The Role of Fruit Juices in a Healthy Diet

Theresa A. Nicklas, DrPH
Professor
Children's Nutrition Research Center
Baylor College of Medicine
Department of Pediatrics

USDA

BCM
Baylor College of Medicine

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).

American Academy of Pediatrics Policy Statement (2001)

- 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)

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Committed to the attainment of optimal physical, mental, and social health and well-being for all infants, children, adolescents, and young adults.

Review Article

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

- Nicklas TA, O'Neil CE, Kleinman R. "The Relationship Among 100% Juice Consumption, Nutrient Intake, and Weight of Adolescents 12 to 18 Years." NAASO: The North American Association for the Study of Obesity's 2007 Annual Scientific Meeting, New Orleans, Louisiana, Oct 2007. Abstract No. 538-P.
- Johnson L, Mander AP, Jones LR, Emmett PM, Jebb SA. Is sugar-sweetened beverage consumption associated with increased fatness in children? *Nutrition.* Jul-Aug 2007;23(7-8):557-563.
- LaRowe TL, Moeller SM, Adams AK. Beverage patterns, diet quality, and body mass index of US preschool and school-aged children. *J Am Diet Assoc.* Jul 2007;107(7):1124-1133.
- O'Neil CE, Nicklas TA, Kleinman RE. "The Relationship among 100% Juice Consumption, Nutrient Intake, and Weight of Children 2-11 Years." Pediatric Academic Societies' 2007 Annual Meeting, Toronto, ON, Canada, May 2007. Publication 8406.4.
- O'Connor TM, Yang SJ, Nicklas TA. Beverage intake among preschool children and its effect on weight status. *Pediatrics.* Oct 2006;118(4):e1010-1018.
- Striegel-Moore RH, Thompson D, Affenito SG, et al. Correlates of beverage intake in adolescent girls: the National Heart, Lung, and Blood Institute Growth and Health Study. *J Pediatr.* Feb 2006;148(2):183-187.
- Blum JW, Jacobsen DJ, Donnelly JE. Beverage consumption patterns in elementary school aged children across a two-year period. *J Am Coll Nutr.* Apr 2005;24(2):93-98.
- Newby PK, Peterson KE, Berkey CS, Leppert J, Willett WC, Colditz GA. Beverage consumption is not associated with changes in weight and body mass index among low-income preschool children in North Dakota. *J Am Diet Assoc.* Jul 2004;104(7):1086-1094.
- Berkey CS, Rockett HR, Field AE, Gillman MW, Colditz GA. Sugar-added beverages and adolescent weight change. *Obes Res.* May 2004;12(5):778-788.
- Forshee RA, Storey ML. Total beverage consumption and beverage choices among children and adolescents. *Int J Food Sci Nutr.* Jul 2003;54(4):297-307.
- Kloeblen-Tarver AS. Fruit juice consumption not related to growth among preschool-aged children enrolled in the WIC program. *J Am Diet Assoc.* Sep 2001;101(9):996.
- Skinner JD, Carruth BR. A longitudinal study of children's juice intake and growth: the juice controversy revisited. *J Am Diet Assoc.* Apr 2001;101(4):432-437.
- Alexy U, Sichert-Hellert W, Kersting M, Manz F, Schoch G. Fruit juice consumption and the prevalence of obesity and short stature in German preschool children: results of the DONALD Study. Dortmund Nutritional and Anthropometrical Longitudinally Designed. *J Pediatr Gastroenterol Nutr.* 1999;29(3):343-349.
- Skinner JD, Carruth BR, Moran J, 3rd, Houck K, Coletta F. Fruit juice intake is not related to children's growth. *Pediatrics.* 1999;103(1):58-64.

