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Development and Application of Interactive, Culturally Specific Strategies for the Consumption of High-fiber Foods in Puerto Rican Adolescents

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ABSTRACT

Healthy eating practices in the adolescents can prevent the development of obesity and other chronic diseases in the adulthood. The consumption of fruits, vegetables, and whole grains in Puerto Rican adolescents is low and might be contributing to the high prevalence of food-related chronic diseases, such as obesity in this group. The purpose of the study was to develop and apply interactive methods and strategies that help adolescents make healthy food choices. Over time, healthy food choices can delay or prevent food-related chronic diseases in the adulthood. Information from the focus groups helped to develop nutrition education materials that were age-culturally specific. Following nutrition education, the consumption of foods high in dietary fiber such as fruits, vegetables, and whole-grain cereals improved significantly in Puerto Rican adolescents. A modified socioecological model for dietary fiber-rich foods consumption in Puerto Rican adolescents, demonstrated that effective nutrition education strategies reduced the barriers to dietary fiber-rich foods consumption on the adolescents, their parents and the community promoting healthy eating choices of fruits, vegetables, and whole-grain cereals, to prevent food-related chronic diseases in the adulthood.

KEYWORDS

Dietary fiber; adolescents; obesity; chronic diseases; culture; nutrition education; Hispanic nutrition

Introduction

A sustainable healthy eating practice during adolescence can prevent the development of obesity and other chronic diseases in the adulthood. Data from CDC (2017) indicate that 17% of children and adolescents (2–18 years of age) in the United States are obese. Moreover, the Youth Risk Behavior Surveillance System (CDC 2017) also reported that 24.2% of Puerto Rican adolescents (grades 9th through 12th) were overweight or obese. Children that are obese have a higher risk of developing degenerative diseases like cardiovascular disease and diabetes in their adulthood (Rankin et al. 2015).

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Dietary fiber-rich f fruits, vegetables, and whole grain cereals consumption have been associated with obesity prevention because it promotes satiety and thus, avoidance of overeating (Turner and Lupton 2011). According to the Institute of Medicine (IOM 2005; IOM 2012), adults and children should consume between 25 and 38 g of dietary fiber a day or 14 g per 1000 kilocalories a day. Specifically, teens must consume from 25 to 31 grams per day. Although fresh fruits, vegetables, and whole grain cereals are good sources of dietary fiber; however, its consumption is low for children and adults in Puerto Rico compared to United States. The Youth Risk Behavior Surveillance System (CDC 2017) reported that 14.3% of Puerto Rican adolescents from grades 9th through 12th, did not eat fruit, and 16.4% did not eat vegetables, whereas in the United States, only 5.6% did not consume fruits and 7.2% did not consume vegetables. Adequate intake of dietary fiber-rich food, such as fruits and vegetables prevents children from being obese and from subsequent food-related chronic diseases in adulthood (Jarpe-Ratner et al. 2016).

Data from the National Health and Nutrition Examination Survey (NHANES 2017) demonstrated that the intake of whole grain products in adolescents does not meet the requirements of the Dietary Guideline for Americans (2015) of at least 3 servings of whole grain equivalents per day, especially in low-income adolescents (Tester et al. 2017). Examples of whole grains include whole wheat, amaranth, barley, buckwheat, corn, millet, oats, quinoa, brown rice, rye, sorghum, triticale, and wild rice. The Dietary Guidelines recommend consuming five fruits and vegetables a day. The dietary recommendation for dietary fiber in teens is between 25–31 g per day.

The World Health Organization guidelines for adolescents' nutrition presented several research gaps that need to be addressed in order to reduce the food-related chronic diseases such as obesity in this group (WHO 2018). For this reason, this study intends to reduce the lack of evidence from other regions or countries, the need of information on the adolescent's food preferences, their main influencers, and barriers of their food selection as well as to provide culturally strategies to reduce these gaps.

