



Understanding fruit and vegetable intake of Native American children: A mixed methods study



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ARTICLE INFO

Article history:

Received 10 September 2015

Received in revised form

2 March 2016

Accepted 3 March 2016

Available online 8 March 2016

Keywords:

Native American

Mixed methods

IMB model

Fruits

Vegetables

Children

Caregivers

ABSTRACT

Native American children experience greater rates of obesity and risk for chronic diseases in comparison to their counterparts in other ethnic groups. Contributing to this risk may be inadequate consumption of fruits and vegetables. The objective of this study was to investigate the fruit and vegetable consumption of Native American children between the ages of 2 and 5 by using an exploratory sequential mixed methods research design. This study first collected qualitative data from caregivers of Native American children ($n = 45$) and stakeholders in Native American communities ($n = 10$) to gain perspectives of fruit and vegetable consumption. Data was then utilized to develop a fruit and vegetable survey which was administered with a fruit and vegetable food frequency questionnaire. These quantitative assessments were administered to caregivers of Native American children ($n = 92$) to gain an understanding of predictors of fruit and vegetable intake among this population. This study was guided by the Information-Motivation-Behavioral Skills (IMB) model of health behavior. Findings from the mixed methods analysis demonstrate that, while the IMB model may be a useful tool to utilize in explaining the complex relationship between factors that impact fruit and vegetable consumption among Native American children, a revised model may be appropriate to use in future intervention development.

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1. Introduction

Childhood overweight and obesity has been associated with numerous chronic health conditions, including some cancers, cardiovascular diseases, asthma, early onset of type 2 diabetes and premature death (Centers for Disease Control and Prevention, 2012; Pulgarón, 2013). The costs associated with these rising rates of obesity are numerous, and include direct and indirect medical costs as well as physical, mental and emotional burdens (World Health Organization, 2003).

Significant obesity disparities have been observed among children in different racial and ethnic groups. Between 1998 and 2011, among children aged 2 to 4, the overall obesity prevalence across all ethnic groups increased from 13.05% in 1998 to 15.21% in 2003, and then decreased slightly to 14.74% in 2011 (Pan, McGuire, Blanck, May-Murriel, & Grummer-Strawn, 2015). From 1998 to 2011, the obesity prevalence among Non-Hispanic white children increased

from 10.52% to 12.75%. Prevalence of obesity among non-Hispanic black children increased slightly from 11.10% to 11.85% and Hispanic children also experienced a slight increase from 18.13% to 18.70%. Experiencing a significantly greater increase in prevalence of obesity was American Indian and Alaskan Native children, whose rates increased from 16.32% to 21.11% (Pan et al., 2015), indicating a significant obesity disparity among this population.

While numerous factors are responsible for this disparity, a contributing factor may be inadequate fruit and vegetable consumption. Although insights into the dietary patterns of this population are limited, research has consistently indicated that inadequate fruit and vegetable consumption is an issue that requires public health attention (LaRowe et al., 2010; Story, Neumark-Sztainer, Resnick, & Blum, 1998; Stroehla, Malcoe, & Velie, 2005). Numerous studies indicate an inverse association between fruit and vegetable consumption and development of obesity (Panagiotakos, Chrysohoou, Pitsavos, & Stefanadis, 2006; Togo, Osler, Sorensen, & Heitmann, 2004; Wang, Ge, & Popkin, 2003), although the specific mechanism by which consumption of fruits and vegetables may prevent obesity has been subject to interpretation. A potential pathway is that, as energy intake is associated with weight gain,

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fruit and vegetable intake may impact obesity rates as a result of their high volume to energy ratio, whereby individuals may be cued to satiety prior to consuming large amounts of energy (Prentice & Jebb, 2003). Additionally, fruit and vegetable consumption may lead to a reduction in total caloric intake by an increase in total dietary fiber, which can cue satiety signals (Rasoamanana, Even, Darcel, Tomé, & Fromentin, 2013). Finally, increasing intake of fruits and vegetables may displace consumption of energy-dense foods, which may indirectly impact obesity prevalence.

Compared to other groups in the United States, relatively few interventions have been developed that specifically target improving the nutritional status of Native Americans (Fialkowski, Okoror, & Boushey, 2012). Critical to the success of a program targeted to address health behaviors is that the program is guided by a theory or guiding framework (DiClemente, Salazar, & Crosby, 2013). For programs geared toward Native Americans to be successful, community members need to be involved in the development and implementation of the program and researchers must employ more rigorous designs to develop and evaluate such programs (Baranowski, Anderson, & Carmack, 1998; Satterfield et al., 2003). Aspects of culture must also be taken into consideration during each and every part of program development and implementation, and it is especially critical that recommendations from community members be addressed during program development (Kautz & Longstaff, 2004; Roubideaux et al., 2000).

