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Fruits and vegetables consumption among Costa Rican adolescents

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SUMMARY. Scientific evidence indicates that lower levels of fruit and vegetables consumption are associated with an increased risk of developing cancer and cardiovascular disease. Therefore, an increase of these foods' consumption may substantially improve public health. The purpose of this study was to examine the consumption of fruits and vegetables in 214 urban and rural adolescents in relation to the 5-A-DAY recommendation. Mean daily servings of fruits (1.7 servings) were not far from the minimum recommendation of 2 daily fruit servings. This mean decreased to 1.21 servings when banana was not counted. Mean vegetable intake (1.1 servings, including legumes) was well below the minimum recommendation of 3 vegetable servings per day. Urban adolescents and females consumed significantly (p= 0.000) fewer fruits and vegetables servings than did rural youngsters and males. However when pulses were not counted the mean daily servings of vegetables were higher in urban adolescents (p=0.029). Only 16 from 214 adolescents (6%) consumed five or more servings of fruits and vegetables per day. This proportion decreased dramatically to 2% (p= 0.000) when pulses and banana were not counted. Examination of the factors associated with low intake of fruit and vegetables could be beneficial to develop effective interventions targeted to increase their consumption among adolescents.
Key words: 5-A-DAY, fruit, vegetables, adolescents, Costa Rica.

RESUMEN. Consumo de frutas y vegetales en adolescentes costarricenses. La evidencia científica indica que los niveles más bajos del consumo de frutas y vegetales están asociados con un mayor riesgo de desarrollar cáncer y enfermedad cardiovascular. Por lo tanto, un incremento en el consumo de tales alimentos puede mejorar sustancialmente la salud pública. El objetivo de este estudio fue evaluar el consumo de frutas y vegetales en 214 adolescentes urbanos y rurales costarricenses en comparación con la recomendación de 5-Al-Día. Los resultados indican que el consumo promedio diario de frutas (1.7 porciones) no estuvo tan distante de la recomendación mínima de 2 porciones por día. No obstante el consumo promedio de vegetales (1.1 porción, incluyendo leguminosas) estuvo muy por debajo de la recomendación mínima de 3 porciones diarias. Los adolescentes urbanos y las mujeres consumieron una cantidad significativamente menor (p=0.000) de frutas y vegetales que los jóvenes rurales y los hombres. Sin embargo, cuando las leguminosas no fueron contabilizadas el consumo promedio de vegetales fue mayor en los jóvenes urbanos (p=0.029). Solamente 16 de 214 adolescentes (6%) consumieron cinco o más porciones de frutas y vegetales por día. Esta proporción disminuyó dramáticamente a 2% (p=0.000) cuando las leguminosas y el banano no fueron contabilizados. El análisis de los factores asociados con el bajo consumo de estos alimentos podría ser de gran utilidad para desarrollar intervenciones efectivas orientadas a incrementar su consumo entre los adolescentes.
Palabras clave: 5-Al-DIA, frutas, vegetales, adolescentes, Costa Rica.

INTRODUCTION

On the basis of numerous and consistent epidemiological data, some health organizations have indicated that a daily minimum consumption of 5 to 9 servings of fruits and vegetables, especially citric fruit and green leafy vegetables, reduce cancer and cardiovascular disease risk (1-3). The 5-A-DAY recommendation is not specific for adolescents, but has been considered adequate for them, in order to encourage this type of dietary pattern (4).

The habit of eating a large number of vegetables and fruits in early life has been identified as a significant positive predictor of fruit and vegetable consumption among adults (5). Furthermore, adolescents' eating patterns are important determinants of adult risk of chronic diseases (6).

A large body of scientific evidence indicates that lower levels of fruit and vegetables consumption are associated with an increased risk of developing at least 15 different types of cancer (1-3). Time-tread studies in Japan, Poland, and the USA have shown decreasing mortality for stomach cancer with increasing consumption of vegetables or fruit (5).

A myriad of substances in vegetables and fruits have been shown or postulated to have anticarcinogenic properties. These include dithiolthiones, isothiocyanates, indole-3-carbinol, allium compounds, isoflavones, protease inhibitors, saponins, phytosterols, inositol hexaphosphate, vitamin C, D-limonene, lutein, folic acid, beta and aplha carotene, lycopene, selenium, vitamin E, flavonoides, and dietary fiber. Many are potent inducers of detoxification enzymes, inhibitors of cell proliferation or antioxidants agents (7,8).

