The Journal of Nutrition
Nutritional Epidemiology

The Positive Deviance Approach Can Be Used to Create Culturally Appropriate Eating Guides Compatible with Reduced Cancer Risk[1–3]

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Abstract

The 1997 World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR) Report provides 14 individual guidelines to reduce global cancer risk. The positive deviance approach could be appropriate for creating class-appropriate, healthy eating menu guides for consuming a diet to minimize cancer risk in Guatemala. Guatemalan adult participants ($n =$ 873) were enrolled in the Concordance Project from 3 socioeconomic strata: rural area ($n = 301$), lower urban ($n = 298$), and higher urban ($n = 274$). Participants with intakes below recommended nutrient intakes and current smokers were excluded from the analysis. Concordance with 14 selected WCRF/AICR individual guideline components was evaluated. We selected participants for making a set of 14 rotating menus for a cancer prevention healthy eating guide. A priority sorting through the 873 participants of the survey identified a total of 23 and 21 model participants, respectively, from the rural and urban poor groups (concordant with 12 of 14 recommendation components) and 15 from the urban middle class (concordant with 11 of 14 recommendation components), with the highest degree of concordance with the WCRF/AICR guidelines. The most commonly violated recommendation was sugar consumption, followed by maintaining weight stability. The FFQ for 14 individuals from each class were transformed into a day menu to create a rotating diet guide derived from members of each social group. A potentially useful personal guide for eating compatibly with adequate nutrient intake and reduced cancer risk, appropriate to the culture and economic means of distinct social classes in Guatemala, is approaching the stage for application. J. Nutr. 139: 755–762, 2009.

Introduction

Cancer is a growing cause of morbidity and mortality across the world (1,2), including in developing countries (3,4). Consuming a diet that is enriched in protective foodstuffs and avoids noxious items can lower the risk of cancer by up to 30% or more (5,6). The World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR)[6] expert panel report, *Food, Nutrition, and the Prevention of Cancer* (6), produced summary recommendations to reduce cancer risk through lifestyle behaviors and dietary practices at 14 levels. The Concordance Project (7) set out to evaluate the concordance of free-living participants in 4 nations, including Guatemala, with the tenets of the WCRF/AICR recommendations.

A major goal of the investigators of the Concordance Project was to derive lessons that could be put to practical application in helping individuals to reform their diets and maintain a healthy pattern of consumption. The positive deviance (PD) theory for community education emerged in the 1990s (8–13). It is predicated on the notion that even in situations of limited resources, there are some individuals or households that can manage to provide, e.g., the food, shelter, or caring that leads to adequate food security, housing, or health (14,15). Stated another way, it is a process of deriving lessons from the more successful elements of a community or society. We hypothesized that those individuals who manage to consume a healthful, risk-lowering diet in a situation of widespread unhealthful eating could provide insights into how appropriate consumption can be achieved. This proper, healthy eating might overcome barriers of adverse cultural pressures, economic restrictions, or educational deficits.

We used the information on "successfully concordant" individuals within the Concordance survey data to construct a suggested pattern of healthful, cancer-protective eating. The data were used to prepare a set of 14-d menus for each social class

[1] Supported by the American Institute for Cancer Research, the International Nutrition Foundation, and Akzo Nobel.
[2] Author disclosures: M. Vossenaar, E. Mayorga, M.J. Soto-Méndez, S.B. Medina-Monchez, R. Campos, A.S. Anderson, and N.W. Solomons, no conflicts of interest.
[3] Supplemental Tables 1–3 are available with the online posting of this paper at jn.nutrition.org.
[6] Abbreviations used: AICR, American Institute for Cancer Research; EAR, estimated average requirements; FCT, food composition table; PD, positive deviance; RNI, recommended nutrient intake; SES, socioeconomic strata; WCRF, World Cancer Research Fund.
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Manuscript received October 8, 2008. Initial review completed November 7, 2008. Revision accepted January 29, 2009.
First published online February 18, 2009; doi:10.3945/jn.108.100362.

represented in the Concordance population to serve as guides for food preparation and consumption. In this article, we present the details and caveats of the process to construct these strata-specific guides and the substance of their guidance.

Population and Methods

Population and sample

This study was part of a multicentric survey designed to assess concordance with the population goals and individual guidelines for cancer prevention of the WCRF/AICR (6). The Concordance Project included adult population samples from the Netherlands ($n = 1052$), Scotland ($n = 849$), Mexico ($n = 790$), and Guatemala ($n = 873$). Culturally sensitive cancer-related dietary and lifestyle questionnaires were developed concurrently in the 4 nations. The examined behaviors included total diet (comprising total energy, macronutrients, and specific micronutrient intakes), food preparation techniques (such as charring of meat, temperature of cooking meat), use of supplements, smoking habits, body weight history, and physical activity. Detailed methods and results for the Concordance Project were published previously (7,16).