The purpose of this study was to conduct mixed methods formative research to guide the development of a fruit and vegetable-focused nutrition intervention for caregivers of Native American children. Qualitative inquiry explored perceptions held by caregivers and Native American children regarding fruits and vegetables. Results from this research indicated that peer support, food insecurities, cultural norms, self-efficacy and skills to prepare fruits and vegetables impact caregivers of Native American children's ability to provide fruits and vegetables. Participants in the qualitative phase also expressed a desire to increase knowledge regarding fruits and vegetables, including variety, benefits and recommendations for consumption. Findings from the qualitative phase informed the development of a quantitative survey which measured the constructs of the Information-Motivation-Behavioral Skills Model among caregivers as they relate to the fruit and vegetable consumption of Native American children. This quantitative research concluded that caregiver fruit and vegetable-related behavioral skills is significantly associated with child fruit and vegetable consumption, caregiver fruit and vegetable-related information is significantly associated with fruit and vegetable related motivation and caregiver fruit and vegetable-related motivation is significantly associated with behavioral skills. The extent to which findings from the quantitative phase converged or diverged with findings from the qualitative phase were evaluated in a final mixed methods phase.

2. Materials and methods

2.1. Study design

The study utilized a mixed methods study design, which Creswell and Plano Clark (Creswell & Plano Clark, 2007) describe as a type of research in which qualitative and quantitative data are collected, analyzed and integrated to better understand a research problem. Using these methods allows researchers to employ a variety of strategies to answer questions that cannot be addressed by qualitative or quantitative methods exclusively. Specifically, this research employed an exploratory sequential design.

An exploratory sequential design is deemed appropriate when relevant quantitative instruments are unavailable (Creswell & Plano

Clark, 2011), as is the case with the topic with predictors of fruit and vegetable consumption among Native American children. This three-phase approach begins with a qualitative investigation, follows with the use of those findings to develop a new quantitative instrument and then concludes with the administration of the assessment tool in the quantitative phase (Creswell & Plano Clark, 2011).

In employing a transformative exploratory sequential instrument design, this study began with the collection of qualitative data which then guided the development of a quantitative instrument. All of the data that was collected and analyzed was done within the framework of the Information-Motivation-Behavioral Skills model, with the ultimate goal of addressing health disparities within the Native American population. See Fig. 1 for a detailed description of study steps, procedures and products. All components of the study received University Institutional Review Board Approval (IRB# 20140314133EP, 20141214985EP) as well as approval from all required tribal officials.

2.2. Qualitative data collection and analysis

Six focus groups were held in community settings such as community colleges and Head Start centers. Each focus group had between three and twelve participants ($n = 45$) who self-identified as a primary caregiver of a Native American child between the ages of 2 and 5 years old. Participants specified which focus group they would participate in, which was typically dictated by location and convenience. Ten interviews with community stakeholders were held in locations selected by the interviewee and were typically private rooms in office buildings. Informed consent was reviewed and obtained in writing prior to initiating each focus group and interview. A trained interviewer conducted the focus groups and interviews. All focus group and interview sessions were digitally recorded and transcribed. Focus group sessions lasted between 35 and 75 min and interviews lasted between 20 and 60 min.

A written script was used to guide both the focus group and interview discussions. The questions were based on the IMB Model constructs to extract information about perceptions related to fruit and vegetable intake among Native American children and caregivers. These questions were reviewed by community stakeholders and revised accordingly. The focus group sessions followed standard focus group procedures (Krueger & Casey, 2000). To increase the trustworthiness of the findings (Krefting, 1991), at the conclusion of each focus group, the facilitator summarized the session and asked for confirmation and clarification of these statements. Interviews used open-ended guidelines suggested by Merriam (2009). Focus groups and interviews were conducted until it was determined that saturation was reached (Krueger & Casey, 2000). Audio recordings were transcribed verbatim and then entered into the QSR NVivo software package (NVivo version 9, QSR International, Melbourne, Australia, 2010) to aid in data analysis. Transcripts were analyzed using qualitative content analysis strategies (Krippendorff, 2003). A complete description of the qualitative data collection and analysis strategies utilized has been described elsewhere (Sinley & Albrecht, 2015a).

2.3. Quantitative instrument development

Data from the qualitative phase was utilized to develop an IMB model-based survey instrument. Each of the model's constructs (information, motivation and behavioral skills) comprised a subscale of the survey instrument. The survey utilized Likert-type responses to questions across all subscales, with higher subscale scores reflecting higher amounts of accurate information, total motivation and levels of behavioral skills. The survey was reviewed by an expert panel, including extension educators, community

