The Role of Fruit Juices in a Healthy Diet

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Baylor College of Medicine
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100 Percent Juice Consumption in Children:
Are there nutritional benefits?
Is there a link to weight status?
100% fruit juice is a nutrient dense beverage

Vitamin C

Potassium

Folate
Why is Juice Sometimes Attacked?

- Juice tastes good, is naturally sweet, so assumption is kids may over consume juice (most do not).
- Some people think 100 percent juice contains “added sugar” (it does not).
- Some research suggests juice consumption is linked to overweight status in children (most studies don’t support this idea).
For children **1 to 6 years old**, fruit juice intake should be limited:
- 4 to 6 oz/day

For children **7 to 18 years old**, fruit juice intake should be limited to:
- 8 to 12 oz/day (2 servings)
A Review of the Relationship Between 100% Fruit Juice Consumption and Weight in Children and Adolescents

Carol E. O’Neil, PhD, MPH, LDN, RD
Theresa A. Nicklas, DrPH

Am J Lifestyle Medicine (In Press)
No Relationship Between Fruit Juice Consumption and Overweight Status in Children: 14 studies


Some Relationship Between Fruit Juice Consumption and Overweight Status in Children: 6 studies

100% Juice Consumption and Weight Status: Where is the Weight of the Scientific Evidence?

Some Relationship

None are based on a nationally representative sample

6 studies

No Relationship

4 longitudinal 7 based on a national sample

14 studies
New Studies: NHANES Data Analysis

- **PURPOSE:** To examine the impact of 100% juice consumption by children and adolescents on food and nutrient intake, and body weight status.

- **SUBJECTS:** A nationally represented US sample of children and adolescents (N = 7,557).
Children Ages 2-11

## Demographics of the Sample (Children 2-11 years)

<table>
<thead>
<tr>
<th>Age Group (Years)</th>
<th>2-3</th>
<th>4-8</th>
<th>9-11</th>
<th>Total (2-11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Population</td>
<td>878 (24)</td>
<td>1692 (47)</td>
<td>1048 (29)</td>
<td>3618</td>
</tr>
<tr>
<td>Mean Amount Consumed (ounces) (mean ± SE)</td>
<td>6.0 (0.63)</td>
<td>3.5 (0.40)</td>
<td>3.6 (0.29)</td>
<td>4.1 (0.17)</td>
</tr>
<tr>
<td>Total Calories from Juice (mean ± SE)</td>
<td>86 (8.5)</td>
<td>50 (5.6)</td>
<td>51 (4.2)</td>
<td>58 (2.5)</td>
</tr>
<tr>
<td>% of Total Daily Calories from Juice</td>
<td>5.0 (0.39)</td>
<td>2.6 (0.26)</td>
<td>2.5 (0.20)</td>
<td>3.3 (0.15)</td>
</tr>
<tr>
<td>Non-Juice Consumers</td>
<td>394 (45)</td>
<td>991 (59)</td>
<td>676 (65)</td>
<td>2061 (57)</td>
</tr>
<tr>
<td>Juice Consumers</td>
<td>484 (55)</td>
<td>701 (41)</td>
<td>372 (35)</td>
<td>1557 (43)</td>
</tr>
</tbody>
</table>

100% juice consumption is not excessive
Demographics of the Sample (Children 2-11 years)

<table>
<thead>
<tr>
<th></th>
<th>2-3</th>
<th>4-8</th>
<th>9-11</th>
<th>Total (2-11)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>n (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juice Consumers Only</td>
<td>484 (55)</td>
<td>701 (41)</td>
<td>372 (35)</td>
<td>1557 (43)</td>
</tr>
<tr>
<td>&gt; 0 &lt; 6 oz.</td>
<td>142 (29)</td>
<td>197 (28)</td>
<td>96 (26)</td>
<td>435 (28)</td>
</tr>
<tr>
<td>&gt; 6 &lt; 12 oz.</td>
<td>186 (38)</td>
<td>304 (43)</td>
<td>158 (42)</td>
<td>648 (42)</td>
</tr>
<tr>
<td>&gt; 12 oz.</td>
<td>159 (33)</td>
<td>200 (29)</td>
<td>118 (32)</td>
<td>474 (30)</td>
</tr>
<tr>
<td>Mean Amount</td>
<td>16.1 (1.5)</td>
<td>11.8 (0.77)</td>
<td>11.0 (0.62)</td>
<td>10.6 (0.26)</td>
</tr>
<tr>
<td>(ounces) (mean ± SE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Calories from Juice</td>
<td>226 (20.2)</td>
<td>166 (10.8)</td>
<td>154 (10.0)</td>
<td>150 (4.2)</td>
</tr>
<tr>
<td>(mean ± SE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of Total Daily Calories from Juice</td>
<td>12.2 (0.80)</td>
<td>8.4 (0.54)</td>
<td>8.0 (0.44)</td>
<td>8.5 (0.25)</td>
</tr>
</tbody>
</table>
## Nutrient Intake by 100% Juice Consumers