Additionally in several articles, nutrients in fruit and vegetables such as dietary fiber, potasium, folate, antioxidants and polyphenolic flavonoids have been associated with reduced risk of cardiovascular disease (9). Particularly cruciferous and green leafy vegetables and citrus fruit and juice have been associated with a protective effect against risk of ischemic stroke (10).

Primary prevention programs are required to encourage the fruit and vegetables consumption from an early age. This appears to be quite important in developing countries, such as Costa Rica, which has a delayed epidemiological model where chronic and infectious diseases coexist (11). Ischemic disease and stomach cancer are the leading causes of death among Costa Rican adults (12).

The purpose of this study was to examine adolescents' intake of fruits and vegetables in relation to the 5-A-DAY recommendation.

METHODS

The sample was selected from the Costa Rican' Greater Metropolitan Area and its burdening rural areas, which has the greatest concentration of adolescent population enrolled in high school.

A sample of 300 Costa Rican adolescents, ages 13-17, 48% from urban areas and 52% from rural, was selected from 10 public high schools (6 high schools in each area). The high schools were selected with probability proportional to size from a list of all public high schools in the study area. In each high school, 30 students, 50% of each gender, were selected randomly. Written parental and adolescent consent was required to participate in the study.

Prospective 3-d diet records were used for dietary data collection. The three days included one weekend day and the previous or next two days (Sunday, Monday and Tuesday or Thursday, Friday and Saturday). Each adolescent recorded the food eaten at home, school or any other site, including the kind of food eaten, ingredients of each preparation, cooking technique, brand names and any other necessary specifications.

Groups consisting of 5-6 adolescents were established to introduce them on the adequate procedure for the food record. Series of three to six photographs of food usually eaten in Costa Rica were used for each adolescent to estimate portion size while keeping the food record. Food records were verified by trained nutritionists who checked them in detail with each youngster. Foods and three-dimensional food models were used to verify the size of some portions reported by the adolescents. Six trained nutritionists conducted all dietary assessments.

Gram weights for each food were converted to number of fruits or vegetables servings based on the methods of Krebs-Smith et al (13) and Cleveland et al (14). Around seventy-five percent of foods reported by adolescents were mixtures requiring desegregation before their ingredients could be categorized into the fruits or vegetables group. Fruit and vegetables not consumed as mixtures were assigned directly to their corresponding group.

Inclusion/exclusion criteria and serving size guidelines specified by National Cancer Institute (15) were used to calculate the number of servings of fruits and vegetables for each record. Avocados, coconut, olives, nuts, seeds, chips and root vegetables like potatoes were excluded. Only 100% non-sweetened fruit juices were included. Food-or ingredient specific weights consistent with NCI definitions for servings were derived from data reported for Costa Rica by Chaverri and Rodríguez (16). A serving was defined as follows: One medium piece of fruit (such as orange or guava), ¾ cup of juice, ¼ cup of dried fruit, 1 cup of leafy vegetables and ½ cup of cooked or sliced fruits or vegetables. Fruits were categorized as (1) citrus, melon and berries, or (2) others (such as papaya, apple, guava, banana, pineapple or mango). Vegetables were categorized as (1) green/yellow vegetables, (2) others (such as tomato, lettuce, cucumber, cilantro, celery, radish, onions, cabbage, peppers or beets), or (3) pulses (legumes).

Variance analysis was used to test differences in mean of servings consumed daily between groups and Chi-square to test differences in the proportion of adolescents consuming various numbers of servings of fruit or vegetables per day.

RESULTS

Of the 300 eligible adolescents, 91% consented to participate in the dietary survey. The sample consisted of 144 males and 130 females; 48% were urban adolescents and 52% rural. All adolescents were from the same ethnic background (mestizo). Mean age was 15 $\pm$ 1.3 years old.

Mean daily servings of fruits (1.7 servings) were not far from the minimum recommendation of 2 fruit servings daily (Table 1). However, the proportion of servings of citrus fruit, melons and berries (22% of total) were well below the suggested proportion, which is about one-half of total fruit servings. Banana was by far the most popular fruit consumed; accounting for 29% of total fruit servings. Fruit juice, mainly orange juice, contributed 14% of total fruit servings. Other fruits frequently consumed were orange, pineapple, papaya and hog plum.