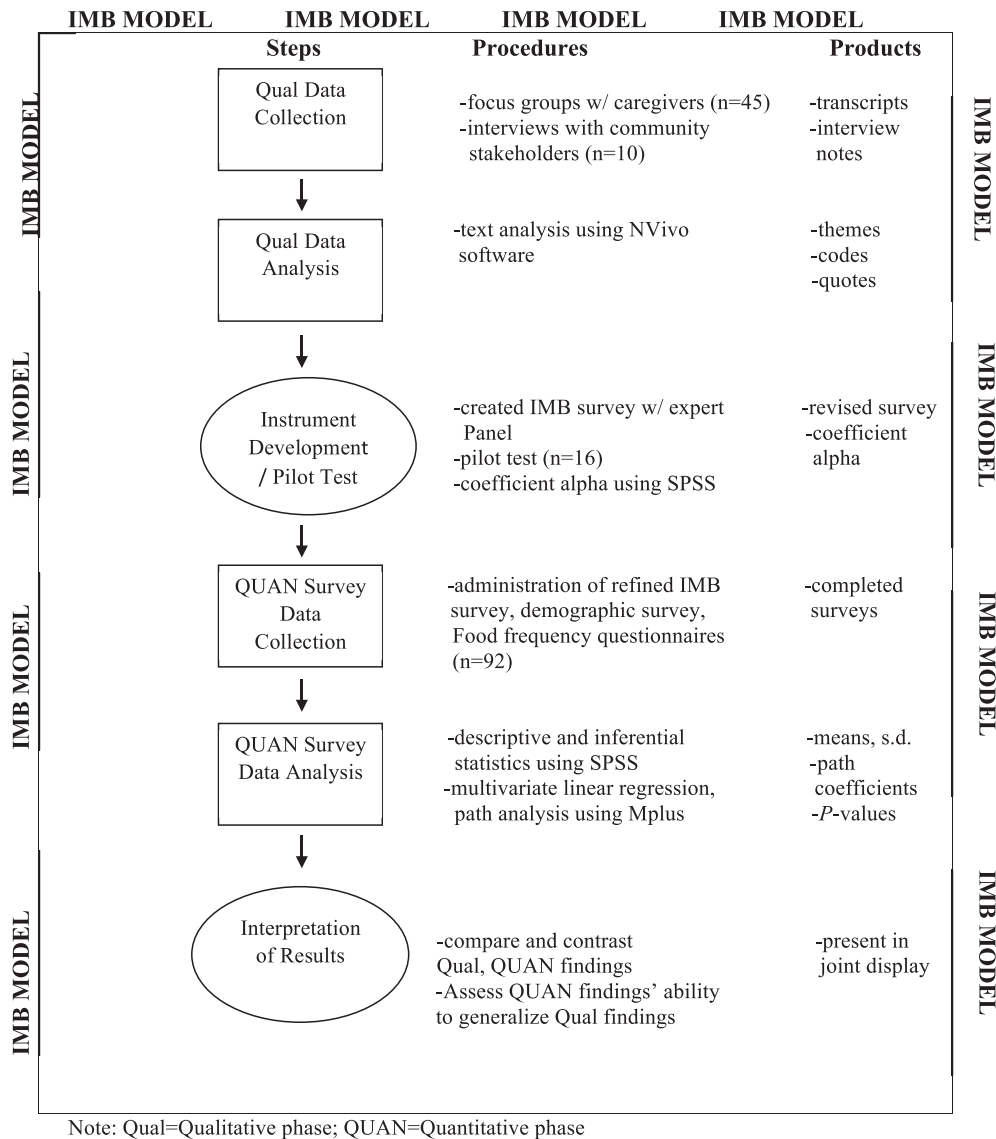


Fig. 1. Transformative exploratory sequential mixed methods project exploring fruit and vegetable consumption among Native American children.

stakeholders and survey development experts. The survey was shortened and clarified for cultural appropriateness by the expert panel members. Content validity was provided by nutrition experts, to provide feedback regarding survey item's clarity, construct relevance and construct representativeness. (McGartland, Berg-Weger, Tebb, Lee, & Rauch, 2003).

The survey was pilot tested among caregivers of Native American children ($n = 16$) who were recruited through word of mouth from a local community center serving the Native American population. Piloting procedures included practices of survey administration to establish any participant burden and suitability of the developed instrument for this population. Participants of the pilot test provided feedback on the survey regarding readability and content validity. Participants provided informed consent to participate in this pilot study and received a \$20 gift card for their participation.

Coefficient alpha for the information, motivation and behavioral skills scales from the pilot test were found to be $r = 0.501$; $r = 0.711$ and $r = 0.865$, respectively, indicating a good internal consistency for both motivation and behavioral skills (Creswell, 2005). Removing items from the information subscale resulted in a final

$r = 0.521$. While still considered a low alpha, this reflects the findings from the qualitative phase (Sinley & Albrecht, 2015a), which indicated a need to assess a wide range of informational deficits relating to fruits and vegetables. Changes to all sub-scales were made as recommended by participants to increase readability. Based on pilot study results, the survey was reduced in length from 58 to 37 questions. The final instrument contained 10 information items ($r = 0.521$), 13 motivation items ($r = 0.711$) and 14 behavioral skills items ($r = 0.865$).

2.4. Quantitative data collection and analysis

Quantitative data were collected utilizing a convenience sample of English-speaking caregivers of Native American children between the ages of 2 and 5 ($n = 92$). A target sample size of 76 was estimated to detect medium-sized effects ($r = 0.24 - 0.36$) in planned path analysis (Cohen, 1992). The IMB model survey was administered with a modified fruit and vegetable all day screener (Thompson et al., 2002) and a demographic survey. The surveys were administered during health fairs and other community events

held at Native American reservations and community centers serving the Native American communities across Nebraska.

