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Original Research

Is Consumption of Fruit Juice Associated with an Increased Risk of Overweight or Obesity in Canadian Youth?

Esta Asociado el Consumo de Jugo de Fruta con el Sobrepeso y la Obesidad en los Niños en Edad Escolar en Canadá?

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Abstract

Background: Obesity rates in Canada have tripled in the last three decades. Up to 32% of 5-17-year-olds in Canada are overweight (20%) or obese (12%). Excess weight in childhood has been linked to health issues that are major public health concern. For children, fruit juice is an important proportion of their daily fruit and vegetable servings. However, little is known about the association of fruit juice consumption and obesity.

Objective: To investigate the association of consumption of fruit juice and the risk of overweight or obesity in 12 to 17 year-olds in Canada.

Methods: Using the Canadian Community Health Survey (CCHS 2011-1012) we examined the association of fruit juice consumption and the risk of overweight or obesity in Canadian youth, while controlling sex, household income, healthy diet, and physical activity.

Results: After adjusting for relevant confounders, consumption of more than one fruit juice a day remained associated with a lower odds of overweight or obesity. Even though the 95% CI for all the daily fruit juice consumption categories examined in the adjusted model included '1', fruit juice consumption was associated with a reduction in the odds of being overweight or obese between 16% and 27%.

Conclusion: We found a moderate negative association of daily consumption of fruit juice and overweight or obesity in Canadian youth. However, before any dietary recommendation on this age group of children are established, more research is needed to clarify the role of sex and healthy diet in this association.

Resumen

Introducción: Las tasas de obesidad en Canadá se han triplicado en las últimas tres décadas. En este país, el 32 % de los niños entre 5 y 17 años de edad tienen sobrepeso (20%) u obesidad (12%). El exceso de peso durante la niñez, se ha asociado a alteraciones de salud que son un problema de salud pública. Para los niños, el jugo de frutas es una parte importante en su consumo diario de frutas y vegetales. Sin embargo, se sabe poco acerca de la asociación entre el consumo de jugo de frutas y la obesidad.

Objetivo: Investigar la asociación entre el consumo de jugo de frutas y el riesgo de sobrepeso u obesidad en adolescentes entre 12 y 17 años en Canadá.

Métodos: Se analizaron datos de la Encuesta de Salud Comunitaria Canadiense para explorar la asociación entre consumo de jugo de frutas en adolescentes canadienses, controlando por sexo, ingresos económicos, dieta saludable y actividad física.

Resultados: Después de ajustar el análisis por las variables de confusión, el consumo de jugo de frutas al día se mantuvo asociado con una disminución en el odds de sufrir sobrepeso u obesidad. A pesar de que el 95% de intervalo de confianza para todas las categorías de consumo de jugos de fruta analizadas en el modelo ajustado incluyeron el valor de '1', el consumo d e jugo de frutas estuvo asociado a una reducción en el odds de tener sobrepeso u obesidad entre un 16 y 27%.

Conclusión: Se encontró una asociación negativa moderada entre el consumo de jugo de frutas y el sobrepeso y la obesidad en estos adolescentes.

Key Study Facts

Objective	To examine whether the consumption of fruit juice is associated with an increased risk of overweight or obesity in 12 to 17-year-olds in Canada
Study design	Cross-sectional
Source of data	Canadian Community Health Survey (CCHS 2011/2012) conducted by Statistics Canada
Population/Sample	124,929 respondents completed the CCHS 2011-2012 10,445 were between 12 and 17 years or age 8,474 with complete data were included in the analysis
Statistical analysis	Multivariable logistic regression modeling Key variables: Outcome variable: BMI class. Two categories: (1) Normal BMI (neither overweight nor obese) and (2) Overweight or Obese Explanatory variable: Daily consumption of fruit juice (number of times fruit juice was consumed per day). Five categories: (1) 0, (2) > 0 to ≤ 1 /day, (3) > 1 to ≤ 2 / day, (4) > 2 to ≤ 3 / day, (5) > 3 / day Confounding variables: sex, household income, daily consumption of fruits and vegetables (excluding fruit juice), and physical activity index
Main finding	After adjusting for sex, household income, consumption of fruits and vegetables (not including fruit juice), and physical activity, consumption of more than one fruit juice a day was associated with a moderate reduction in the odds of overweight or obesity