There are barriers to dietary fiber-rich foods consumption in adolescents in the US and amongst Hispanics. These barriers are mostly related to social and cultural factors in food preparation, lack of access to affordable healthy foods (Nepper and Chai 2016; Nicklas et al. 2013), high availability of unhealthy foods, among others (Tiedje et al. 2014). One reported barrier from the children's perspective is the preference for unhealthy foods due to taste preferences. Studies from McMackin et al. (2013) emphasized that although children and parent know about the health benefits of consuming whole grain foods, the acceptability is low due to taste and texture preferences.

Focus groups provide qualitative information on the participants' perceptions on dietary practices, beliefs, and behaviors that impact food intake (Bisogni et al. 2012; Tiedje et al. 2014). Data from the focus groups can provide important information on possible barriers to dietary fiber-rich foods consumption in order to develop educational strategies to overcome them. Qualitative research has been shown to be instrumental in advancing our understanding of social and behavioral aspects of food and eating (Bisogni et al. 2012). A focus on the beliefs and practices and the meanings people associate with food, healthy diet, and health can enlighten culturally appropriate health intervention programs and create a healthy eating environments to inform policy approaches (Blondin et al. 2016; Kahan and Zvenyach 2016) as well as the access to dietary fiber-rich foods (Valpiani et al. 2015). Researches (Horner 2000; Namey et al. 2016) that conducted focus groups with adolescents documented that they have the necessary cognitive capacity to analyze day to day situations, make abstract constructs, and problem-solve hypothetical cases. Furthermore, studies with Latino populations tend to conclude that they are very social and hospitality is important to them (Dixon and Stein 2000). These studies point out that data-gathering is more effective in group sessions than in individual interviews, therefore making focus groups an ideal methodology to be used in research with Puerto Rican children. An exploratory mixed methods design was selected to collect qualitative data through the focus groups dietary behavior changes while a quantitative pre and post questionnaire was employed (Zoellner and Harris 2017) to observe the relationship between the information from the focus groups transformed into actions following intervention.

The socio ecological model (SEM) serves as the theoretical framework that helps to understand the factors and barriers that influence dietary behaviors. (Dietary Guidelines for Americas 2015; Story 2002; Ohri-Vachaspati et al. 2015; Verstraeten et al. 2014) which leads to health outcomes. This model has been used to understand cultural barriers to fruit and vegetable consumption (Robinson 2008four) as well as to determine the factors influencing childhood obesity (Gonzalez-Casanova et al. 2014). Briefly, the model shows levels of influences in dietary behaviors: (1) individual (influenced by age, gender, preferences), (2) interpersonal (parents and peers influences, cultural factors), (3) community (schools, municipalities, food markets), (4) societal (social media, public policy).

Nutrition education strategies to promote healthy eating and dietary fiber consumption for children that have been effective for this group according to the study of Dudley, Cotton, and Peralta (2015) are specialty nutrition education courses existing health, parental involvement, and experiential learning approaches. The preferred experiential learning for adolescents to promote dietary fiber consumption are cooking lessons, community garden, cooking and food preparation, literary abstraction like role play whereby

a character exemplifies good eating behaviors, web-based, and social media activities (Ganann et al. 2012). Although plenty studies have been done, information on education strategies for adolescents for obesity prevention is limited.

A variety of programs have been designed to promote healthy eating, many of them, targeting children (Gyawu et al. 2015), parents or caregivers (Diaz-Rios et al. 2016), teachers (Mayfield and Graves 2014) as well as others on the community (Jarpe-Ratner et al. 2016). These programs have developed a wide variety of techniques to appeal to their audiences and engage them enough to achieve real learning, including music and dance (Gyawu et al. 2015), social media (Roth et al. 2018), websites (Economos et al. 2019), workshops (Prescott et al. 2019) and educational materials through internet communications (Olson 2016).