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. If participants reported having more than one child under their care in this age group, participants filled out the survey responses for the youngest applicable child. As compensation for completing the surveys, participants received fruit and vegetable recipe and activity booklets and a \$10 gift card.

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 was conducted to estimate parameters for the IMB model. Direct associations and standard errors were generated for each pathway. Indirect associations were determined as the product of parameter estimates along a given path. Standardized and unstandardized coefficients and *P* values were calculated. Direct and indirect associations were considered significant at $P < 0.05$. Models were fitted with Mplus (Version 7.11) software (Muthén and Muthén, Los Angeles, California). Descriptive statistics of the demographic variables were determined using the Statistical Package for Social Sciences (Version 19). A complete description of the quantitative data collection and analysis strategies utilized has been described elsewhere (Sinley & Albrecht, 2015b).

2.5. Mixed methods data analysis

After collection and analysis of the quantitative data, the researchers returned to the qualitative findings and compared and contrasted results from the two phases within the framework of the IMB model. Findings from the multivariate linear regression and path analysis were compared to themes and quotes from the qualitative focus groups and interviews. Points of contention and areas of convergence between the qualitative and quantitative phases were dissected in the final analysis and interpretation phase. The connected data was interpreted within the framework of the IMB model and revisions to the IMB model as it related to the topic of fruit and vegetable consumption among Native American children were proposed to explain disagreements between the two phases.

3. Results

Qualitative focus group participants were predominately female (93.33%) and ranged in age from 15 to 64 years old with a mean age of 38.15 (s.d. \pm 15.29). 46.67% of participants reported some post high-school training or education and cared for an average of 3.44 children. Qualitative interview participants held a variety of positions within Native American communities and all positions required that they interact with Native American toddlers and/or families. Interview participants had a combined 57 years of experience working with the population of interest.

Quantitative study participants were also 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 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. \pm 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. \pm 1.0). The mean age of children that participants cared for was 6.5 (s.d. \pm 2.7).

The findings from the individual qualitative and quantitative

phases has been reported elsewhere (Sinley & Albrecht, 2015a, 2015b). Results from the mixed methods analyses are presented here. Analysis of the quantitative phase showed four relationships of statistical significance, which are detailed in Table 1. These results provide support for themes from the qualitative phase and use of the IMB model to address the topic of fruit and vegetable intake of Native American children.

3.1. Caregiver fruit and vegetable-related information was significantly associated with caregiver fruit and vegetable-related motivation ($\beta = 0.348$)

Greater amounts of knowledge regarding a variety of topics related to fruits and vegetables, including recommendations for intake, benefits of consumption and the quality of fruits and vegetables were associated with greater amounts of motivation related to fruits and vegetables. Comprising the motivation construct were the subthemes of social support, parental attitudes and child attitudes. Findings from the qualitative data support these findings. In discussions with caregivers and community stakeholders, the themes of information and motivation were discussed and the connection between the two was clearly communicated by study participants. As one focus group participant stated,

“For me, it’s about knowing that (vegetables) are just better for you. Like having, like cucumbers, I’ll buy cucumbers all the time, because those are one of the things that I like that I know are healthy. They are low-calorie and I am trying to be better about what I snack on.” –FG1P1

This quote clearly demonstrates the relationship between caregiver knowledge and motivation, with an alignment between the knowledge of the caloric content of a specific vegetable and positive attitudes toward consuming that vegetable.

A community stakeholder reflected on the dynamic relationship between information and motivation within the Native American community. As the interview participant stated,

“I think it’s the education. I think it’s education all the way through ... You know, they might have grown up where their mom never cooked or taught them how to prepare a meal or the importance of eating together as a family ... The circle is just broken ... But there are misperceptions and there are fears and I just think it’s so important because, I mean, what you feed your children can make everything different. So I think it’s just educating them and letting them know.” –S1

As indicated by these words from a key member in this community, information is closely linked to the attitudes held by caregivers about healthy foods.

3.2. Caregiver fruit and vegetable-related motivation was significantly associated with caregiver fruit and vegetable-related behavioral skills ($\beta = 0.666$)

Greater amounts of motivation was also associated to increases in behavioral skills. Comprising the behavioral skills construct were the subthemes of role modeling self-efficacy, cooking self-efficacy and skills to offer children fruits and vegetables. The qualitative findings supported these results, with caregivers in the focus groups discussing interactions between these constructs. As one focus group participant stated,

“This is a lifestyle that we really want to teach them and that’s where ... It’s very important that the kids physically see us

Table 1
Joint display of mixed methods research findings exploring fruit and vegetable consumption of Native American children.

