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Original Research

Seasoning ingredient variety, but not quality, is associated with greater intake of beans and rice among urban Costa Rican adults

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ABSTRACT

Exposure to a variety of flavors may promote food enjoyment, but few studies have examined the relationship between food seasoning and food intake. We hypothesized that using a higher variety (number) of 11 seasonings to prepare 2 staple foods (beans, white rice) would be associated with intake of those foods in a population-based case-control study of Costa Rican adults in urban vs rural areas (n = 1025), where cooking and dietary practices differ. Participants were surveyed about the variety of seasoning ingredients added when preparing beans or rice. Ingredients were also categorized by their dietary quality (healthfulness), and scores for seasoning variety and quality were created. Multivariable linear regression was used to determine the association between variety and quality scores (continuously and in tertiles (T)) and intake of each staple food. Seasoning variety was positively associated with daily servings of beans (β = .02, P = .01; 1.31 and 1.23 servings/day in T2 and T3 versus 1.02 servings/day in T1, P < .05) and rice (β = .04, P = .005) in the urban areas only. No differences in ingredient quality across increasing intakes of beans or rice were noted, and the joint associations between variety and quality were not significant. In conclusion, a greater variety, but not quality, of seasoning ingredients was positively associated with intakes of beans and rice in urban Costa Rican adults. Our results suggest that increasing the variety of seasonings added to beans may be a culturally-appropriate strategy to improve intake of this healthy staple food among urban Costa Rican adults.

1. Introduction

White rice and beans are staple foods in many Latin American countries [1]. Among Costa Rican adults, white rice (herein referred to as rice throughout) and beans represent the primary sources of energy and protein intake respectively [2–4]. Between 1995 and 1999, Costa Rica experienced the second highest growth rate (12%) in rice consumption among countries with

Abbreviations: BMI, Body mass index; T, Tertile.

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similarly high rice intake [5], while bean intake has decreased by 46% over the last 30 years [6,7]. Rapid urbanization has exacerbated the reduction in bean intake in some areas of Costa Rica potentially due to higher incomes and greater availability of processed foods, while rural residents have tended to maintain more traditional cooking and dietary practices [3,4]. Therefore, strategies to improve dietary quality in urban regions of Costa Rica are especially warranted.

Excessive rice intake, a food with putative unfavorable metabolic effects [8–10], is concerning given the global rise in obesity-related chronic diseases [11], including in Costa Rica [12–14]. The concomitant reduction in bean intake is noteworthy because beans are nutrient-dense, affordable sources of both protein and fiber and have been previously shown to be associated with lower levels of cardiometabolic risk factors [8] and incidence of myocardial infarction [13] in Costa Ricans. Despite awareness of the adverse health consequences of excess rice and reduced bean intake, expressed preferences for how these foods should taste has made it challenging for Costa Rican adults to improve dietary quality by interchanging the level of intake of these staple foods [7]. Thus, it is important to consider alternative methods to improve diet quality in this population. As such, intervention strategies that promote bean intake and reduce rice intake have the potential to improve cardiometabolic health in this population.

One strategy targeting food choice that may be easy for individuals to implement is to increase variety within healthful, less energy-dense foods. Food variety has been shown to increase food intake within and across meals [15], and it may be possible to harness this preference to increase consumption of healthier foods. The "variety effect" is robust at the food level, but researchers have only recently started exploring whether increasing the perception of variety [16,17] and enhancing sensory variety (eg, variety in color, shape, texture, and flavor or seasoning) can influence intake [18–21]. Research has also found that using herbs and spices to enhance the flavor of healthful foods can increase intake [22,23], which may be an applicable strategy to improve diet quality in diverse populations.

However, it remains unknown whether greater seasoning variety is associated with the intake of staple Costa Rican foods (i.e. beans and rice), and if the dietary practices in urban versus rural areas influence those associations. Similarly, researchers have not examined whether the dietary quality of staple foods is maintained or improved with greater sensory variety. Finally, research in population studies is limited because few studies measure variables related to sensory variety.

Therefore, using unique data from urban and rural Costa Rican adults, our primary research objective was to examine whether greater seasoning variety used in the preparation of beans or rice was associated with intake of these foods, with the hypothesis that seasoning variety would be positively associated with intakes of beans and rice. Additionally, because dietary variety is not always associated with dietary quality [24,25], in exploratory analyses, we examined the associations between ingredient quality and intake as well as the joint associations of variety and quality on bean and rice intake. In order to examine our research objectives, we analyzed secondary data from a population-based case-control study of Costa Rican adults that collected unique detailed information about the seasonings used to prepare beans or rice, as well as a validated assessment of intake of these staple foods. This research enhances our understanding of how culturally-accepted food preparation practices influence the intake of staple foods. Ultimately, such knowledge advances human nutrition by identifying dietary targets for interventions that could help mitigate the adverse health effects driven by the nutrition transition in Costa Rica [14].

2. Methods and materials

2.1. *Study population*

Participants were a subset of cases and controls who took part in a population-based study of heart disease in Costa Rica between 1994 and 2004. Detailed descriptions of study methodology have been previously published [3,26]. Cases were identified as survivors of a first acute myocardial infarction; control participants were randomly selected from the National Census and Statistics Bureau of Costa Rica and matched for age, sex, and area of residence at the county level with cases. Control participants were excluded if they had a history of myocardial infarction or if their physical or mental status precluded participation.

For this analysis, we used data from a subset of 1025 out of 1062 participants who responded to questions about the ingredients they used to prepare beans and rice. The subset represented approximately 23% of the full sample (n = 4540) (Supplemental Fig. 1) [13].

This study was conducted according to the guidelines in the Declaration of Helsinki and the Human Subjects Committee of Harvard T.H. Chan School of Public Health and the University of Costa Rica approved all human subject procedures.

2.2. *Dietary assessment*

Diet was measured using a validated, country-specific semi-quantitative food frequency questionnaire [27]. Bean and rice intake were assessed by asking participants to specify the portion size and frequency with which they consumed each food over the previous year. Frequency categories ranged from <1 serving/month or never to ≥6 servings/day; 1 serving of cooked beans corresponded to 1/3 cup and 1 serving of cooked rice corresponded to two-thirds cup. Mixed rice and bean dishes did not contribute substantively to intake of either food (median intake: 1 serving/wk) [8] and were excluded from the present analysis.

Participants were first asked whether they cooked rice and beans (affirmative for 98.7% and 95.7% of those asked, respectively). If so, the primary person in the household preparing the foods responded to open-ended questions about the recipes. Ingredient amounts for rice, beans, salt, solid fat, and oil were directly weighed or measured and fieldworkers visually confirmed the type of oil used for cooking. Participants were then asked whether they added 8 ingredients typically used in Costa Rican cuisine. For beans, these ingredients were onion, garlic, cilantro, celery, sweet pepper, bouillon cube, oregano, and English/Worcestershire sauce. For rice, the ingredients were onion, garlic, cilantro, celery, sweet pepper, bouillon cube, carrots, and *achiote* (annatto).

2.2.1. *Variety assessment*

The 8 common ingredients added to beans or rice were assessed as "no", "sometimes," and "yes", which were assigned