### Nutrients/Day

<table>
<thead>
<tr>
<th>Nutrients/Day</th>
<th>0 Oz</th>
<th>&gt; 0 ≤ 6 Oz</th>
<th>&gt; 6 ≤ 12 Oz</th>
<th>&gt; than 12 Oz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy, kcal</td>
<td>1827.6</td>
<td>1725.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1882.1</td>
<td>2138.1&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Carbohydrate, g</td>
<td>252.6</td>
<td>253.9</td>
<td>262.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>276.3&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Potassium, mg</td>
<td>1972.1</td>
<td>2166.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2377.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2742.0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Vitamin C, mg</td>
<td>60.3</td>
<td>86.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>120.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>180.2&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Total fat, g</td>
<td>69.6</td>
<td>69.1</td>
<td>64.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>59.6&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup>Significantly different from zero consumption, p < 0.0001

100% juice consumption is a valuable contributor of nutrients.
<table>
<thead>
<tr>
<th>Nutrients/Day</th>
<th>0 Oz</th>
<th>&gt; 0 ≤ 6 Oz</th>
<th>&gt; 6 ≤ 12 Oz</th>
<th>&gt; than 12 Oz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnesium, mg</td>
<td>205.4</td>
<td>212.5</td>
<td>223.7(^a)</td>
<td>233.9(^a)</td>
</tr>
<tr>
<td>Iron, mg</td>
<td>13.2</td>
<td>13.3</td>
<td>14.5(^a)</td>
<td>14.6(^a)</td>
</tr>
<tr>
<td>Vitamin B6, mg</td>
<td>1.5</td>
<td>1.5</td>
<td>1.6(^a)</td>
<td>1.8(^a)</td>
</tr>
<tr>
<td>Total folate, mcg</td>
<td>327.5</td>
<td>351.8</td>
<td>361.6(^a)</td>
<td>385.4(^a)</td>
</tr>
<tr>
<td>Sodium, mg</td>
<td>2904.3</td>
<td>2880.9</td>
<td>2893.2</td>
<td>2680.3(^b)</td>
</tr>
</tbody>
</table>

\(^a\)Significantly different from zero consumption, p < 0.0001
\(^b\)Significantly different from zero consumption, p < 0.05
Impact of 100% Juice Consumption on Added Fat, Added Sugar and Milk Intake

100% juice consumers have overall better diets

1.6 1.5 1.6 1.4
14.7a 18.5a 20.1a 23.1

0 20 40 60 80 100
0 20 40 60 80 100

Grams
Grams

0 1 2
0 1 2

Servings
Servings

Amount Consumed
- 0 ounces
- > 1 < 6 ounces
- > 6 ≤ 12 ounces
- > 12 ounces

a significantly different than zero consumption, p < 0.0001
Whole Fruit Consumption by 100% Juice Consumers

Amount of 100% Juice Consumed (ounces)

Fruit Serving

0.83
1.20\(^a\)
1.36\(^a\)
1.66\(^a\)

\(^a\) Significantly different from zero consumption, \(p < 0.0001\)

Amount Consumed
- 0 ounces
- \(> 0 \leq 6\) ounces
- \(> 6 \leq 12\) ounces
- \(> 12\) ounces
# Impact of 100% Juice Consumption (oz/day) on Weight

## 100% Juice Consumption Groups (Oz/Day)*

<table>
<thead>
<tr>
<th>Adiposity Measures</th>
<th>0 Oz</th>
<th>&gt; 0 ≤ 6 Oz</th>
<th>&gt; 6 ≤ 12 Oz</th>
<th>&gt; than 12 Oz</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body Mass Index, kg/m²</strong></td>
<td>17.5</td>
<td>17.7</td>
<td>17.5</td>
<td>17.8</td>
</tr>
<tr>
<td><strong>Waist Circumference, cm</strong></td>
<td>59.6</td>
<td>60.1</td>
<td>59.5</td>
<td>60.7</td>
</tr>
<tr>
<td><strong>Tricep Skinfold, mm</strong></td>
<td>12.0</td>
<td>12.0</td>
<td>12.0</td>
<td>12.4</td>
</tr>
<tr>
<td><strong>Percentile for Weight-For-Age</strong></td>
<td>61.2</td>
<td>60.2</td>
<td>60.8</td>
<td>62.9</td>
</tr>
<tr>
<td><strong>Z-Score for Body Mass Index-For-Age</strong></td>
<td>0.40</td>
<td>0.32</td>
<td>0.33</td>
<td>0.36</td>
</tr>
</tbody>
</table>