Although current nutrition education materials available appear to increase nutrition knowledge, there is a concern in some investigations that more knowledge does not immediately translate to improved eating habits. There appears to be a gap between knowledge and action when it comes to nutrition. Roth et al. (2018) found that although the multicomponent nutrition education program designed by their team influenced the knowledge and attitudes regarding fruits and vegetables in school-age children and parental influences (Santiago-Torres et al. 2014), they did not observe a significant increase in students' fruit and vegetable consumption. Other investigators also found the benefits of the interactive school-based nutrition program for Hispanics to prevent childhood obesity (Fernandez-Jimenez et al. 2019)

On the other hand, Jarpe-Ratner et al. (2016) found that a hands-on-based approach that included experiential cooking as well as a nutrition education program on consumption of fruits and vegetables did result in a change in behavior and recommend it as a way to improve nutrition in low-income communities. Likewise, Diaz-Rios et al. (2016) found acceptance and effectivity in delivering nutrition education to Latino audiences with a three-part culturally sensitive approach that "included facilitated group discussions (Talk), emotion-based messaging (Heart), and skill-building activities and goal setting (Hands)." They stress that including distinctive cultural values of this population increases the chances of acceptance and action toward a real change in this population's eating behavior.

The study intends to determine the barriers to dietary fiber-rich foods consumption in a group of Puerto Rican adolescents and to explore how can a culturally specific, interactive, healthy food intervention improve dietary fiber consumption in this population. Focus groups will help to gather the information on barriers to dietary fiber consumption, while the development and implementation of culturally and age-specific education strategies and measurements of food consumption pre and post intervention allowed

measuring its impact in dietary behaviors while improving the consumption of food rich in dietary fiber.

Materials and methods

This is a two-phase study that first investigates the barriers for dietary fiber-rich foods consumption in adolescents through focus groups; secondly, design and implement culturally and age-specific educational strategies to reduce these barriers resulting in positive eating practices that promote dietary fiber consumption following an effective nutrition education. Complete methodology on how the focus groups were conducted was explained elsewhere (Rodriguez et al. 2018) Approval of the focus group questionnaires and protocol was requested and obtained from the University of Puerto Rico at Mayagüez Institutional Review Board for Protection of Human Subjects. Written consent and assent were obtained from participants' PCs and the children.

Participants

The participants were selected from the 4-H Youth Development Program of the Agricultural Extension Service (PRAES) at the University of Puerto Rico. The participants for the focus groups were adolescents (n = 52) from ten Extension 4-H clubs, aged 12 to 14 years old and their parents (n = 17). To assure total representation of the Island of Puerto Rico, participants were selected from each rural and urban region were selected. Clubs selected represented coastal, interior, and mountainous areas in Puerto Rico. The inclusion criteria include that the members from the clubs had to be between the target ages of 12 to 14 years and should not have had any nutrition course at the time of the project. A total of 339 adolescents participated in the intervention and answered a questionnaire before and after the nutrition lessons intervention. All participants were between the ages of 12 to 14 years old, 64% were from urban areas and 36% from rural settings; 47% were female, 49% male, and 4% did not answered.

This group of adolescents participated in the nutrition education lessons program to improve eating practices on fresh fruits, vegetables, and whole grain foods. A nonintervention group participate in the validation process of the educational materials. More information of the intervention methodology was presented elsewhere (Rodríguez, Correa-Matos, and Rodríguez-Pérez 2019).

Study design

Phase I-Barriers to dietary fiber-rich foods consumption

To obtain information on barriers to dietary fiber of fruits, vegetables and whole grain cereals consumption and nutrition knowledge from adolescents and their

parents, seven focus groups were conducted and described elsewhere (Rodriguez et al. 2018). Briefly, a total of seven focus groups were conducted: five with adolescents and two with their caregivers. The participants were selected from the 4-H Youth Development Program of the Agricultural Extension Service (PRAES) at the University of Puerto Rico from rural and urban regions. The number of participants per group ranged from 7 to 12. Participants were identified by a number code to maintain confidentiality. The process of conducting these focus groups followed the designs recommended by (Krueger and Casey 2015, Morgan et al. 2015; Steward and Shamdasani 2015), by including one moderator and one assistant moderator trained in the methodology. Focus groups were audio-recorded and transcribed verbatim. Approval of the focus group questionnaires and protocol was requested and obtained from the University of Puerto Rico at Mayagüez Institutional Review Board for Protection of Human Subjects.

