<td>0.001*</td>
</tr>
</tbody>
</table>

*p < 0.05

Results of the second multivariate linear regression of caregiver behavioral skills on caregiver information and caregiver motivation can be found in Table 4. Approximately 52% of the variance in caregiver behavioral skills was explained by the model. The effect of caregiver motivation on caregiver behavioral skills was significant with $\beta = 0.666$, $p < 0.05$, suggesting that as caregivers increase their levels of fruit and vegetable-related motivation, they also increase their levels of fruit and vegetable-related behavioral skills. While there was no significant direct effect on caregiver motivation on child fruit and vegetable intake, there was a significant indirect effect, with the relationship being mediated by behavioral skills, with $\beta = 0.294$, $p < 0.0001$. The effect of caregiver information on caregiver behavioral skills was not significant, with $\beta = 0.136$, $p > 0.05$. The chi-square for the final model was 80.441, with 5 degrees of freedom ($P = 0.000$), indicating that the data was not a fit to the overall model based on the significance level of $p < 0.05$.

Table 4. Parameters from multivariate multiple regression predicting caregiver fruit and vegetable behavioral skills

<table>
<thead>
<tr>
<th>Predictors</th>
<th>β</th>
<th>B</th>
<th>s.e.</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information</td>
<td>0.136</td>
<td>0.077</td>
<td>1.77</td>
<td>0.076</td>
</tr>
<tr>
<td>Motivation</td>
<td>0.666</td>
<td>0.061</td>
<td>1.99</td>
<td>0.000*</td>
</tr>
<tr>
<td><strong>R²</strong></td>
<td>0.524</td>
<td>0.061</td>
<td>1.99</td>
<td>0.000*</td>
</tr>
</tbody>
</table>

*p < 0.05

**DISCUSSION**

This study evaluated the applicability of the IMB model to identify variables that are associated with fruit and vegetable intake among Native American children representing several Midwestern tribes across Nebraska. There was a wide range in the age of study participants (17 to 87 years old), with several grandmothers reporting that they are caregivers of Native American children, as is common with this population (Simmons and Dye, 2003). The mean age of children in the care of respondents was 6.5, which is notably greater than the required age of children for participation. This is attributed to the fact that caregivers were asked to list the age of all children.
currently in their care, and not only in the age group required for this research. The mean age of
the child eligible for the study and that caregivers reported intake on was 3.7.

Caregivers reported the fruit and vegetable consumption of the children in their care, with
an average reported intake of 2.1 cups per day of fruit and 2.2 cups per day of vegetables. This is
higher than what has been reported for similar populations (Stroehla, Malcoe and Velie, 2005;
Story, Neumark-Sztainer, Resnick and Blum, 1998) and indicates that study participants have
children who are meeting the United States Department of Agriculture’s 2015 Dietary Guidelines
for Americans for fruits and vegetables (United States Department of Agriculture, 2015). However, it must also be taken into consideration that caregivers may have over-estimated intake,
as has been reported as a concern with these types of assessments (Pearson, Atkins, Biddle, Gorely
and Edwarson, 2009). Food frequency questionnaires and all day screeners have been criticized
for this very issue (Huybrechts, De Backer, De Bacquier, Maes and De Henauw, 2009), but the
usefulness of these tools in establishing patterns and quintiles of intake has been confirmed,
establishing as a useful tool when researchers seek to understand associations between patterns of
intake, as opposed to a true estimate of intake alone (Sauvageot, Alkerwi1, Albert and Guillaume,
2013).

The results of the multivariate linear regression and path analysis on the direct and indirect
effects between IMB model constructs (information, motivation and behavioral skills) and fruit
and vegetable consumption using multivariate linear regression and path analysis demonstrated
several key findings. Greater caregiver fruit and vegetable-related behavioral skills were
significantly associated with child fruit and vegetable consumption via a direct pathway. This
relationship suggests that nutrition programs that aim to increase both objective skills and
perceived self-efficacy among caregivers may increase the fruit and vegetable consumption of
Native American children. Objective skills for nutrition education programming to focus on should
include cooking, gardening and selection of fruits and vegetables. Self-efficacy to offer fruits and
vegetables regularly and serve as a role model to their children are additional areas of opportunity
for future nutrition education programs.

Additionally, greater caregiver fruit and vegetable-related motivation was significantly
associated with caregiver fruit and vegetable-related behavioral skills via a direct pathway, and
was associated with child fruit and vegetable consumption via an indirect pathway. This
relationship suggests that nutrition education programs to address fruit and vegetable consumption
among this population should do so within a broader community context to build environmental
and social supports to increase child fruit and vegetable consumption. Increasing social acceptance
and availability of fruits and vegetables may result in an increase in caregiver behavioral skills to
provide fruits and vegetables to their children and subsequent increased intake. This suggests that
policy changes to improve and address access to fruits and vegetables among this population may
also improve intake and, ultimately, the health status of Native American children.