For this study, only the Guatemalan sample of 873 individuals was used, disaggregated into 3 socioeconomic strata (SES) subsamples: rural area ($n = 301$), lower urban SES ($n = 298$), and higher urban SES ($n = 274$). Individuals were selected in a convenient sampling area in Guatemala City and rural areas west of the city to reach the desired number and age distribution. Participants were recruited on the basis of voluntary participation. Men and women aged 18–70 y from both lower and higher SES and living in both urban and residential areas were selected.

Research design and ethics

This article is based on secondary data analysis of survey data from the Concordance Project. The Human Subjects Committee of the Center for Studies of Sensory Impairment, Aging and Metabolism approved the study protocol. All participants signed a written informed consent form at the time of questionnaire completion.

Data collection methods

Trained field nutritionist interviewers conducted personal interviews in the rural and lower SES urban areas. In higher SES urban areas, data collection was conducted predominantly through personal interviews ($n = 184$) but also using postal questionnaires ($n = 90$), because participants preferred to take the questionnaires home due to time constraints. To better account for seasonal variation, data were collected during an entire calendar year (May 2001–April 2002). The overall response rate was >95%. Exclusion criteria included pregnancy, lactation in the first 6 mo, and participants with incomplete questionnaires.

Dietary assessment. Two sets of dietary assessment tools were designed, 1 for the lower SES (urban and rural) and 1 for the higher SES (urban). The dietary assessment tool for the lower SES comprised a 166-item semiquantitative FFQ. Eight additional food items were included in the questionnaire for the higher SES. The magnitude of consumption was based on a 1-y time frame; for each item that was affirmed as consumed, its frequency across a range of options from "never" to "4–6 times per day" was assigned. Most food items queried included a portion size in household measures. The newly developed tools were pilot tested to assess cognitive and practical issues such as ease of comprehension and time needed to complete.

A country-specific nutrient analysis program was developed using SPSS version 12.0. Daily intakes of foods were linked with the Central American food composition table (FCT) (17) and secondarily with the USDA FCT obtained online from the USDA database (18). The methods were described previously (16).

Lifestyle assessment. A series of additional questions, relevant to the assessment of concordance with the 1997 WCRF/AICR recommendations (**Table 1**), were included in the data collection tool in domains such as food preparation methods, use of dietary supplements, use of tobacco, and history of weight change.

Selection of participants for the development of menus: the primary screening

Participants with estimated intakes below recommended nutrient intakes (RNI) and current smokers were excluded from analysis and were not considered as potential PD models for dietary guidance. Self-reported smoking habits were used. We used the FAO/WHO RNI values (19) as the standard for evaluating nutrient intakes of 11 selected micronutrients: vitamins A and C, thiamine, riboflavin, niacin, vitamin B-6, folate, vitamin B-12, calcium, iron, and zinc. Gender-specific values for adults aged 19–50 y were used for the entire sample. Because of the high intake of unrefined maize, iron bioavailability of 5% and a "low" zinc bioavailability were assumed for the lower SES; by contrast, an iron bioavailability of 15% and a "high" zinc bioavailability were assumed for the higher SES. Participants with adequate intakes for 9 of the 11 micronutrients were considered to consume a diet generally complying with recommended consumption of micronutrients.

Selection of participants for the development of menus: the secondary screening

Concordance with selected WCRF/AICR individual guideline components for cancer prevention was evaluated. The exact evaluation criteria applied are described below and summarized in **Table 2**. The issues related to setting evaluation criteria are discussed in detail in a previous publication (20). A total of 14 recommendation components from 10 of the 14 WCRF/AICR recommendations related to diet and lifestyle were evaluated.

The first WCRF/AICR recommendation component assessed was to choose predominantly plant-based diets. Each food item listed in each population-specific questionnaire was classified as a plant- ($n = 117$) or animal-based ($n = 54$) food. The ratios of estimated weight of daily intakes of foods from plant origin to foods from plant and animal origin were generated.

Adequate consumption of vegetables (excluding potatoes and beans; $n = 26$) and fruits (excluding bananas; $n = 20$) was estimated. A maximum of 1 portion of vegetable or fruit juice (i.e. 80 mL) was taken into account. We did not account for composite dishes. The number of portions of vegetables and fruits was estimated by dividing the daily intake by 80 g (standard portion size according the WCRF/AICR convention). Adequate consumption of food items classified as starchy or protein-rich foods ($n = 50$) was assessed. These included foods such as tortillas, pasta, rice, bread, and other cereals, as well as banana and plantain. We estimated the number of portions of starchy or protein-rich foods by dividing the daily intake by 80 g (standard portion size).

Dietary variety was assessed for vegetables and fruits (excluding fruit juices, potatoes, and beans as members of these food groups) and starchy or protein-rich foods of plant origin. Variety was assessed as the number of items consumed at least weekly as a percentage of all listed in the FFQ.