The focus groups questions (Table 1) included information on healthy foods knowledge, consumption of fresh fruits, vegetables and whole grains, barriers to healthy eating, and proposed strategies to increase dietary fiber consumption. The questions were asked to adolescents and their caregivers. Literature on conducting focus groups with children has documented that children aged ≥11 years possess the necessary cognitive capacity to analyze day-to-day situations, make abstract constructs, and problem-solve hypothetical cases (Dixon and Stein 2000; Horner 2000). Other studies with Latino populations tend to conclude that they are very social and hospitality is important to them (Dixon and Stein 2000; Morgan 1997; Tiedje et al. 2014). These studies point out that data gathering is more effective in group sessions than in individual interviews which make focus groups an ideal methodology for use in research with Puerto Rican children.

The number of focus groups was established a priori following the rule of thumb stating that high levels of redundancy are achieved by the third to fourth group, or after 20 individual interviews (Guest, Bunce, and Johnson 2006; Namey et al. 2016, Francis et al. 201). When the focus groups were

Table 1. Questions for focus groups.

Questions for the adolescents' focus groups
(1) What is your favorite food?What foods do you think are healthy?
(2) What things don't allow you to eat healthy your home, and when you go out?
(3) How do you think an educational program must be developed to motivate young people like you to fruits, vegetables, and whole grains?
Questions for the parent/caregivers focus groups
(4) What do your children like to eat the most?
(5) What foods do you think are healthy?
(6) What things make it difficult for your children to eat healthy foods such as fresh fruits, vegetables, and whole grains: when they are at school, in your home, and when they go out?
(7) How do you think an educational program must be developed to motivate young people like your children to eat fresh fruits, vegetables, and whole grains?

carried out, a Pareto curve analysis was performed to determine both levels of focus group and individual data saturation (Guest, Bunce, and Johnson 2006; Namey et al. 2016) Ninety percent saturation was obtained at 20 of 69 participants, and 90% saturation was obtained at 2 of 7 focus groups.

Phase II-Development implementation and evaluation of nutrition education strategies to increase dietary fiber-rich foods consumption

The information obtained from the focus groups was used to prepare educational materials and strategies to increase knowledge and dietary fiber-rich foods consumption. A curricular guide was developed to increase nutrition knowledge on the importance of the consumption of fresh fruits, vegetables, and whole grain cereals consumption, strategies to overcome barriers to access and affordability of fresh fruits, vegetables, and whole grains. An activity guide was developed to accompany the main curricular guide. Most experiential learning activities promoted the development of cooking skills and the opportunity to try new foods or combination of culturally accepted foods with the integration of fruits and vegetables for adolescents. Nutrition education guides were validated with a nonintervention group.

The evaluation of the 6-weeks nutrition education intervention consisted of the implementation of the six 45–60-min lessons on healthy eating practices and dietary fiber consumption and an experiential learning activity. The activities consisted of video-taped recipe preparation of high fiber foods (fruits, vegetables and whole-grain cereals), role-play on how to overcome barriers for healthy eating and foods access among others. A pre- and posttest design was employed to determine changes in the following dietary behaviors following nutrition education and activities to increase in consumption of vegetables, fruits, whole-grain rice, and cereals. For this phase, participants that fill in the requirements must have not received a nutrition lesson in the club, they must be members from any of the 10 Extension 4-H clubs, which is mostly comprised of children attending public schools, and must be between ages 12 to 14 years old.