Qualitative theme	Sample qualitative quote (ID)	Sample survey question	IMB model construct	β	P-value
Benefits of fruits and vegetables	"Because of my diabetes now I'm feeding them differently, more fruits and vegetables and less sugary stuff." (FG2P5)	Giving my child adequate amounts of fruits and vegetables may keep them from getting diabetes.	Information	Motivation 0.348	0.0000**
Fruit and vegetable food safety	"Some (vegetables) are worse than others. You always hear about tomatoes and spinach making people sick, so I don't even buy them." (FG3P1)	Some fruits and vegetables give you food poisoning.		Behavioral skills 0.136	0.076
Fruit and vegetable quality	"I want to know what the fruits and vegetables are actually good for. Are they all the same?" (FG1P1)	All fruits and vegetables are equally healthy for my child.		Fruit and vegetable intake -0.020	0.841
Social support	"I am the only one in my family, in my house, that cares about fruits or vegetables at all ... and that is just so frustrating to me." (FG2P3)	I am the only one in my family that cares about eating healthy.	Motivation	Behavioral skills 0.666	0.0000**
Parental attitudes	"I mean, there are only certain (vegetables) that I'll eat. But my kids, they will eat anything." (FG1P2)	There are only a few vegetables that I like to eat		Fruit and vegetable intake (direct) -0.006	0.967
Child attitudes	"It's a struggle, I can't even get my son to try a tomato." (FG6P5)	My child likes it when I offer them a new vegetable.		Fruit and vegetable intake (mediated by behavioral skills) 0.294	0.0000**
Role modeling self-efficacy	"My daughter, she'll see and she'll be kind of checking it out and be like, ok, if mom is doing it so let me try this." (FG3P3)	When it comes to eating fruits, I feel that I am a good role model for my child.	Behavioral Skills	Fruit and vegetable intake 0.442	0.001*
Cooking self-efficacy	"I can follow a recipe and it doesn't turn out half the time if I'm not familiar with cooking it." (FG4P4)	Cooking meals with vegetables is easy for me.			
Skills to offer fruits and vegetables	"I push the vegetables at my house. I know when you eat at my house you are gonna eat your vegetables." (FG3P1)	I make fruits available to my child every day.			

* $P \leq 0.001$; ** $P \leq 0.0001$.

eating fruits and vegetables because that's how they learn."
-FG1P1

This quote demonstrates the role caregivers' personal attitudes about fruits and vegetables play in influencing their ability to role model fruit and vegetable consumption.

A community stakeholder discussed the role that caregiver motivation, specifically parental attitudes plays in impacting the skills to offer fruits and vegetables. When asked about programs to improve and address behavioral skills, the interview participant stated,

"If it is something they don't want to hear ... they think it doesn't apply to them, and the ones that it does apply to, don't want to hear it. It's a touchy subject, I just know that those presentations didn't go over very well. It's not a lack of desire, you know, people know inherently what's right, 'I should be reading books, I should be feeding my kids fruits and vegetables.' When you offer healthy things and they don't buy into it, it's sometimes, it's pride. We don't want to feel inadequate. We don't want to feel like we're not good enough." -M1

3.3. Caregiver fruit and vegetable-related motivation was significantly associated with child fruit and vegetable intake ($\beta = 0.294$)

This relationship between caregiver motivation and child fruit and vegetable intake was significant via an indirect pathway and was mediated by caregiver behavioral skills. In returning to the qualitative data, several quotes from caregivers reflect this complex

relationship. As one caregiver reflected,

"I'm not gonna lie, I bought some mangos and they sat in the fridge for like three days before I'm like, 'I gotta figure out how to cut those up.' They almost went bad but it's just too much."
-FG4P4

Echoing this sentiment was the participant of another focus group who lamented,

"And the cooking, it's so much easier to say, 'Here's a bag of chips, leave me alone,' you know?" -FG1P2

These statements demonstrate how caregiver attitudes related to fruits and vegetables may ultimately impact their child's intake, but the influence of skills related to preparation of fruits and vegetables on this association make the dynamic relationship difficult to decipher.

One community stakeholder supported these ideas about the relationship between caregiver motivation and child fruit and vegetable intake by discussing how social supports are needed to sustain dietary changes:

"It can happen with support from the community to change at several different levels. If we show you how to cook and what to do with fruits and vegetables ... but if the support isn't here, it would probably go back to the way it was pretty quickly." -S3

3.4. Caregiver fruit and vegetable-related behavioral skills were significantly associated with child fruit and vegetable intake ($\beta = 0.442$)

Greater amounts of caregiver behavioral skills were associated with an increased intake of fruits and vegetables among the children in their care. Support for this association was found throughout the qualitative data. One caregiver discussed how role modeling impacted her child's fruit and vegetable consumption by stating,

"I try to feed him with the family or with everybody else just to show him that everybody else is trying it too and then he will definitely go for it." –FG6P6

This idea resonated with other caregivers, one who stated,

"I will pretend like I'm eating it and if she thinks I'm eating it then she will try it." –FG2P5

Another focus group participant discussed the important role that cooking skills play in impacting her children's fruit and vegetable intake by stating,

"They want anything and everything cooked with any kind of vegetables. Like I made pork chops, if I had bell peppers I had to cut 'em up and let 'em fry with my pork chops. Or if I have any kind of chicken, I gotta let it cook with the bell peppers and onions in it. I am cooking all the time with vegetables." –FG3P5

A community stakeholder echoed these beliefs about the role cooking skills play in offering healthy foods, by stating,

"I do cooking classes with healthy foods that aren't too out there. And then at the end they are like, 'Oh my gosh, I really love this and want to make this at home now.'" –S2

These quotes clearly describe the important role that behavioral skills play in directly impacting children's intake of fruits and vegetables.