The WCRF/AICR individual guidelines recommend limited intakes of refined sugar, alcoholic drinks, red meat, and total fats and oils. Values for extrinsic sugar were derived from the USDA FCT obtained online (18) and also from manufacturer food labels. Usual consumption of alcoholic drinks was queried using a FFQ, as was usual intake of red meat (including beef, mutton, lamb, pork, and products from these meats). Composite dishes with a red meat component were taken into account. Usual fat intake, in all foods, was estimated as the percent of total energy. The cutoff values used to classify participants as concordant or nonconcordant were taken from the population goal of the same WCRF/AICR recommendation.

A number of lifestyle-related recommendations were assessed. The first recommendation was to avoid being underweight or overweight. Data were available from both measured and self-reported weights and heights. Body weight and height were measured by trained staff with participants wearing light indoor clothing with emptied pockets and no shoes. Measured weight and height were used to compute BMI when available and self-reported measurements were used otherwise. A further recommendation was to limit weight gain during adulthood to <5 kg. Participants were asked their current weight and weight at the age of 21 y. The difference in weight was used to assess weight gain during adulthood. Participants younger than 28 y old were excluded from this analysis.

TABLE 1 The cancer prevention recommendations (population goals; individual guidelines) from the 1997 WCRF/AICR expert report[1]

Food supply and eating
Population to consume nutritionally adequate and varied diet based primarily on foods of plant origin
Choose predominantly plant-based diets rich in a variety of vegetables and fruits, pulses (legumes), and minimally processed starchy staple foods
Maintaining body weight
Population average BMI throughout adult life to be within range BMI 21–23; individual BMI maintained between 18.5 and 25
Avoid being underweight or overweight and limit weight gain during adulthood to <5 kg (11 pounds)
Maintaining physical activity
Population to maintain, throughout life, an active lifestyle equivalent to a physical activity level of at least 1.75, with opportunities for vigorous physical activity
If occupational activity is low or moderate, take 1-h-long brisk walk or similar exercise daily, and also exercise vigorously for a total of at least 1 h/wk
Vegetables and fruits
Promote year-round consumption of a variety of vegetable and fruits, providing ≥7% total energy
Eat 400–800 g (15–30 ounces) or ≥ 5 portions (servings) per day of a variety of vegetables and fruits all year round
Other plant foods
A variety of starchy or protein-rich foods of plant origin, preferably minimally processed, to provide 45–60% total energy. Refined sugar to provide <10% of total energy
Eat 600–800 g (20–30 ounces) or ≥7 portions (servings) per day of a variety of cereals (grains), pulses (legumes), roots, tubers, and plantains. Prefer minimally processed foods. Limit consumption of refined sugar
Alcoholic drinks
Consumption of alcohol is not recommended. Excessive consumption of alcohol to be discouraged. For those who drink alcohol, restrict it to <5% total energy for men and <2.5% total energy for women
Alcohol consumption is not recommended. If consumed at all, limit alcoholic drinks to <2 drinks per day for men and 1 for women
Meat
If eaten at all, red meat to provide <10% total energy
If eaten at all, limit intake of red meat to <80 g/d (3 ounces). It is preferable to choose fish, poultry, or meat from nondomesticated animals in place of red meat
Total fats and oils
Total fats and oils provide 15 to ≤30% total energy
Limit consumption of fatty foods, particularly those of animal origin. Choose modest amounts of appropriate vegetable oils
Salt and salting
Salt from all sources should amount to <6 g/d (0.25 ounces) for adults
Limit consumption of salted foods and use of cooking and table salt. Use herbs and spices to season foods
Storage
Store perishable food in ways that minimize fungal contamination
Do not eat food which, as a result of prolonged storage at ambient temperatures, is liable to contamination with mycotoxins
Preservation
Perishable food, if not consumed promptly, to be kept frozen or chilled
Use refrigeration and other appropriate methods to preserve perishable food as purchased and at home
Additives and residues
Establish and monitor the enforcement of safety limits for food additives, pesticides, and their residues and other chemical contaminants in the food supply
When levels of additives, contaminants, and other residues are properly regulated, their presence in foods and drinks is not known to be harmful. However, unregulated or improper use can be a health hazard and this applies particularly in economically developing countries
Preparation
When meat and fish are eaten, encourage low-temperature cooking
Do not eat charred food. For meat and fish eaters, avoid burning of meat juices. Consume the following only occasionally: meat and fish grilled (broiled) in direct flame; cured and smoked meats
Dietary supplements
Community dietary pattern to be constituent with reduction of cancer risk without the use of dietary supplements
For those who follow the recommendations presented here, dietary supplements are probably unnecessary and possibly not helpful for reducing cancer risk
Tobacco
Discourage production, promotion, and use of tobacco in any form
Do not smoke or chew tobacco

[1] Reproduced with permission from the AICR (6).