Introduction

Obesity rates in Canada have tripled since 1985(1). Up to 32% of 5 to 17-year-olds in Canada are overweight (20%) or obese (12%) (2). This percentage has remained relatively stable since 2008, but is still higher than the 19% reported for this age group in 2007 (2). Excess weight in childhood has been linked to a number of physical and emotional health issues. Some of the associated health risks of obesity (e.g. heart disease, hypertension, stroke, type 2 diabetes, and cancer) are a major public health concern (3), particularly because obese children tend to become obese adults (4). Lack of physical activity (PA) and unhealthy eating are among the main health behaviours linked with obesity in both children and adults (5). In Canada, only 4% of children aged 12 to 17 meet the Canadian Physical Activity Guidelines for Children & Youth (2). In addition, over 75% of 14- to 18 year olds do not eat the recommended daily minimum of five servings of vegetables and fruits (5).

For children and teens, fruit juice is 32%–41% of their daily fruit and vegetable servings (5) and it is usually consumed as a healthier option to sugar-sweetened beverages. In recent years, the fact that fruit juice provides a high amount of sugar, without the fibre that accompanies whole fruits, has raised concerns about its potential to increase risk of overweight and obesity. The study of the association between fruit juice consumption and overweight and obesity has produced mixed results. One study found that among preschool-aged children in the United States, fruit juice consumption was associated with obesity (6), but not among school-age children in Greece (7). In Canada, no association emerged between consumption of fruit juice and overweight and obesity was found among children and youth aged 2-18 year-olds (8); in addition, this study used data collected in 2004, and no subsequent studies have looked at this association in Canada at the population level. Therefore, little is known about the association of fruit juice consumption and obesity and being overweight.

The objective of this study was to examine whether the consumption of fruit juice is associated with an increased risk of overweight or obesity in 12 to 17 year-olds in Canada, using the results from the Canadian Community Health Survey (CCHS 2011-1012), a national cross-sectional survey designed to be representative of 98% of the population of Canadians. This rich data set in a big sample size was ideal to explore this association in Canadian youth, while controlling for known confounders such as sex, household income, healthy diet, and physical activity.

Clarifying the role of fruit juice consumption in the obesity epidemic will have important public health implications and may guide not only future dietary recommendation for this age group of children, but also future research, practice and policy.

MethodS

Study Design

This cross-sectional study is based on the combined data for 2011 and 2012 from the Canadian Community Health Survey (CCHS 2011/2012) conducted by Statistics Canada (9). The CCHS collects information by administering interviews on topics related to health, well-being, the use of health care services and socio-demographic characteristics of the Canadian population. During 2011 and 2012, CCHS data were collected from 124,929 respondents aged 12 or older, residing in households in all Canadian provinces and territories. Residents of aboriginal reserves, health care institutions, and some remote areas were excluded, as well as full-time members of the Canadian Forces.
Analytic Sample.

For the purpose of this study, only respondents aged 12 to 17 years were included. Respondents within this age range were excluded if they did not provide valid responses from which to calculate daily consumption of fruit juice and body mass index (BMI) class. In addition, respondents were excluded if they did not provide valid responses to the following potential confounding variables: sex, household income, daily consumption of fruits and vegetables (excluding fruit juice), and the physical activity index.

Out of the total 124,929 respondents to the CCHS 2011-2012, 10,445 were between 12 and 17 years or age. Participants were included if valid responses were available for BMI class and daily consumption of fruit juice (Figure 1). Exclusions included invalid responses to potential confounding variables (Figure 1). The final number of respondents included in the analysis was 8,474.

Study Variables

The outcome variable was BMI class, a derived Statistics Canada variable specific for 12 to 17 year-olds, calculated using the Cole system (10). Respondents were assigned to one of two categories:

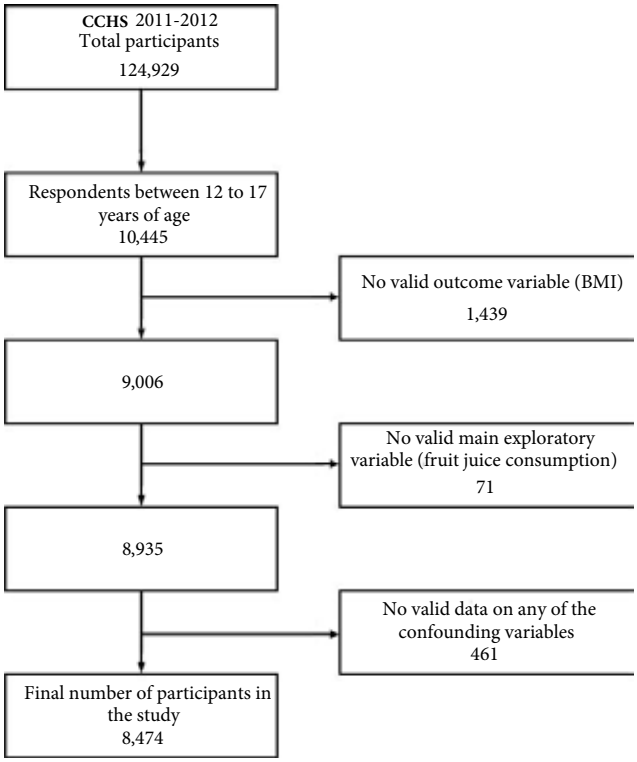

Figure 1. Analytic sample for the study of the association between fruit juice consumption and overweight or obesity in Canadian youth: Canadian Community Health Survey (CCHS 2011-2012).

Normal BMI (neither overweight nor obese) and Overweight or Obese. The explanatory variable was daily consumption of fruit juice, a derived Statistics Canada variable that measured the number of times fruit juice was consumed per day (frequency). Dietary information in CCHS 2011-2012 was collected via 24-h recall by trained interviewers. Respondents were assigned to one of five categories, from no fruit juice consumption (reference) to more than three fruit juices a day (Table 1).

Confounding variables included: sex, household income (divided into five categories from less than $20,000/year to more than $80,000/year); daily consumption of fruits and vegetables excluding fruit juice (divided into two categories: less then 5 serving per day or 5 or more servings per day); and physical activity index, a categorical classification of the level of physical activity in leisure time (divided into three categories: inactive, moderate active, active) (Table 1).

Analysis Plan

Multivariable logistic regression modeling was used to examine the association between the dichotomized BMI category and the five categories of daily consumption of fruit juice, adjusting for known confounding factors (sex, household income, daily consumption of fruits and vegetables (excluding fruit juice), and physical activity index. Analysis was generated using SAS 9.4 software (11), using sampling weights provided by Statistics Canada, in order for the results to be representative of the survey population. This study is covered by policy #87 of the University of British Columbia to perform data analysis of de-identified Statistics Canada survey data.

Results

Out of the 124,929 participants in the CCHS 2011-2012 (11), 10,445 were youth between 12 and 17 years of age. A total of 8,474 participants in this age range had valid data on all variables of interest and therefore were included in this study (Figure 1). The study sample was approximately evenly distributed among males (52%) and females (48%) (Table 1). Almost half (48%) of the participants had a household income greater than $80,000. Three in four (76%) youth were physically active or moderately active, but only 29% had 5 or more servings of fruits and vegetables a day.

Table 1. Association between fruit juice consumption and overweight or obesity in Canadian youth: Canadian Community Health Survey (2011-2012) Sample Characteristics.

Variable*	Complete study sample	Normal BMI	Overweight or Obese
Body Mass Index (BMI)	8,474 (100)	6,568 (77)	Overweight: 1,427 (17) Obese: 479 (6) Overweight/Obese: 1,906 (22)
		n (unweight row %)	
Juice Consumption (frequency, day)			
0	527 (6)	397 (6)	130 (7)
>0 to ≤1	5,722 (68)	4,394 (67)	1,328 (70)
>1 to ≤2	1,320 (16)	1,064 (16)	256 (13)
>2 to ≤3	569 (7)	446 (7)	123 (6)
>3	336 (4)	267 (4)	69 (4)
Sex			
Male	4,398 (52)	3,203 (49)	1,195 (63)
Female	4,076 (48)	3,365 (51)	711 (37)
Household Income			
<$20,000	505 (6)	372 (6)	133 (7)
$20,000-$39,999	1,196 (14)	868 (13)	328 (17)
$40,000-$59,999	1,370 (16)	1,044 (16)	326 (17)
$60,000-$79,999	1,351 (16)	1,021 (16)	330 (17)
>$80,000	4,052 (48)	3,263 (50)	789 (41)
Fruit & Vegetables Consumption (no fruit juice)(day)			
<5 servings	6,043 (71)	4,659 (71)	1,384 (73)
≥5 servings	2,431 (29)	1,909 (29)	522 (27)
Physical Activity Index			
Active	4,590 (54)	3,611 (55)	979 (51)
Moderate Active	1,892 (22)	1,450 (22)	442 (23)
Inactive	1,992 (24)	1,507 (23)	485 (25)

* n(%)