Statistical analyses

Concept frequency analysis was used for the focus groups, which allows for determining how many times a specific category was mentioned by any of the participants. Extension analysis was also employed, counting how many different people referred to the same category. Data for intervention (pre- and post-test) were analyzed through Analysis of Variance ANOVA using a Linear Mixed Model. The fixed factor was time and random factors were ID and 4-H clubs, with a significance level of 5%. Means comparisons were done in three times using a Least Significant Difference (LSD) test. Statistical

analyses were performed with SPSS software (version 25.0, Armonk, NY: IBM Corp, 2017). Items measured frequency of consumption with a Likert-type 5-point scale (5 = everyday; 4 = almost every day; 3 = sometimes; 2 = almost never; 1 = never). Questionnaire was evaluated for content validity and face validity. The content validity analysis was performed by a committee of experts including the authors (PI and Co-PI) both with expertise in nutrition and developers of the curriculum content. The face validity was determined through a pilot-testing of the questionnaire for clarity and understanding with a group of 4-H club's members (N = 15) of similar ages (12–14 years old), that did not participated in the intervention.

Results

Results from focus groups

Seven focus groups were conducted. Five focus groups were conducted with adolescents ages 12 to 14 years (N = 52, 35 females and 17 males) and two focus groups were conducted with parents or caregivers (N = 17, 13 females and 4 males). Results from focus groups showed that both early-adolescents and their parents have an understanding on which foods are healthy. Although 93% of parents and 86% of earlyadolescents knew the health benefits of consuming foods rich in dietary fiber (fresh fruits, vegetables, and whole grains), the consumption associated with preferences of these foods was low. Only for 47% of parents and 12% of adolescents consumed adequate amounts of sources of dietary fiber every day (Table 2). However, children prefer and consume low- fiber fast foods followed by culture-related foods. Culture-related foods were: rice with stewed beans, chicken or corned beef; fried meats, plantains and potatoes; pasta, and sugared desserts. These foods were low in dietary fiber, high in carbohydrates, fats and salt and sugars, which could promote obesity if overconsumed. White rice was considered a staple food, the integration of brown rice in Puerto Rican lunch programs was not culturally accepted by parents and caregivers.

The major barriers that prevented the consumption of dietary fiber in fruits, vegetables, and whole grains were associated with the practice of selecting low nutrient-density eating-out or buying convenience foods. The reason for buying these types of foods was associated with the following barriers: (1) the busy schedules of parents/caregivers, students' after school activities; (2) financial constraints; (3) sociocultural factors, and (4) and personal preferences. It seemed that some parents gave money to the adolescents to buy at the convenience stores or fast foods, allowing young people making decisions about the foods selected without previous knowledge about how healthy or not is the food selected. Early-adolescents unanimously expressed that they did have knowledge on the fact that the foods selected

Table 2. Results from the focus groups.

Focus groups findings	Adolescents (n = 52)	Caregivers (n = 17)
What food do you eat the most?		
Fast Food	39 (75.00%)	8 (47.06%)
Culture-related foods (fritters)	7 (13.42%)	6 (35.29%)
Fruits, vegetables and whole grains	6 (11.58%)	3 (17.65%)
What foods do you think are the healthiest?		
Fruits	13 (32.69%)	5(29%)
Vegetables	19 (36.54%)	7 (41%)
Whole Grains	17(25.00%)	4 (24%)
Other food groups: milk, eggs, meats	3 (5.77%)	1 (5.88%)
Barriers to healthy eating of dietary fiber		
Eating out		
Unhealthy food choices (fast foods)	34(65.38%)	16 (94.12%)
Financial issues	15(28.85%)	1 (5.88%)
Culture-related foods	3 (5.77%)	-
At home		
Unhealthy foods choices (candies)	34 (65.38%)	-
Financial issues	-	9 (52.94%)
Culture – related foods	18 (34.62)	8 (47.06%)
At school		
Refusal to eat at school lunch	12 (23.08%)	-
Eating at convenience store	40 (76.92%)	-
Strategies to improve healthy eating		
Move to a healthier environment	52 (100%)	17 (100%)
Hands-on activities (interactive)	52 (100%)	-

at convenience stores around the school were not healthy. Both caregivers and early-adolescents agreed that it is important to be educated in healthy eating strategies, and to promote changes for a healthier environment. Early adolescents indicated that *hands-on* interactive activities such as recipe preparation, school gardening, videos prepared to motivate this group to eat healthier, and easy to read educational materials helped them to increase the consumption of fruits, vegetables, and whole grains (Table 2).