The WCRF/AICR report recommends an active lifestyle. The Guatemalan physical activity questionnaire comprised an extensive 5-page section intended to include all activities undertaken during a usual week and weekend. The activities evaluated included: sleeping, mealtimes, activities at work, commuting, household activities, exercise, and leisure time activities such as religious activities, watching television, and reading. A physical activity analysis program was developed using SPSS version 12.0. Food preparation methods relevant to cancer prevention were also examined. A composite question on the usual consumption of baked poultry, fish, and red meat was included. Participants who reported consuming grilled poultry, fish, or red meat more often than once per month were considered nonconcordant. Lastly, habitual use of supplements was queried and the reason for using supplements was queried using a multiple choice question, which included options such as "for general health purposes," "to prevent heart disease," and "to prevent cancer." Participants who consumed supplements with the purpose of preventing the onset of cancer were considered nonconcordant.

TABLE 2 The operative evaluative criteria used to assess selected individual-level guidelines within the surveyed samples in 4 nations

WCRF/AICR recommendation component	Evaluation variable for individual concordance	Cutoff criteria
	Dietary components	
Choose predominantly plant-based diets	The ratio of estimated daily intakes of foods from plant origin:foods from plant and animal origin (in g)	>0.5
Consume ≥5 portions (servings) of vegetables and fruits per day	Daily vegetables (excluding potatoes and beans) and fruit intake (including a maximum of 1 portion of juice)	≥5 portions/d[1]
Consume >7 portions of starchy or protein-rich food per day	Daily consumption of starchy or protein-rich foods	>7 portions/d[2]
Eat a variety of vegetables and fruits	Percentage of types of vegetables (excluding potatoes and beans) and fruits (excluding fruit juices) consumed at least weekly	>20%[3]
Eat a variety of starchy or protein-rich food	The percentage of starchy or protein-rich food items consumed at least weekly	>37%[3]
Limit consumption of refined sugar	Daily consumption of mono- and disaccharides (excluding fruit and including juices) as % total energy	<10 energy %[4]
Limit alcohol drinks to <2 drinks per day for men and 1 for women	Daily consumption of alcoholic drinks	<1 drink for women <2 drinks for men[5]
Limit intake of red meat to <80 g/d (3 ounces)	Daily red meat intake (beef, lamb, pork and products from these meats)	<80 g
Limit consumption of fatty foods, particularly those of animal origin	Daily consumption of fat as % total energy	15–30 energy %[4]
	Lifestyle components	
Avoid being underweight or overweight	Measured or self-reported BMI	BMI 18.5–25.0 kg/m^2[4]
Limit weight gain during adulthood to <5 kg (11 pounds)	Weight gain since age 21 y (participants aged ≥28 y old)	gained <5 kg
Populations to maintain an active lifestyle equivalent to a physical activity level of at least 1.75	Total activity score based on activities at work, commuting activities, household activities and leisure time activities	10,000 MET-h/d[3]
Do not eat charred food	Consumption of grilled poultry, fish, or red meat	Consumption of grilled poultry, fish, or red meat less often than once per month[3]
For those who follow the recommendations presented here, dietary supplements are probably unnecessary and possibly not helpful for reducing cancer risk	Consumed supplements with the purpose of preventing the onset of cancer	Nonconsumers

[1] 1 portion = 80 g for vegetables and fruits.
[2] 1 portion = 80 g for starchy or protein-rich foods.
[3] Criteria derived by the current investigators.
[4] Based on WCRF/AICR population goals (6) rather than individual guideline.
[5] 1 drink = 250 mL of beer, 100 mL of wine, 25 mL of spirits or equivalent.

Based on individual concordance with the selected 14 WCRF/AICR components described above, participants were selected to make a set of 14 rotating day-menus for a cancer prevention healthy eating guide. The process consisted of determining the number of participants concordant with all 14 components examined, then 13 of 14, 12 of 14, and so on. The aim was to select at least 14 participants with the highest concordance for each SES group. This process was completed separately for each SES.

Selection of participants for the development of menus: the tertiary screening

Once we selected the participants with the highest concordance with the 1997 WCRF/AICR individual guidelines, a further selection of participants was necessary to reduce the number to 14 participants. This selection was made based on the weakest behavior of this population, namely refined sugar intake and total estimated energy intake.

Developing healthy eating consumption guides

The diet of the 14 selected participants was examined carefully. This included estimated daily intakes of energy, macronutrients, and selected micronutrients and the examination of food items consumed most frequently. This was done using estimated daily intakes of each item listed in the FFQ in g/d. Menus were developed using recipes that included the most frequently consumed food items. Each participant was used to develop a single day-menu that included breakfast, lunch, dinner, and combined snacks. The nutrient value of the menus was adapted to compensate for high intakes of refined sugar and total energy intake.