TABLE 1
Mean number of servings of fruits and vegetables consumed daily by urban and rural adolescents

Foods	Recommendation	Average	Urban (n=131)	Rural (n=143)	p value *	Males (n=144)	Females (n=130)	p value *
FRUITS								
Citrus, melon and berries	≥ 1	0.35 ± 0.05	0.37 ± 0.19	0.34 ± 0.12	0.116	0.41 ± 0.18	0.29 ± 0.13	0.000
Other fruits	≥ 1	1.38 ± 0.52	1.29 ± 0.54	1.45 ± 0.62	0.024	1.56 ± 0.69	1.21 ± 0.54	0.000
Banana[1]		0.52 ± 0.04	0.50 ± 0.27	0.53 ± 0.23	0.322	0.56 ± 0.24	0.48 ± 0.26	0.009
Total fruits (TF)	≥ 2	1.73 ± 0.36	1.66 ± 0.30	1.79 ± 0.41	0.003	1.97 ± 0.42	1.51 ± 0.51	0.000
TF excluding banana	≥ 2	1.21 ± 0.16	1.16 ± 0.38	1.26 ± 0.46	0.032	1.41 ± 0.38	1.02 ± 0.56	0.000
VEGETABLES								
Green/yellow vegetables	≥ 1	0.21 ± 0.02	0.23 ± 0.17	0.19 ± 0.12	0.024	0.22 ± 0.15	0.21 ± 0.13	0.558
Pulses [2]		0.72 ± 0.12	0.61 ± 0.22	0.82 ± 0.16	0.000	0.83 ± 0.13	0.62 ± 0.17	0.000
Other vegetables [3]	≥ 2	0.21 ± 0.01	0.20 ± 0.13	0.21 ± 0.15	0.558	0.21 ± 0.17	0.22 ± 0.19	0.649
Total vegetables (TV)	≥ 3	1.14 ± 0.21	1.05 ± 0.22	1.22 ± 0.19	0.000	1.26 ± 0.14	1.06 ± 0.22	0.000
TV excluding pulses	≥ 3	0.42 ± 0.08	0.44 ± 0.11	0.40 ± 0.18	0.029	0.43 ± 0.19	0.42 ± 0.11	0.599

[1] Bananas are generally included in the other fruits group. [2] Pulses are generally included in the other vegetables group. [3] Other vegetables include tomato, lettuce, cucumber, cilantro, celery, radish, onions, cabbage, peppers and beets. * Tested with analysis of variance.

Mean vegetable intake (1.1 servings) was well below the minimum recommendation of 3 vegetables servings daily. Mean servings of dark-green and deep-yellow vegetables (18% of total) were not consistent with the suggested proportion of one-third of total vegetable servings. Pulses (legumes) were the largest source of vegetable servings, accounting for 63% of total vegetable intake. Cabbage, tomato, cucumber, lettuce and carrots were the most popular vegetables consumed.

Recently the World Cancer Research Fund (WCRF)/ American Institute for Cancer Research (AICR) panel (3), concluded that although there are theoretical reasons to believe that diets high in pulses and plantains such as banana might protect against some cancers, evidence is currently very limited. Therefore these foods should not be included in the 5-A-DAY recommendation (3). According with this, the mean daily vegetable serving in urban and rural adolescents did not even average one half of a single serving and the mean servings of fruits averaged was scarcely 1.2 per day.

Urban adolescents and females consumed significantly ($p= 0.000$) fewer fruits and vegetables servings than did rural youngsters and males. However when pulses were not counted the mean daily servings of vegetables were higher in urban adolescents ($p=0.029$). Only 16 in 214 adolescents (6%) consumed five or more servings of fruits and vegetables per day (Table 2). This proportion decreased dramatically to 2% ($p= 0.000$) when pulses and banana were not counted.

Fully 50% of adolescents consumed less than a serving of fruit per day. This percentage increased around 6% ($p=0.012$) when banana was not counted. Around 20% of adolescents consumed daily less than a single serving of vegetables. This proportion increased about 13% ($p=0.013$) in urban areas and over 30% ($p=0.000$) in rural areas when pulses were not counted. Only 18% of adolescents consumed at least three daily servings of vegetables, however this proportion decreased almost two thirds ($p=0.000$) when pulses were excluded.

Urban adolescents were more ($p< 0.05$) likely to have had less than a single serving of fruits and vegetables than rural adolescents, although this pattern disappeared when banana and pulses were not counted. However rural adolescents were much more ($p=0.032$) likely than urban to have had two or more servings of fruits even though banana was not counted. There were no significant trends associated with gender in the number of servings of fruits or vegetables reported as consumed.