*aSignificantly different from zero consumption, p < 0.05

100% juice consumption is not associated with overweight
Impact of 100% Juice Consumption (oz/day) on the Likelihood of Being Overweight or At Risk of Being Overweight

<table>
<thead>
<tr>
<th>Age Groups</th>
<th>0 oz</th>
<th>&gt; 0 ≤ 6 oz</th>
<th>&gt; 6 ≤ 12 oz</th>
<th>&gt; 12 oz</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Odds Ratio (95% CI)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 – 3 Years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>2.79 (1.01, 7.75)</td>
<td>1.21 (0.28, 5.20)</td>
<td>0.74 (0.31, 1.76)</td>
<td>1.00 (1.00, 1.00)</td>
</tr>
<tr>
<td>At Risk of Being Overweight</td>
<td>1.60 (0.60, 4.27)</td>
<td>1.22 (0.43, 3.47)</td>
<td>1.39 (0.57, 3.40)</td>
<td>1.00 (1.00, 1.00)</td>
</tr>
<tr>
<td>4 – 8 Years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>0.81 (0.40, 1.63)</td>
<td>0.63 (0.25, 1.60)</td>
<td>0.90 (0.36, 2.22)</td>
<td>1.00 (1.00, 1.00)</td>
</tr>
<tr>
<td>At Risk of Being Overweight</td>
<td>1.06 (0.59, 1.90)</td>
<td>0.72 (0.34, 1.53)</td>
<td>1.09 (0.59, 2.00)</td>
<td>1.00 (1.00, 1.00)</td>
</tr>
<tr>
<td>9 – 11 Years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>1.59 (0.84, 3.03)</td>
<td>2.87 (1.03, 7.94)</td>
<td>1.66 (0.69, 4.00)</td>
<td>1.00 (1.00, 1.00)</td>
</tr>
<tr>
<td>At Risk of Being Overweight</td>
<td>0.98 (0.51, 1.88)</td>
<td>1.22 (0.50, 2.98)</td>
<td>0.84 (0.39, 1.82)</td>
<td>1.00 (1.00, 1.00)</td>
</tr>
</tbody>
</table>
Summary of Results

- Mean daily JC by children was 4.1 ounces, contributing a mean intake of 58 calories (3.3% of total energy intake).
- On average, 57% of children did not consume juice.
- JC did not replace milk consumption.
- Children who consumed > 6 oz 100% juice had significantly higher intakes of carbohydrate, vitamins C and B6, potassium, riboflavin, magnesium, iron and folate than non-consumers.
- Juice consumers had significantly lower intakes of fat, saturated fat, added fat and added sugar than non-consumers.
- 100% JC was not associated with overweight.
- There was no difference in the likelihood of being overweight among the JC groups compared to non-consumers.
Conclusion

- On average, children drank less than 6 oz/day of 100% juice.

- 100% JC was associated with higher intakes of several vitamins and minerals, and lower intakes of fat, saturated fat, added fat and added sugar, than children who did not consume fruit juice.

- 100% JC was not associated with overweight in children 2-11 years of age, confirming that intake of 100% juice is not excessive; is a valuable contributor of nutrients in children’s diets; and, does not have an adverse effect on weight.
O’Neil CE, Nicklas TA, Kleinman R. Relationship between 100% Juice Consumption and Nutrient Intake and Weight of Adolescents. J Adolesc Health Prom. (Submitted).
Summary of Results

- Mean daily JC by adolescents was 3.7 ounces, contributing a mean intake of 51 calories (2.2% of total energy intake).
- On average, 72% of adolescents did not consume juice.
- JC did not replace milk consumption.
- Adolescents who consumed 100% juice had significantly higher intakes of vitamin C, potassium, and magnesium than non-consumers.
- Adolescents who consumed > 6 oz 100% juice had significantly higher intakes of folate and vitamin B6.
- Adolescents who consumed 100% juice had significantly lower intakes of total fat, saturated fat, added sugar, and added fat than non-consumers.
- 100% JC was not associated with overweight.
- There was no difference in the likelihood of being overweight among the JC compared to non-consumers.
Conclusion

- On average, adolescents are not consuming at least one serving (6 oz) of 100% juice per day.

- 100% JC was associated with higher intakes of several vitamins and minerals, and lower intakes of total fat, saturated fat, added fat and added sugar, than nonconsumers.

- 100% JC was not associated with overweight.
“Overweight, Yet Undernourished”

People consume more calories than they need without meeting recommended intakes for several nutrients. One way to help these individuals is to improve the nutrient density of their diets.
Reported dietary intakes of the following nutrients are low enough to be of concern:

- For adults: vitamins A, C, and E, calcium, magnesium, potassium, and fiber.
- For children: vitamin E, calcium, magnesium, potassium, and fiber.
- At the same time, in general, Americans consume too many calories and too much saturated and trans fat, cholesterol, added sugars, and salt.