The total energy and nutrient contribution of the developed menus was estimated. The FAO/WHO estimated average requirements (EAR) (21) were used as the standard to evaluate the nutrient value of the 11 selected micronutrients, namely: vitamins A and C, thiamine, riboflavin, niacin, vitamin B-6, folate, vitamin B-12, calcium, iron and zinc.

Statistical analysis

Data were analyzed using SPSS version 12.0. Means and SD were computed for descriptive purposes for each population sample. Chi-square test was used to analyze differences in the percentage of individuals whose habitual intake met or exceeded the gender-specific RNI for each of the 11 micronutrients examined. We used post hoc analysis for proportions, using standard residual values within −1.96 and 1.96, to determine which differences were significant. $P < 0.05$ was considered significant.

Results

Nutrient intakes. The initial screening eliminated current smokers and individuals with estimated intakes below RNI levels for at least 9 of the 11 index nutrients. The proportion of participants with intakes above the RNI was greater for the higher SES than for the lower SES samples for the majority of nutrients examined (**Table 3**). Vitamin C intakes above the RNI were virtually uniformly achieved, without differences across groups. A similar situation of high concordance across the groups, above 90%, was observed for thiamine, riboflavin, and niacin. Overall, the proportion of participants with intakes above RNI values was >90% for the urban elite for vitamins A and B-6 and iron and zinc. For calcium and folate, the proportion was <90% for all 3 social strata.

The primary screening. Based on reported smoking habits and estimated intakes of selected micronutrients, 447 individuals, or 51% of the whole sample eligible to advance to the next selection steps, were disqualified from analysis (**Fig. 1**). The majority (35%) did not meet the nutrient intake criteria and 18% were smokers. There was an overlap in 4% of participants who failed on both screening categories. Whereas current smoking was the major factor for elimination of upper-class candidates, failure to meet nutrient recommended intakes was a factor in 45% of the rural and urban low-income participants (Fig. 1).

The secondary screening. In selection for concordance with 14 selected WCRF/AICR recommendation components, 136 of the 137 (99.3%) rural residents were concordant with at least one-half of the 14 items (**Table 4**). This was similarly true for 130 of the 133 (97.7%) participants in the lower urban SES group, but only 147 of 177 (83.0%) passed the initial screening in the upper-class group. At the level of 11 components satisfied, there were only 15 members of the urban elite and only 2 of these were adherent to 12 components. In the 2 lower-income subsamples, however, over one-third of the candidates were concordant with 11 of 14 components. Only 23 and 21 of the rural and urban marginal participants, respectively, were adherent to 12 component criteria. These individuals constituted the finalists. One lone participant from the urban lower-class group fulfilled 13 component recommendations, but no participant was concordant for all 14.

It is pertinent to examine the pattern among components to which the leaders among the participants adhered (**Table 5**). For 7 of the components (plant-dominant diet, vegetables and fruits intake and variety, alcohol and red meat limitation, and supplement use), all 59 finalists were concordant. Over 90% met the criteria for appropriate weight and avoiding charred food. Our finalists were generally uniformly poor at maintaining a stable weight during adulthood and limiting refined sugar. This latter social class, however, was poorer than the lower-income groups at maintaining an active lifestyle, consuming enough starchy and protein-rich plants, and limiting consumption of fats. The identical respective patterns were also observed when the analogous analysis was repeated with only the 42 individuals, 14 for each social group, who represented the consumption upon which the menus were finally modeled (data not shown).

Nutrient value of the healthy eating consumption guides. Our overall process generated a prescriptive array of day-menus, 42 in all, with 14 rotating menu fares created for each social group (**Supplemental Tables 1–3**). The expected cultural differential between the urban elite's fare and that of the 2 lower-income groups were reflected in the selection of food and beverage items.

The originally calculated cumulative intakes of energy and micronutrients, derived from the FFQ, reflected the not-uncommon distortion of overreporting of actual intake in FFQ (22) (**Table 6**). When comparing the energy medians as reported with the medians tabulated from the array of menus constructed, they were lower by 13–36%. Reflected in the decrease of curtailing sugar intake were the lower carbohydrates, reflecting median reductions of 315, 134, and 53 g, across the respective social groups. Fat and protein rations for daily intake in the prescriptive menus also declined with the corrections of residual nonconcordance that contributed to the formulation of the actual menu recommendations. The median micronutrient contributions of the menus were above the EAR devised for the United Nations system recommendations (21) for 9 of the 11 micronutrients

TABLE 3 Percentage of individuals whose habitual intake, by FFQ estimate, met or exceeded the gender-specific daily RNI for each of 11 selected micronutrients examined