DISCUSSION

The specific foods counted as fruits and vegetables and the serving sizes used in those calculations may affect adolescent's estimates of fruit and vegetables intake (11). Therefore, it is difficult to compare the intake of these foods between adolescents from different areas. Even though, it is possible to deduce that the fruit intake between Costa Rican youngsters is similar to the one reported for US and the vegetable intake is significantly lower (17). Vegetables consumption by US adolescents, excluding starchy vegetables, is of 1.3 portions/d; about 1 portion/d more than the one reported by Costa Rican youngsters.

TABLE 2
Percentage of urban and rural adolescents consuming various numbers of servings of fruits and/or vegetables per day

Servings	Including pulses and bananas						Excluding pulses and bananas					
	Urban (n=131)	Rural (n=143)	p value*	Males (n=144)	Females (n=130)	p value*	Urban (n=131)	Rural (n=143)	p value*	Males (n=144)	Females (n=130)	p value*
FRUITS												
< 1	59.5	46.2	0.037	55.5	49.2	0.357	64.9	53.9	0.084	59.0	59.2	0.929
1-< 2	20.7	27.3	0.257	22.2	26.1	0.540	20.6	20.9	0.930	20.8	20.8	0.882
≥ 2	19.8	26.5	0.243	22.3	24.6	0.759	14.1	25.2	0.032	20.2	20.0	0.913
VEGETABLES												
< 1	29.8	11.2	0.000	22.3	17.7	0.425	42.7	46.1	0.657	46.5	42.3	0.564
1-< 3	51.9	70.6	0.002	58.3	65.4	0.279	49.6	47.5	0.821	45.8	51.5	0.411
≥ 3	19.3	18.3	0.892	19.4	16.9	0.705	7.7	6.4	0.854	7.7	6.2	0.803
AT LEAST:												
2 fruits servings and 3 vegetables servings	7	5	0.658	5	6	0.922	3	1	0.449	2	2	0.666

*Tested with x^2 test

The results of this study, reflect the general eating patterns found in Costa Rica. Using the Apparent Food Consumption data from 7402 Costa Rican households, Meza and Rodríguez (18) found that most of their sample consumed less than 150 grams of fruit and vegetables daily. This quantity was well below the minimum 400 g/d recommended by the World Cancer Research Fund (WCRF)/American Institute for Cancer Research (AICR) panel (3).

The proportion of Costa Rican adolescents consuming less than a single serving of fruit and vegetables is worrisome. Low intake of fruit and vegetables are consistent associated with a higher risk of cancer and cardiovascular disease (9,10,19-22). This appears particularly important in Costa Rica where stomach cancer incidence is the highest in the world after that reported in Japan (3) and the mortality rate of ischemic disease is similar than the reported in Canada and the United States (23).

The effect of low fruit and vegetables consumption on the pathobiology of atherosclerotic lesion and cancer has not been studied in young subjects; however, several studies indicate that correcting the risk factors previously identified in older subjects since adolescence, is essential for stemming the disease progression in later years (6).

This study points out that it is necessary to encourage the fruits intake but especially dark green and/or deep yellow vegetables consumption among adolescents. These foods intake promotion seems to be controversial when the presence of pesticides is taken into consideration. This has been discussed for a long time, and seems to take importance now that the intake of these kinds of foods is promoted strongly. However, recently the World Cancer Research Fund (WCRF)/American Institute for Cancer Research (AICR) panel (3), concluded that there is no convincing evidence that any food contaminant, including chemical contaminants, modifies the risk of any cancer, nor is there evidence of any probable causal relationship. On the contrary, several epidemiological data, suggest that higher intake of vegetables and fruit is a protective factor against at least 15 different types of cancer (1-3).

Nutrition interventions to increase fruit and vegetables among Costa Ricans are urgently required, in order to reduce in a close future, the high mortality rates of cancer and ischemic disease. Examination of the factors associated with low intake of fruit and vegetables among adolescents can be used to develop more effective interventions to increase these foods consumption. The educational effort designed to increase adolescents' fruit and vegetables intake should be driven by data on their current knowledge, perceptions, and other psychosocial factors. Taste preferences, cost, and availability are related to fruit and vegetable intakes (24,25). In addition, most studies find positive associations of nutrition knowledge, self-efficacy, belief in a relationship between diet and health, intrinsic motives, and stage of dietary change with fruit and vegetable consumption (24,26,27).

Dietary interventions should include the adolescents' school and family environment, so that adults reinforce and improve knowledge, attitudes and practices tending to increase the consumption of fruits and vegetables. Parents and educators should be good models of healthy-dietary behaviors.

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