Finally, caregiver fruit and vegetable-related information was significantly associated with
caregiver fruit and vegetable-related motivation via a direct pathway. These findings suggest that
programs that aim to increase caregiver knowledge of fruits and vegetables may ultimately
increase their attitudes regarding fruits and vegetables. Informational topics to address in future
programming should include benefits of consumption, recommendations regarding amounts of
fruits and vegetables throughout the lifespan and nutrients contained in different fruits and
vegetables.
Based on the findings from this study, future interventions to address fruit and vegetable consumption among young Native American children should focus on addressing caregiver fruit and vegetable related information, motivation and behavioral skills. These results are consistent with previous quantitative studies conducted with this population whereby family and social supports (Story, Neumark-Sztainer, Resnick and Blum, 1998), knowledge (Cooper et al., 2015) and attitudes (Wang, Ge and Popkin, 2003) have all been linked to the purchase and consumption of fruits and vegetables. Additional research has suggested that caregiver knowledge and skills is linked to child eating behaviors (Molaison, Connell, Stuff, Yadrick and Bogle, 2005; Slusser et al., 2012). However, this is one of the first studies that has investigated the relationship between the caregiver variables of information, motivation and behavioral skills and child fruit and vegetable consumption among the Native American population.

The IMB model suggests that targeted interventions to improve the fruit and vegetable intake of Native American children should address caregiver-related deficits in information, including benefits of fruits and vegetables, fruit and vegetable food safety and quality principles of fruits and vegetables. Interventions should also address motivation, including social supports, such as cultural influences, access and availability, caregiver attitudes and child attitudes regarding fruits and vegetables. Finally, interventions to improve fruit and vegetable intake of Native American children should address behavioral skills, including caregiver role modeling and cooking self-efficacy, as well as caregiver skills to offer fruits and vegetables.

While numerous fruit and vegetable-based interventions have been developed and implemented for a wide variety of audiences (Ganann, Fitzpatrick-Lewis, Ciliska and Peirson, 2012), relatively few interventions have targeted Native American children and their caregivers specifically. Those that have been developed have been relatively limited in scope, and have focused specifically on singular barriers to consumption, such as self-efficacy (Rinderknecht and Smith, 2004), family supports (Caballero et al., 2003) and addressing cultural challenges (LaRowe, Wubben, Cronin, Vannatter and Adams, 2007). This research is unique in that it explores the relationships between the three constructs of the IMB model (and the accompanying sub-constructs determined by a previously conducted qualitative phase) and fruit and vegetable consumption of Native American children. These findings are also distinctive in that the survey utilized direct quotes from members of the population regarding the constructs of interests, whereby the administration of this survey and the subsequent findings provided validation for the results of the qualitative phase (Creswell and Plano Clark, 2011). These formative findings may serve as building blocks for a comprehensive nutrition education program that addresses several aspects of fruit and vegetable-related behavior change.

While the topic of culture is not specifically addressed through the IMB model, elements of culture were incorporated into the administered survey, as guided by quotes from the qualitative phase (Sinley and Albrecht, 2015). Additionally, the researchers acknowledge that, when working with the Native American community, the issue of culture shapes any and all interactions with participants and any potential nutrition programs. A revised IMB model that is guided by The Circle of Courage (Brendtro, Brokenleg and Van Bockern, 2005) and insights from Native American community members was developed by the researchers during the qualitative research phase (Sinley and Albrecht, 2015). This revised model should continue to guide future program development.

There are limitations to be noted when considering the results of this quantitative cross-sectional analysis. This study had a relatively small sample size (N=92), although it was adequately
powered to detect the effects needed for the statistical analyses conducted (Cohen, 1992). The study was also conducted over an extensive period of time, which was beneficial for establishing trust among participants, but potentially introduced an element of bias due to seasonal availability of fruits and vegetables, which may have increased or decreased access for certain members of the population from which this study sampled. Additionally, while study participants represented at least four major tribes representative of the Great Plains, including Omaha, Santee Sioux, Ponca and Winnebago (United States Bureau of Reclamation, 2010), these results may not be generalizable to Native American population across the United States, as is oftentimes the case with research conducted with a specific sub-set of an ethnic group (Banks and McGee Banks, 2003). Finally, the conducted multivariate analysis did not account for variables outside of the constructs of the IMB model that may contribute to differences in intake, such as age, gender or caregiver education level, as the aim of this phase of research was to explore model fit.

The issue of establishing trust is especially critical when conducting research with Native American groups (Christopher, 2005). Also critical is that community leaders and tribal officials are engaged in the project from inception (Caldwell et al., 2005). This research is one piece of a mixed methods study conducted over the course of several years on Native American reservations and community centers, in which community elders and tribal officials provided approval, insight, recommendations to ensure successful implementation. While the survey administrator was not of Native American descent, trust had been established with many of the participants by the researcher’s frequent attendance at events on the reservations and at community centers. This ensured that participants felt comfortable to provide honest answers to survey questions and ask clarifying questions when necessary. It is important to consider that, while the researcher encouraged participants to answer survey questions as honestly as possible, some participants may have given more positive answers to survey questions as a result of social desirability.

CONCLUSION

The IMB model may be a useful tool to use in explaining the complex relationship between caregiver constructs and fruit and vegetable consumption among Native American children. This model may serve as an aid in understanding predictors of fruit and vegetable intake among Native American children and future programs may build on addressing deficits within each construct to improve intake among this population.

Using the IMB model, this study provides important insight into variables associated with consumption of fruits and vegetables among Native American children. Future research should investigate the applicability of the IMB model in exploring this issue in other tribal communities across the United States. Research should also utilize these findings to develop pilot nutrition education programs to address fruit and vegetable consumption among Native American children through interventions with caregivers by addressing information, motivation and behavioral skills integrated with cultural underpinnings.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Nettie Grant Sikyta, Dawne Price, Jodene Reynolds and Candy Schott, who provided invaluable insights and assistance throughout the research process. This research was supported by funding from the United States Department of Agriculture-USDA NIFA 2011-67002-30202.
REFERENCES