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The mean consumption of fruit and vegetable servings per day, without counting fruit juice, was 3.98 (SD 2.54; range: 0 – 28.7). The prevalence of overweight (17%) or obesity (6%) in this study sample was 22% (Table 1). Fruit juice consumption was very common; 94% of the study sample consumed fruit juice with 68% consuming up to one fruit juice a day and only 4% consuming fruit juice more than three times a day. The mean consumption of fruit juice per day was 1.13 (SD 1.18; range: 0 – 20). Participants with normal BMI according to categories appropriate for youth were equally distributed by sex; however, 63% of the participants with BMI in the overweight or obese category were males. The majority (73%) of participants with a BMI in the overweight or obese category had less than 5 servings of fruits and vegetables a day; however, the majority (69%) of participants with a normal BMI also had less than 5 servings of fruits and vegetables a day (Table 1).

In the unadjusted model, daily consumption of > 1 to ≤ 2 fruit juices a day was associated with a 17% decrease odds of being overweight or obese, while consumption of more than 3 fruit juices a day was associated with only a 7% decrease, compared to youth who did not consume any fruit juice. After adjusting for sex, household income, consumption of fruits and vegetables (not including fruit juice), and physical activity, consumption of more than 1 fruit juice a day remained associated with a lower odds of overweight or obesity (Table 2). Even though the 95% CI for all the daily fruit juice consumption categories examined in the adjusted model included '1', fruit juice consumption of > 1 to ≤ 2 times a day; > 2 to ≤ 3 a day and even more than 3 a day, were associated with a 27%, 16%, and 24% reduction in the odds of being overweight or obese, respectively (Table 2).

As anticipated in terms of the understanding of confounding,

Table 2. Unadjusted and adjusted multinomial logistic regression results: Relationship between fruit juice consumption and overweight or obesity in Canadian youth, Canadian Community Health Survey Sample (2011-2012) (n= 8,474).

Variable	OR	95% CI
Fruit juice consumption per day (frequency) (day)	Unadjusted Model	
0	1.00 (Ref)	
>0 to ≤1	1.10	0.80 - 1.51
>1 to ≤2	0.83	0.56 - 1.22
>2 to ≤3	1.04	0.65 - 1.64
>3	0.93	0.56 - 1.53
Fruit juice consumption per day (frequency) (day)	Adjusted Model	
0	1.00 (Ref)	
>0 to ≤1	1.02	0.74 - 1.40
>1 to ≤2	0.73	0.49 - 1.10
>2 to ≤3	0.84	0.54 - 1.33
>3	0.76	0.46 - 1.28
Sex		
Male	1.00 (Ref)	
Female	0.55	0.46 - 0.67
Household Income		
<$20,000	1.00 (Ref)	
$20,000-$39,999	1.06	0.71 - 1.59
$40,000-$59,999	0.99	0.67 - 1.48
$60,000-$79,999	1.16	0.78 - 1.74
>$80,000	0.73	0.50 - 1.06
Fruit & Vegetables Consumption (no fruit juice)(day)		
<5 servings	1.00 (Ref)	
≥5 servings	1.24	1.01 - 1.54
Physical Activity Index		
Active	1.00 (Ref)	
Moderate Active	1.12	0.91 - 1.38
Inactive	1.22	0.96 - 1.55

OR: Odds Ratio; 95% CI: 95% Confidence Interval

the odds of obesity were lower from women than men and for higher incomes. The strongest confounders of the effect of fruit juice consumption on BMI were sex and fruit and vegetables consumption. Adding the variable sex into the model, changed the OR of >3 fruit juices/day 14% from 0.93 to 0.80. Sex (reference = male), together with fruit and vegetables consumption (reference = less than 5 serving per day) changed the OR of >3 fruit juices/day from 0.93 to 0.78, a decreased of 16%.

Discussion

The goal of this study was to investigate whether the consumption of fruit juice is associated with an increased risk of overweight or obesity in 12 to 17 year-olds in Canada, using the Canadian Community Health Survey (CCHS 2011-1012). We found that after adjusting for sex, household income, consumption of fruits and vegetables (not including fruit juice), and physical activity, consumption of more than one fruit juice a day is associated with a moderate reduction in the odds of overweight or obesity.