	RNI[2]					
Nutrient	Males	Females	Rural	Lower urban	Higher urban	*P*-value[1]
				%		
n			301	298	274	
Vitamin A, *μg RE/d*	600	500	71[a]	70[a]	94[b]	<0.001
Vitamin C, *mg/d*	45	45	100	99	99	0.542
Thiamine, *mg/d*	1.2	1.1	98[a]	95[b]	94[b]	0.016
Riboflavin, *mg/d*	1.3	1.1	92[a]	92[a]	98[b]	0.003
Niacin, *mg/d*	16	14	96[a]	92[b]	95[a]	0.032
Vitamin B-6, *mg/d*	1.3	1.3	88[a]	88[a]	93[b]	0.036
Folate, *μg/d*	400	400	60[a]	58[a]	76[b]	<0.001
Vitamin B-12, *μg/d*	2.4	2.4	67[a]	78[b]	92[c]	<0.001
Calcium, *mg/d*	1000	1000	83	75	77	0.038
Iron, *mg/d*	27.4[3]/9.1[4]	58.8[3]/19.6[4]	54[a]	46[a]	93[b]	<0.001
Zinc, *mg/d*	14.0[3]/4.2[4]	9.8[3]/3.0[4]	22[a]	30[a]	100[b]	<0.001

[1] *P*-value using 1-way ANOVA. Values in a row without a common superscript letter were statistically different based on post hoc analysis using standard residual values within −1.96 and 1.96.
[2] FAO/WHO RNI values for adults aged 19–50 y (19).
[3] An iron bioavailability of 5% and low zinc bioavailability were assumed for the lower SES.
[4] An iron bioavailability of 15% and high zinc bioavailability were assumed for the higher SES.

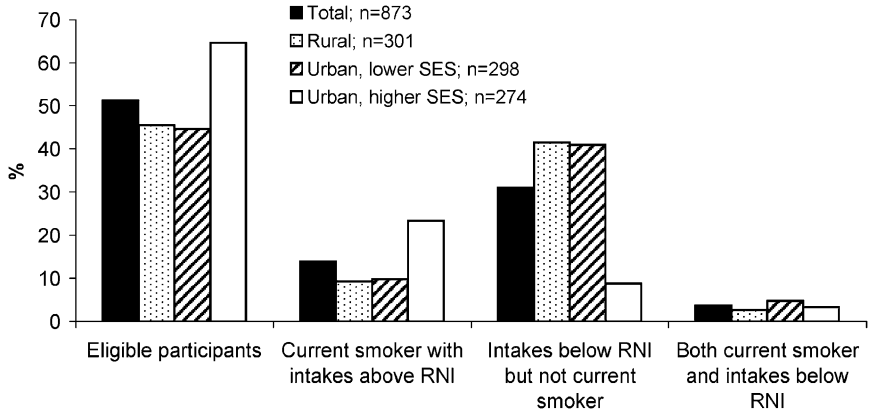

FIGURE 1 Proportion of participants selected or eliminated in the primary screening of participants based on smoking habits and estimated intakes of selected micronutrients. Self-reported current smoking habits were used. The FAO/WHO RNI values (19) were used as the standard when evaluating nutrient intakes of 11 selected micronutrients, including vitamins A, C, B-6, and B-12, thiamine, riboflavin, niacin, folate, calcium, iron, and zinc. Gender-specific values for adults aged 19–50 y were used for the entire sample. An iron bioavailability of 5% and a low zinc bioavailability were assumed for the lower SES, whereas an iron bioavailability of 15% and a high zinc bioavailability were assumed for the higher SES. Participants with intakes above the RNI for 9 of 11 selected nutrients were considered to consume a diet generally complying with recommendations.

examined. The exceptions were iron for lower SES females, with elevated requirements due to menstrual losses, and zinc for lower SES males. For both groups, the high-fiber, high-phytate intake from maize tortillas led us to assume low bioavailability for these trace elements (19). The high intakes of vitamin A can be explained in part by the mandatory fortification of table sugar with preformed vitamin A at 10 mg/kg (**Table 7**).

Discussion

There may be a breech between the scientific-technical principles for reducing chronic disease risk and putting them into effective practice in the behavior of at-risk individuals. Health education programs are the presumed connection between science and popular behavior. Many approaches to helping the public to comply with optimal dietary practices for health have been advanced. Within the template of the United States Dietary Guidelines for 2005–2010 (23), the interactive My Pyramid Web site (24) offers detailed portion size and dietary selection guidance to realize the recommended pattern within one's own eating practices.

The present process of creating prescriptive menus for cancer prevention faced admitted limitations on many levels. First, the findings must be interpreted in the context of a host of acknowledged caveats and limitations related to design features of the WCRF/AICR recommendations themselves. We identified considerable vagueness, ambiguity, and lack of clarity in the expression of the individual guidelines, making operative criteria in the survey instruments challenging to construct (20). Since the submission of this article for publication, the WCRF/AICR published a new set of 8 recommendations (25). Although the 2007 recommendations differ, the general considerations still

TABLE 4 Subjects in concordance with selected WCRF/AICR recommendation components by SES

Concordant with at least x recommendation components	SES		
	Rural	Lower urban	Higher urban
		n	
	137	133	177
14	0	0	0
13	0	1	0
12	23[1]	21[1]	2
11	74	54	15[1]
10	105	90	36
9	123	106	71
8	133	120	112
7	136	130	147

[1] The level of concordant recommendations needed to accumulate a PD model participants if a set of 14 rotating menus for the entire nation were the goal of the education effort.