Results for the development, implementation, and evaluation of nutrition education strategies to increase dietary fiber-rich foods consumption

The nutrition education materials were prepared using the information provided on the major barriers to dietary fiber-rich foods consumption: food preference, cultural and socioeconomic factors, accessibility, and age-appropriateness. As a result, two curricular guides were developed for providers and for adolescents to increase knowledge in the sources of dietary fiber and its health benefits. In addition, three hands-on recipe books were prepared to promote the consumption of whole grain rice, fruits and vegetables. These affordable healthy culturally sensitive recipes included ingredients locally produced and readily accessible, low-cost choices for whole-grains, and selection of seasonal fruits and vegetables to increase dietary

fiber-rich foods consumption and satiety preventing obesity in early-adolescents. Other educational materials included recipe demonstrations videos developed by the adolescents and assisted by the providers/teachers.

Results from the participation on the six-week lessons and hands-on activities on 339 early-adolescents (47% were female, 49% male and 4% did not answered) demonstrated that following intervention, there was a significant increase in consumption of fruits, vegetables and whole grain cereals even though brown rice was not well accepted. Figure 1 compares the changes fruits and vegetables consumption.

Discussion

According to CDC (2017), more than 30% of children and adolescents in the United States (US) were obese or overweight, with a higher prevalence in Hispanics. Similarly, in Puerto Rico, a territory of the United States, childhood obesity is around 25%. Obesity was associated with the development of chronic diseases such as diabetes, cardiovascular diseases, and cancer in the adulthood, thus an obesity prevention program must start from the young ages. This study intended to target the early adolescents in order to prevent the development of chronic diseases starting at a young age. Although the early adolescents are still influenced by the parental food choices, they are in a stage where some decision on their eating can be made by themselves.

Poor food choices are associated with the development of obesity. It is known that dietary fiber in fresh fruits, vegetables, and whole grains can combat obesity by increasing satiety and preventing overeating. The consumption of dietary fiber from fruits and vegetables in Puerto Rican

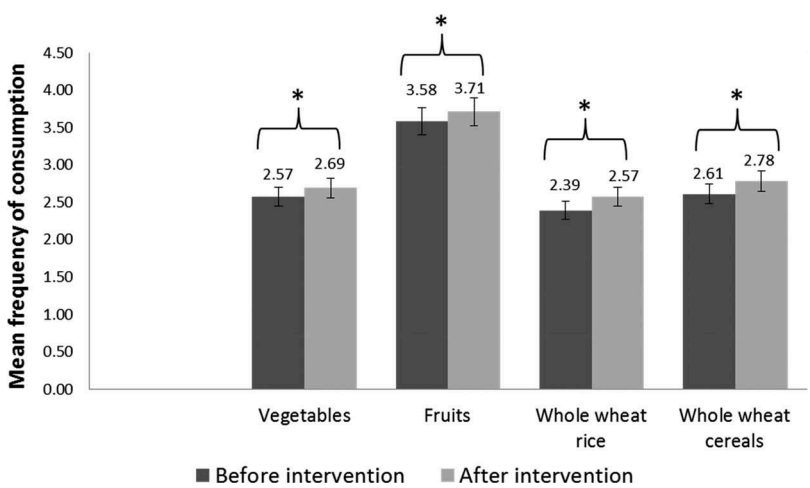

Figure 1. Mean frequency of dietary fiber consumption on fruits, vegetables, and whole-grains before and after dietary intervention. Comparisons before and after interventions within each food group is significantly different ($P < .05$).

adolescents was deficient, because 54% did not consume fruits whereas 64% did not consume vegetables, according to recent data from CDC-YRBFSS (Young Risk Behavioral factors Surveillance System 2017). Our study showed that fruits and vegetables were the least preferred food to be consumed by early-adolescents and their parents. Only 11.58% of the early adolescent's and17.65% of their parents/caregivers preferred to consume fruits and vegetables, which is consistent with the low consumption presented by CDC on their 2017 report (Table 2). It was clearly shown in our study that preferences were playing a role in food choices over food knowledge. Although more than 90% of children and their parents recognized that dietary fiber foods (fruits, vegetables, and whole-grains) are healthy foods and must be consumed daily, they were not consumed in adequate amounts to achieve the dietary fiber requirements of 25–35 g/day for adolescents and their parents.