While the quantitative phase provides support for several aspects of the IMB model as it relates to the fruit and vegetable consumption of Native American children, there are two pathways of the model that are not supported. These findings diverge from the findings from the qualitative phase.

3.5. Caregiver fruit and vegetable-related information was not significantly associated with caregiver fruit and vegetable-related behavioral skills

Greater amounts of caregiver knowledge regarding fruits and vegetables was not associated with increases in caregiver behavioral skills. Contrary to these findings, participants in focus groups discussed that knowledge regarding fruits and vegetables plays a role in the foods that they offer to their children, as one participant stated,

"I always think about what fruits and vegetables are maybe more important than others I guess. Like nutritional value. Like you know, avocados, I really make an effort to give my daughter avocados on a somewhat regular basis." –FG4P6

Participants also discussed the role that knowledge of food safety plays in the offering of specific fruits and vegetables, as

communicated by one caregiver,

"Like I'm always hearing about lettuce and tomatoes and I don't even, I rarely give them those." –FG2P1

While caregivers in these groups discussed that information impacts skills to offer fruits and vegetables to their children, these results were not supported by the quantitative data.

3.6. Caregiver fruit and vegetable-related information was not significantly related with fruit and vegetable intake

Fruit and vegetable information was also not associated with child fruit and vegetable intake via either direct or indirect pathways. During the qualitative phase, caregivers reflected on how information impacts their children's intake, as stated by one participant,

"There's like such a variety of stuff out there and it makes it so much easier when you have a variety. And it's healthier when you have that big variety but uh, with like learning those things. Like how can we learn about these foods so that we can give them to our kids?" –FG4P3

As this caregiver discussed, there are a wide variety of fruits and vegetables available, and sorting out information about these products can potentially impact the amounts of these foods that children consume. However, these results were not supported by the quantitative data.

Based on the results from the mixed methods data analysis, a revised IMB model as it applies to the specific topic of fruit and vegetable consumption among Native American children has been proposed. See Fig. 2 for a pictorial representation of the model. This revised model proposes that the constructs of information, motivation and behavioral skills work in a step-wise process as opposed to information and motivation working concurrently as in the original model (see Fig. 3) (Fisher, Fisher, & Shuper, 2009).

4. Discussion

Little is known about factors that impact the fruit and vegetable intake of Native American children in the United States. This research explored the fruit and vegetable-related information, motivation and behavioral skill assets and deficits held among caregivers of Native American children between the ages of 2 and 5 years old to understand how these variables impact the fruit and vegetable intake of the children in their care. By exploring and developing an understanding of these complex interactions, researchers identified opportunities for fruit and vegetable-focused nutrition interventions and educational materials. Dissection of the qualitative and quantitative data allowed for identification of convergent and divergent findings, which led to a deeper understanding of the dynamic relationship between the IMB model constructs and fruit and vegetable intake among this population.

4.1. Information

The quantitative findings indicate that, while caregiver fruit and vegetable-related information is associated with caregiver fruit and vegetable-related motivation, it is not associated with caregiver fruit and vegetable-related behavioral skills or directly to child fruit and vegetable intake. These findings diverge from the qualitative results and of the original IMB model. This may be due to the fact that the information construct tested in this study was comprised