Only one study had previously attempted to estimate the association between fruit juice consumption and overweight or obesity in Canadian children and youth. That study looked at associations between different drinks and overweight or obesity using data from the CCHRS, Cycle 2.2 conducted in 2004; however, it was unable to estimate an odds ratio (OR) specifically for fruit juice and overweight or obesity in Canadian youth (12-18 years of age) (8). That large study (n=13,824) found that fruit juice was not a dominat drink in children 12-18 years of age at the time. The most significant result of that study was that boys aged 6–11 years whose beverage pattern was characterized by soft drink intake, had increased odds of overweight or obesity (odds ratio 2.3, 95% CI: 1.2–4.1) compared with a "moderate" beverage pattern.

Two studies in Canadian adults have shown opposing associations between fruit beverage consumption and obesity (12,13). Nikpartow et al, used also data from the CCHS, Cycle 2.2, to evaluate beverage intakes in relation to overweight and obesity using BMI (12). This large study (n=14,304) included participants older than18 years, but younger than 66 years. Dietary intake was assessed on the basis of single 24-hour recall. Males and females were classified into distinct clusters based on the dominant pattern of beverage intakes. Logistic regression models found that BMI in women with predominant "fruit drink" pattern was higher than in those with no dominant pattern. After the authors adjusted for energy intake and other potential confounders, high intake of fruit drinks was a significant predictor of overweight (OR=1.84, 95% CI: 1.06-3.20), obesity (OR = 2.55, 95% CI: 1.46-4.47) and overweight/obesity (OR = 2.05, 95% CI: 1.29-3.25) in women, but not in men. One important limitation of this study is that "fruit drink" was not restricted to fruit juice and included other fruit-based sugar-sweetened beverages.

In the present study sex was an important confounder of the relationship between fruit juice consumption and BMI category. Girls in the present study had a significant decreased OR of having a BMI in the overweight or obese category. However, there were more boys in the overweight or obese category than girls, proportionally. To test the confounding effect, a stratified analysis revealed that for boys, after adjusting for all the same confounders, fruit juice consumption of > 1 to ≤ 2 times a day; > 2 to ≤ 3 a day and more than 3 a day, were associated with a 23%, 11%, and 7% reduction in the odds of being overweight or obese, respectively. On the other hand, for girls, fruit juice consumption in the same categories of fruit consumption, were associated with a 28%, 17%, and 46% reduction in the odds of being overweight or obese, respectively. The main difference was in the more than 3 juices a day category where the decreased association of fruit juice was stronger for girls (46%) than for boys (7%). In addition, for boys, consuming five or more servings of fruit and vegetable a day was associated with a 36% increase in the odds of being overweight or obese, whereas girls had an increased odds of being overweight or obese of only 11%.

In order to better understand the relationship between fruit juice consumption and BMI it is important to determine the role of fruit juice when is part of a healthy diet as opposed to being used above and beyond the recommended guidelines for a healthy diet. In our study, unexpectedly, we found that youth consuming five or more serving of fruit and vegetables (excluding fruit juice) was associated with an increased OR of having a BMI in the category of overweight or obese; however, this study was not designed to explore this relationship. Future studies designed at clarifying the interaction between fruit juice consumption and daily serving of fruit and vegetable are needed.

The second study by Akhtar-Danesh et al. at McMaster University, ON aimed to investigate the association between fruit juice consumption and self-reported BMI among adult Canadians (13). This study used data from the CCHS, Cycle 3.1. and included 15,392 Canadian participants between 18 and 64 years of age. After adjusting for sex, age, household income, education, self-rated health, and daily energy expenditure, a regression analysis showed a moderate negative association between fruit juice consumption and BMI, as in the present study. In contrast, Akhtar-Danesh et al. used BMI and fruit juice consumption as continues variables. An important limitation of that study was the lack of adjustment for fruit and vegetable intake, decreasing the validity of the estimated relationship of interest.

Conclusion

Using a nationally representative dataset, we found some association between fruit juice consumption and lowered odds of being overweight or obese in Canadian youth. The consumption of more than one fruit juice a day is associated with a moderate reduction in the odds of overweight or obesity in 12 to 17-year-olds, particularly in girls; however, for boys, this protective effect seems is very low when boys drink more than 3 fruit juices a day and they tend to be inactive. This may suggest that a moderate daily consumption of fruit juice is associated with normal weight status. Because the analysis is based on a cross-sectional dataset, it does not imply a cause and effect relationship. However, the results of this study may have important implications, not only for dietary recommendation on this age group of children, but also for future research, practice and policy in the area of population intervention for chronic disease prevention. However, more research is needed to clarify the role of sex and healthy diet in the association of fruit juice and overweight or obesity

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