Our study is similar to the socioecological models presented by Caperon et al. (2019); Banna et al. (2015), and Robinson (2008), which showed how the adolescents behaviors toward improving the consumption of dietary fiber-rich foods is influenced by several factors at different levels: individual, interpersonal, community, and societal. At the individual level, adolescents prefer to eat fast foods and candies and at lastly, cultural foods. Parents still have a great influence in the adolescents' preferences (interpersonal level) because they tend to consume low fiber foods, mostly from fast foods. Cultural foods are preferred as a second choice following fast foods. Parents tend to reward children's behavior with candies, which impacts their preferences for unhealthy foods, as well as financial constraints and busy work schedules. School (community level) influences adolescents' food intake by offering not well accepted food choices. Social media influences both parental and adolescents food choices. All these influences will end in obesity and foods-related chronic disease. However, following nutrition education, positive changes for improving dietary fiber-rich food consumption preventing diet-related health conditions were observed. From these results, a socioecological model to improve the consumption of dietary fiber-rich foods for adolescents was developed (Figure 2).

It is important to extend nutrition education programs to caregivers and schools. Once adolescents learned about the importance of consuming fiber-rich foods, it was important to transform the knowledge into action assuring that parents and schools must provide age and culturally specific healthy food choices to increase adolescents' acceptance and consumption of dietary fiber-rich foods to prevent childhood obesity and other food-related diseases.

Our study found barriers to dietary fiber consumption in adolescents and their parents. It was noted that these barriers were present at home, at school and while eating out. The most common barriers at home as described by the adolescents were the presence of unhealthy foods like candies, soda and