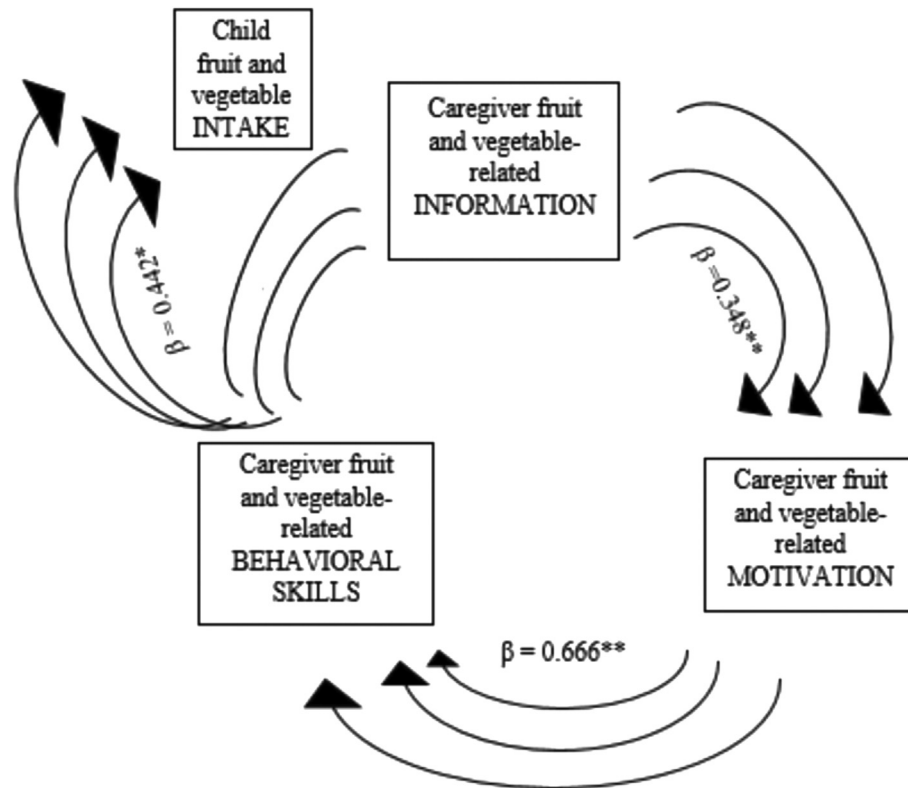


Fig. 2. Revised IMB model as it applies to fruit and vegetable consumption of Native American children $^{*}P \leq 0.001$; $^{**}P \leq 0.0001$.

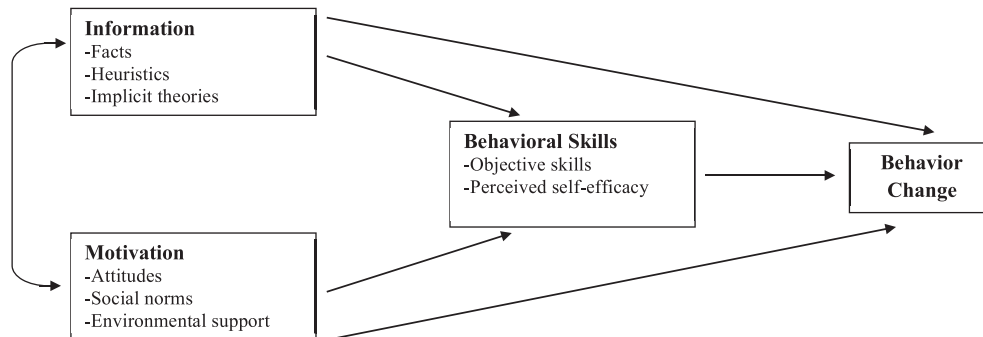


Fig. 3. Original Information-Motivation-Behavioral Skills model.

of a variety of sub-topics, assessing several aspects of fruit and vegetable knowledge. Participants from the qualitative phase determined the broadness of this construct, as the information construct of the IMB model refers to highly relevant knowledge about the health behavior dictated by the population (Fisher & Fisher, 1999). Compared to other health behaviors that have utilized the IMB model (Fisher, Williams, Fisher, & Malloy, 1999; Misovich, Martinez, Fisher, Bryan, & Catapano, 2003; Shell, Newman, Perry, & Folsom, 2011), nutrition-based knowledge in general is a dynamic and wide construct and may be difficult to measure (Parmenter & Wardle, 1999). Additionally, concerns have been raised regarding the degree to which increases in nutrition-related knowledge improves nutrition behaviors (Dickson-Spillmann, Siegrist, & Keller, 2011; Worsley, 2002) and this study validates those concerns.

Findings from the mixed methods analysis did conclude that caregiver fruit and vegetable-related knowledge was positively

associated to motivation, as anticipated by the originally developed IMB model. The motivation construct of the IMB model refers to a range of perceptions related to the health behavior, including social supports and personal attitudes (Fisher & Fisher, 1999). The findings from this study align with those of previously conducted work with parents of young children that have found that increasing nutrition knowledge of healthful foods improves overall attitudes and perceptions of those food items (Coosje Dijkstra, Neter, Brouwer, Huisman, & Visser, 2014; Soederberg Miller et al., 2015). Therefore, although fruit and vegetable-related information was not significantly associated with child fruit and vegetable intake, it is an important component of nutrition education programming. As indicated by caregivers and community stakeholders in this study, nutrition programs aimed toward increasing fruit and vegetable intake among Native American children should focus on increasing understanding of recommendations for intake, benefits of consumption of fruits and vegetables, selection of fruits and vegetables

and fruit and vegetable food safety.

4.2. Motivation

Proponents of the IMB model suggest that motivation to engage in a specific health behavior is directly associated with the health behavior itself. Findings from the mixed methods analysis did not support this theory, as caregiver fruit and vegetable-related motivation was not positively associated with child fruit and vegetable consumption. Caregiver fruit and vegetable-related motivation was, however, directly associated with behavioral skills and there was an indirect relationship between caregiver motivation and child fruit and vegetable intake that was mediated by behavioral skills. These associations indicate that, when working to improve the health status of Native American children by increasing fruit and vegetable consumption, it is important to focus on addressing caregiver motivations, as this can ultimately lead to increased consumption of nutrient-dense fruits and vegetables. These findings are consistent with other studies that have explored fruit and vegetable consumption among young children and the role that parents and caregivers play in increasing intake. It has been suggested that caregivers who have positive attitudes and social supports to offer a variety of nutritious foods have children who consume greater amounts of fruits and vegetables than their counterparts with parents who have a less positive view of nutritious foods (Russell, Worsley, & Liem, 2015; Vanhala, Laitinen, Kaikkonen, Keinänen-Kiukaanniemi, & Korpelainen, 2010). When working on nutrition programs to increase fruit and vegetable consumption among Native American children, educators must focus on increasing positive attitudes of fruits and vegetables, not only from the caregivers, but around other social networks, including family and friends.