TABLE 5 Concordance with selected WCRF/AICR recommendation components by SES[1]

	Concordance based on selection by SES		
	Rural	Lower urban	Higher urban
		%	
n	23[2]	21[2]	15[3]
Dietary components			
Plant-based diets	100	100	100
Vegetable and fruit intake	100	100	100
Starchy or protein-rich food intake	100	100	87
Vegetable and fruit variety	100	100	100
Starchy or protein-rich food variety	100	100	100
Refined sugar intake	0[4]	0[4]	7[4]
Alcohol drink intake	100	100	100
Red meat intake	100	100	100
Limit consumption of fatty foods	100	100	80
Lifestyle components			
Avoid being under or overweight	100	100	93
Weight gain during adulthood	0[4]	5[4]	20[4]
Maintain an active lifestyle	100	100	33[4]
Do not eat charred food	100	100	93
Dietary supplements are probably unnecessary	100	100	100

[1] Values are proportion of participants in concordance.
[2] Participants concordant with 12 of 14 selected WCRF/AICR recommendation components.
[3] Participants concordant with 11 of 14 selected WCRF/AICR recommendation components.
[4] Low concordance (defined as <60%).

TABLE 6 Energy and macronutrient estimated daily intakes of the 14 participants selected for the development of menus by SES[1]

	Rural SES			Lower urban SES			Higher urban SES		
Estimated energy intake, *kJ/d*									
FFQ[2]	19460 ± 3253	20457	(16714–21612)	15968 ± 4915	15068	(11832–19485)	14130 ± 3513	14867	(11183–15914)
Menu[3]	12627 ± 611	12740	(12577–13034)	12083 ± 925	12489	(11162–12812)	12707 ± 197	12686	(12577–12791)
Difference[4]	6833 ± 2889	7373	(4727–8843)	3890 ± 4840	3199	(285–7427)	1424 ± 3546	1905	(−1382–3215)
Estimated protein intake, *g/d*									
FFQ[2]	126 ± 25	131	(104–146)	112 ± 30	113	(85–133)	117 ± 34	116	(84–145)
Menu[3]	92 ± 13	92	(83–100)	95 ± 17	90	(87–98)	108 ± 16	105	(100–120)
Difference[4]	34 ± 19	37	(14–49)	17 ± 38	25	(−20–48)	9 ± 43	13	(−26–44)
Estimated carbohydrate intake, *g/d*									
FFQ[2]	778 ± 120	800	(647–867)	621 ± 198	569	(467–742)	508 ± 128	532	(396–606)
Menu[3]	474 ± 21	479	(464–488)	441 ± 43	432	(411–487)	462 ± 28	459	(450–470)
Difference[4]	304 ± 114	315	(195–388)	180 ± 193	134	(19–340)	46 ± 121	63	(−52–122)
Estimated fat intake, *g/d*									
FFQ[2]	126 ± 30	135	(105–146)	107 ± 31	101	(76–132)	103 ± 32	103	(74–123)
Menu[3]	82 ± 8	84	(77–88)	80 ± 10	78	(74–87)	87 ± 10	88	(85–91)
Difference[4]	44 ± 27	49	(31–65)	27 ± 31	25	(1–52)	16 ± 34	17	(−17–39)

[1] Values are means ± SD, medians, and 25th–75th percentile.
[2] Daily intake based on the FFQ used in the Concordance Project
[3] Daily intake based on menu developed for a single day intake.
[4] Difference computed as FFQ – menu.

apply (as indeed they do for similar recommendations for prevention of other chronic diseases).

Second, some limitations arise at the level of the Concordance Project survey and data analyses at the Guatemalan site. First, the use of convenience samples limited any pretext to national representation. Second, because our population samples were stratified in a strict equal tripartite fashion, the representation of the whole nation was distorted. Another limitation was the use of the FFQ. It has been widely documented that the FFQ approach generally tends to overestimate true energy intakes of individuals and our interview instrument in the Guatemalan sample of the Concordance Project appears to have resulted in a certain degree of overestimation (22,26,27). This overestimation could explain the high adequacy of micronutrient intakes and could have led to the failure to exclude participants with true nutrient intakes below the RNI. We recognize that pooling intake behavior from both sexes and tendencies to overreport energy intakes with FFQ approaches pose challenges for recommending a menu suitable for both sexes and maintaining appropriate micronutrient consumption in practice. Lastly, there are limitations in the FCT.