<table>
<thead>
<tr>
<th>Year</th>
<th>Children, 1-5 years</th>
<th>Children, 6-9 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987-88</td>
<td>77.3</td>
<td>74.1</td>
</tr>
<tr>
<td>1999-93</td>
<td>76.7</td>
<td>68.4</td>
</tr>
<tr>
<td>1997-98</td>
<td>78.5</td>
<td>68.9</td>
</tr>
</tbody>
</table>


- **Age 6 mo-6 y**: 4-6 oz/d
- **Age 7-18 y**: 8-12 oz/d

AAP 100% juice intake recommendations:

- **100% fruit juice**
- **Amount consumed (oz/day)**
- **Age (years)**
Percentage of Individuals Not Consuming the Recommended Number of Pyramid Servings Per Day

Zelman et al.  2006  Nutr Today 40(2):60-68
Proposed Changes in Food Group Consumption

![Bar chart showing percent change in food group consumption for females and males aged 31-50, with 1800 and 2200 calorie diets.](chart.png)

- Fruits: Females -127, Males -190
- Vegetables: Females 61, Males 43
- Grains: Females 8, Males -12
- Meat & Beans: Females 23, Males -11
- Milk: Females 170, Males 94
- Fats: Females -27, Males -41
- Added Sugars: Females -63, Males -67

2005 Dietary Guidelines Advisory Committee Report
What Dietary Patterns Are Associated With Achieving Recommended Nutrient Intakes?

Two major aspects of the USDA dietary pattern contribute to meeting nutrient intake recommendations:

1. Consumption of foods from each of the basic food groups.
2. Consumption of a variety of food commodities within each of those food groups while maintaining appropriate energy balance.
# Changes in the Nutrient Profile of the Fruit Group with All Juices Replaced with Fruits

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Original Nutrient Profile (fruit plus Juice)</th>
<th>Modified Nutrient Profile with FruitReplacing Juices</th>
<th>Percentage Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A (mcg RAE)</td>
<td>18.7</td>
<td>33.38</td>
<td>+78.2%</td>
</tr>
<tr>
<td>Vitamin C (mg)</td>
<td>29.76</td>
<td>21.88</td>
<td>-26.5%</td>
</tr>
<tr>
<td>Folate (mcg)</td>
<td>28.30</td>
<td>14.02</td>
<td>-50.5%</td>
</tr>
<tr>
<td>Thiamin (mg)</td>
<td>0.066</td>
<td>0.040</td>
<td>-39.6%</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>14.559</td>
<td>13.289</td>
<td>-8.7%</td>
</tr>
<tr>
<td>Potassium (mg)</td>
<td>252.93</td>
<td>210.87</td>
<td>-16.6%</td>
</tr>
<tr>
<td>Calories</td>
<td>69.75</td>
<td>54.77</td>
<td>-21.5%</td>
</tr>
<tr>
<td>Fiber (g)</td>
<td>1.339</td>
<td>1.828</td>
<td>+36.6%</td>
</tr>
</tbody>
</table>
## Amounts of Vitamin C in the Food Pattern with Fruit Intake Modified

<table>
<thead>
<tr>
<th>Age/Sex Group (food pattern)</th>
<th>Vitamin C in Original Food Pattern (% RDA)</th>
<th>Vitamin C in Pattern without Fruit Juice (% RDA)</th>
<th>Vitamin C in Pattern with Fruit Replacing Juice (% RDA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females 51-70 (1600 calories)</td>
<td>123%</td>
<td>74%</td>
<td>102%</td>
</tr>
<tr>
<td>Females 31-50 (1800 calories)</td>
<td>141%</td>
<td>92%</td>
<td>120%</td>
</tr>
<tr>
<td>Males 51-70 (2000 calories)</td>
<td>151%</td>
<td>89%</td>
<td>125%</td>
</tr>
<tr>
<td>Males 31-50 (2200 calories)</td>
<td>151%</td>
<td>90%</td>
<td>125%</td>
</tr>
</tbody>
</table>
US 2005 Dietary Guidelines

- ↓ Risk of stroke and CVD
- ↓ Risk of cancers
- ↓ Risk of Type 2 Diabetes
- ↓ Useful component of weight loss programs
Nutrient Profiling of Foods

“Nutrient Profiling of Foods” is defined as the science of ranking foods based on their nutrient composition.
100% Fruit Juice

- Significant source of vitamins and minerals; thus, are nutrient dense.
- 100% JC have better diets overall.
- Important way to get a part of one’s recommended servings of fruit.
- 100% FJ has nutritional benefits over whole fruit.
- Not associated with overweight.

Consumption of Fruit is Protective Against Chronic Diseases


Nothing Captivates Like Juice