4.3. Behavioral skills

The analysis and interpretation of the quantitative and qualitative data demonstrated an association between caregiver fruit and vegetable-related behavioral skills and child fruit and vegetable intake. This association indicates that educational programs and interventions to increase the fruit and vegetable consumption of Native American children should focus on addressing caregiver role modeling, cooking self-efficacy and skills to offer their children fruits and vegetables.

Role modeling is a powerful tool in increasing children's fruit and vegetable consumption. When children see parents or caregivers consuming fruits and vegetables, they are more likely to consume recommended amounts of fruits and vegetables (Draxten, Fulkerson, Friend, Flattum, & Schow, 2014; Palfreyman, Haycraft, & Meyer, 2014). Caregivers who regularly prepare home-cooked meals also have children who are more likely to consume adequate amounts of fruits and vegetables compared to children who regularly consume meals prepared outside of the home (Andaya, Arrendondo, Alcaraz, Lindsay, & Elder, 2011; Rasmussen et al., 2006). Finally, higher self-efficacy to provide fruits and vegetables in ways that children respond positively to is associated to adequate consumption of fruits and vegetables among children (Reinaerts, de Nooijer, & Vries, 2007; Koh et al., 2014). It is imperative to develop programs that address these key components of caregiver fruit and vegetable-related behavioral skills to increase the consumption of fruits and vegetables among Native American children.

4.4. Revisions to IMB model

The IMB model suggests that information and motivation work directly through behavioral skills to impact behavior, but that they are also directly associated with changes to a specific health

behavior. This research suggests otherwise. While caregiver fruit and vegetable-related information was significantly associated with caregiver fruit and vegetable-related motivation, it was not associated with either caregiver fruit and vegetable-related behavioral skills or child fruit and vegetable intake. While caregiver fruit and vegetable-related motivation was significantly associated with caregiver fruit and vegetable-related behavioral skills and child fruit and vegetable intake via an indirect pathway, there was no direct relationship between caregiver fruit and vegetable-related motivation and child fruit and vegetable intake. To help explain the divergence between the quantitative and qualitative results and the IMB model, a revised IMB model has been proposed that considers the constructs of interest in a circular, step-wise fashion, similar to the Stages of Change model (Prochaska & DiClemente, 1983). See Fig. 2 for the revised model. This revised model suggests that, when caregivers of Native American children increase fruit and vegetable-related information, this leads to an increase in fruit and vegetable-related motivation. When fruit and vegetable-related motivations increase, this leads to an increase in fruit and vegetable-related behavioral skills, which ultimately leads to increases in child fruit and vegetable intake. Note that while there is a link to behavioral skills and information, this model does not indicate a direct association. Caregivers can progress through this cycle repeatedly, gradually increasing each construct and corresponding levels of child fruit and vegetable intake, as indicated by the arrows in increasing size outward. While this model has not been tested, researchers propose this as a follow up to this research, in addition to nutrition curriculum development.

4.5. Strengths and limitations

This study utilized convenience sampling during both the qualitative and quantitative phases, which may limit the generalizability of the findings. However, study participants did represent several of the major Native American tribes that are representative of the Great Plains, so these results may be used when considering nutrition program development in the Midwestern states. The quantitative phase of this study also had a relatively small sample size, but was adequately powered to detect the effects needed for the statistical analyses conducted.

This study had many strengths, including trust established by the researchers and the development of partnerships with community stakeholders. The transformative exploratory sequential mixed methods design was an additional strength. The use of this study design allowed the researchers to study the issues of fruit and vegetable consumption among Native American children in-depth, with the goal of ultimately increasing intake and reducing nutrition-related health disparities. The combination of qualitative and quantitative methods allowed the researchers to understand the complex relationships impacting fruit and vegetable consumption in greater detail than would be possible through the use of quantitative or qualitative methods independently.

5. Conclusions

This research demonstrated that there is a complex relationship between caregiver fruit and vegetable-related information, motivation and behavioral skills and the fruit and vegetable intake of the Native American children in their care. Caregiver role modeling, cooking skills and self-efficacy directly impact child fruit and vegetable consumption. Caregiver attitudes and social supports directly impact behavioral skills. Caregiver information regarding recommendations for and benefits of fruit and vegetable intake directly impact caregiver attitudes and motivation related to fruits and vegetables. A revised IMB model that explains these findings

was developed. It is imperative to develop programs that address caregiver fruit and vegetable-related information, motivation and behavioral skills to increase the intake of fruits and vegetables among Native American children to potentially reduce a variety of health disparities faced by this population.

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.

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