Another level of obstacles was encountered in creating the menus. The resultant dietary prescription menus derived from the exercise here are not totally congruent with the individual recommendations of the WCRF/AICR report (6). Rather, they are congruent to the extent that the original survey instrument was able to assess diet-related components of the report. For instance, the recommendation regarding salt (Table 1) could not be made into a questionnaire variable for the Concordance Project (7). Data have shown, at least, that adults living in a rural Guatemalan township consumed relatively low amounts of sodium. Urban cuisine, however, may use sodium more generously and include cured, salted meats and other presalted

TABLE 7 Estimated nutrient value, as percentage of EAR, of the class-appropriate healthy eating menu guides for each of 11 selected micronutrients examined[1]

	Males							Females			
	Estimated nutrient value				Estimated nutrient value as % of EAR				Estimated nutrient value as % of EAR		
Nutrient	Rural SES	Lower urban SES	Higher urban SES	EAR[2]	Rural SES	Lower urban SES	Higher urban SES	EAR[2]	Rural SES	Lower urban SES	Higher urban SES
Vitamin A, *μg RE/d*	2258	2281	3786	429	526	532	883	357	633	639	1061
Vitamin C, *mg/d*	459	693	509	37	1241	1873	1377	37	1241	1873	1377
Thiamin, *mg/d*	2.3	2.5	2.5	1.0	231	249	245	0.9	256	277	272
Riboflavin, *mg/d*	2.5	3.0	3.0	1.1	224	276	272	0.9	274	337	333
Niacin, *mg/d*	25.4	27.0	24.5	12	212	225	204	11	231	246	223
Vitamin B-6, *mg/d*	2.9	3.1	3.0	1.1	262	279	273	1.1	262	279	273
Vitamin B-12, *μg/d*	3.8	3.5	4.2	2.0	189	174	212	2.0	189	174	212
Folate, *μg/d*	620	622	616	320	194	194	192	320	194	194	192
Calcium, *mg/d*	1542	1799	2005	833	185	216	241	833	185	216	241
Iron, *mg/d*	28.9	29.7	29.3	21.6[3]/7.2[4]	134	137	406	58.8[3]/19.6[4]	49	50	149
Zinc, *mg/d*	8.2	9.5	10.0	11.7[3]/3.5[4]	70	81	286	8.2[3]/2.5[4]	100	116	400

[1] Values are medians based on the 14 composite daily menus derived for each SES class, EAR, and estimated nutrient value of the menus as percentage of EAR.
[2] FAO/WHO EAR values for adults aged 19–50 y (21).
[3] An iron bioavailability of 5% and low zinc bioavailability were assumed for the lower SES.
[4] An iron bioavailability of 15% and high zinc bioavailability were assumed for the higher SES.

processed foods. In deriving the menu guides, we took an neutral stance on the original model individual's consumption of salt. Even more troublesome in the construction of our menus was daily sugar intake. In selecting candidates for model diets, the most widely nonconcordant criterion in Guatemala was that of daily sugar consumption within the limits. Guatemala is not alone in its excessive sugar intake. Each of the 4 national samples (the Netherlands, Scotland, Mexico, and Guatemala) in the Concordance Study had a mean sugar intake that exceeded 10% energy contribution for the whole sample (16).

The final major obstacle in menu creation was the high estimated daily energy intakes based on data collected by FFQ. The energy content of the day-menus created was substantially lowered. For the successfully concordant individuals whose dietary habits were the basis of the menus, the median difference in energy content between the FFQ estimates and the day-menus was 7373, 3199, and 1905 kJ for the rural, urban low-income, and urban middle-class groups, respectively. The energy content of the menu created corresponds roughly to the Food and Nutrition Board (28) estimated requirement for adults with a physical activity status of "very active." This might be appropriate for our agrarian sample and some in the urban low-income class, but it would probably lead to overconsumption in the urban populations. The participants from the lower SES selected as the candidate models were universally concordant with the body weight and energy expenditure criteria of the WCRF/AICR (6).

The development of day-menus as personal guides for consumption compatible with adequate nutrient intake and reduced cancer risk is a first step toward behavioral change. Finally, it would be useful to validate and explore the findings at the individual level by more in-depth investigation of specific cases, to check social bias in reporting, or the presence of non-transferable factors (such as dietary choices made in response to symptoms of ill health) and to examine the behavioral factors that lead to the reported lifestyle practices.

Making individuals aware of the positive and negative consequences for cancer risk within the selection of one's habitual consumption is an initial step toward prevention (6). Given our premise that compliance with recommended eating practices for prevention will be challenging for individuals, the PD method provides a practical approach toward culturally specific and realistic dietary recommendations.

A potentially useful personal guide for eating compatible with adequate nutrient intake and reduced cancer risk, appropriate to the culture, and economic means of distinct social classes in Guatemala is approaching the stage for application.

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