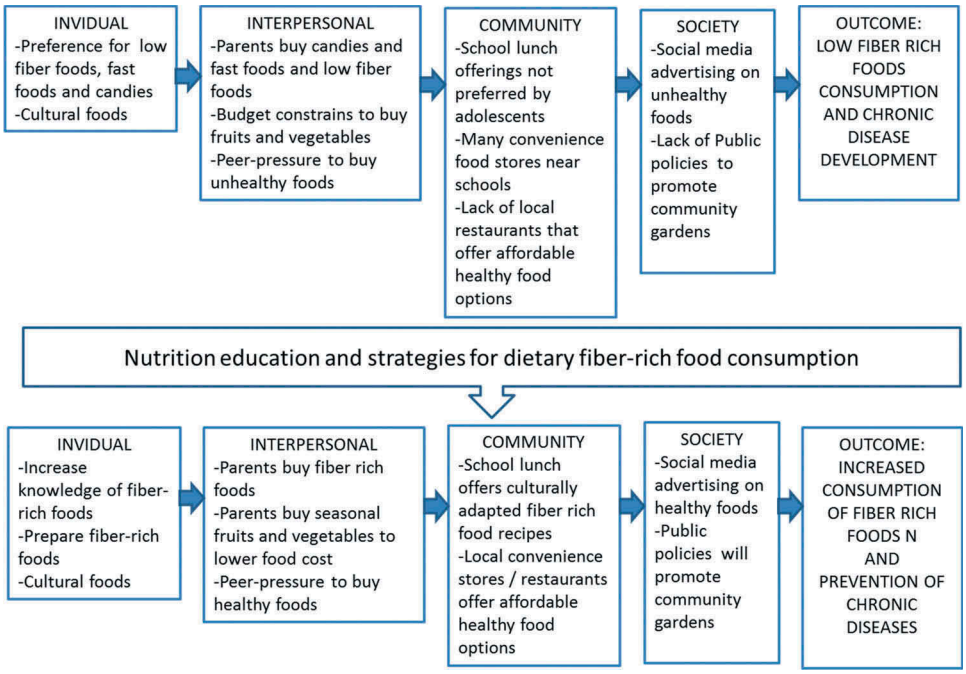

Figure 2. Socioecological model for dietary fiber-rich foods consumption in Puerto Rican adolescents following a nutrition education program. The four levels of the model, individual, interpersonal, community and societal relationships interplay in order to change the outcome of dietary fiber consumption in adolescents. Nutrition education strategies to improve dietary fiber-rich foods in adolescents impact the outcome in the prevention of food-related diseases in the adulthood.

chips, which were used as dessert or as rewards for good behavior, but were low in nutrition density as well as dietary fiber. However, more than half of the parents recognized that financial constraints proned them to sacrifice nutrient quality for quantity in order to feed the entire family. The need to preserve their culture-related foods, such as white rice consumption, was a barrier to consume fruits, vegetables and whole-grains as expressed by approximately 42% of the parents. At school, 76.92% of the students visited the convenience stores around the school because they dislike the foods from the government school lunch program, while the remaining percentage of students got lunch from home. The refusal from eating food from the school lunch room was because adolescents believed that food choices and food preparation styles were not culturally appropriated in terms of taste and variety in the offerings. Moreover, the introduction of high fiber whole-grain rice was not well accepted by the students because white rice is a staple food in Puerto Rican culture, and the way it was prepared, was far from their preference. Both adolescents and students agreed that eating out choices were not a healthy choice, however, this practice was widely used.

The foods mostly eaten out were fast-foods offering pizza, hamburger, tacos and least preferred, cultural foods, which were low in dietary fiber.

The participants of the focus groups, all adolescents and parents, agreed in the importance of developing a nutrition program with age and culturally sensitive educational materials reduced barriers to healthy eating and improved dietary fiber consumption. They suggested that the education programs must be interactive and expanded to the community. Effective nutrition education for dietary fiber consumption for adolescents consisted in the application of knowledge of easy- to- prepare recipe books using fruits and vegetables and also, different alternatives for the preparation of whole grain rice. The development of role-playing videos on the benefits of consuming fruits, vegetables, and whole grains, selecting healthy food in the convenience stores and while eating out, as well as other health improvement activities, were prepared by the adolescents with the assistant of the trained personnel and investigators.

The effective six-week interactive nutrition program that included hands-on, age and culturally appropriate nutrition education strategies reduced barriers to dietary fiber consumption and increase significantly the intake of fruits, vegetables, and whole grain foods following intervention. Although this study did not measure the exact amount of dietary fiber, the 2015 Dietary Guidelines recommend that the adequate food group consumptions per day of fruits and vegetables is five and six for whole grains. The amount of fruits and vegetables and whole grains consumed increased, more work must be done to determine measurable amounts of dietary fiber consumed in order to make reliable food recommendations for improvement based on actual intake. It is important to improve the consumption of high fiber brown rice in the school lunch program through the implementation of culturally adapted recipes. A school-based garden could be a sustainable activity that helps to improve intake of dietary fiber and must be implemented for adolescents (Evans et al. 2015). The limitation of the study was not having a control group to further support the effectiveness of the educational materials.

In conclusion, the results of this study provided insights for the development of a nutrition-education-program focused on affordable healthy culturally sensitive strategies such as recipes including ingredients locally produced and readily accessible, low-cost choices for whole-grains, and selection of seasonal fruits and vegetables to increase dietary fiber consumption and satiety preventing obesity in early-adolescents. This study provided strategies of the consumption of dietary fiber-rich foods as part of the nutrition education program to reduce childhood obesity in Puerto Rican adolescents. Further studies must focus on the importance of overall healthy eating practices of other foods groups and nutrients for adolescents that emphasize in age and culturally appropriate food choices to reduce food-related chronic diseases.

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Disclosure statement

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