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

- Libuda L, Alexy U, Sichert-Hellert W, et al. Pattern of beverage consumption and long-term association with body-weight status in German adolescents - results from the DONALD study. *Br J Nutr.* Nov 2007:1-10.
- Faith MS, Dennison BA, Edmunds LS, Stratton HH. Fruit juice intake predicts increased adiposity gain in children from low-income families: weight status-by-environment interaction. *Pediatrics.* Nov 2006;118(5):2066-2075.
- Welsh JA, Cogswell ME, Rogers S, Rockett H, Mei Z, Grummer-Strawn LM. Overweight among low-income preschool children associated with the consumption of sweet drinks: Missouri, 1999-2002. *Pediatrics.* Feb 2005;115(2):e223-229.
- Melgar-Quinonez HR, Kaiser LL. Relationship of child-feeding practices to overweight in low-income Mexican-American preschool-aged children. *J Am Diet Assoc.* Jul 2004;104(7):1110-1119.
- Dennison BA, Rockwell HL, Nichols MJ, Jenkins P. Children's growth parameters vary by type of fruit juice consumed. *J Am Coll Nutr.* Aug 1999;18(4):346-352.
- Dennison BA, Rockwell HL, Baker SL. Excess fruit juice consumption by preschool-aged children is associated with short stature and obesity. *Pediatrics.* Jan 1997;99(1):15-22.

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

Some Relationship

6 studies

None are based on a nationally representative sample

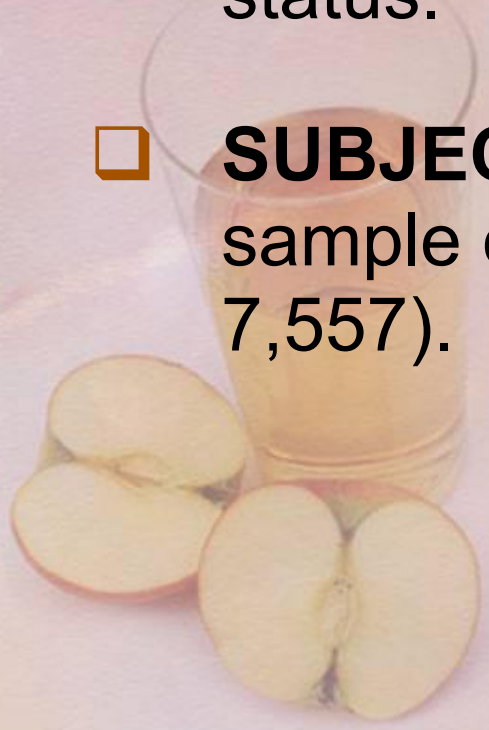
No Relationship

14 studies

4 longitudinal
7 based on a national sample

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

Nicklas TA, O'Neil CE, Kleinman, R. Association between 100% Juice Consumption and Nutrient Intake and Weight of Children 2 to 11 Years. Arch Pediatr Adolesc Med. 2008; 162(6):557-565.

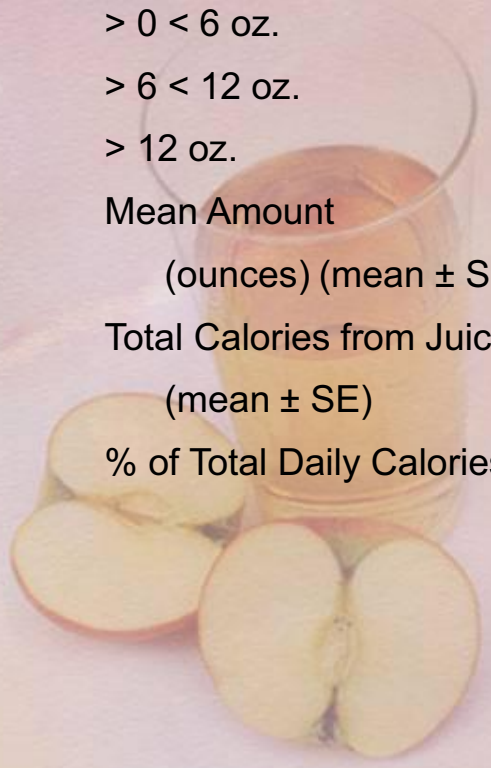
Demographics of the Sample (Children 2-11 years)

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

100% juice consumption is not excessive

Demographics of the Sample (Children 2-11 years)

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



Nutrient Intake by 100% Juice Consumers

	100% Juice Consumption Groups (Oz/Day)			
	0 Oz	> 0 ≤ 6 Oz	> 6 ≤ 12 Oz	> than 12 Oz
Nutrients/Day	**Mean**	**Mean**	**Mean**	**Mean**
Energy, kcal	1827.6	1725.4[a]	1882.1	2138.1[a]
Carbohydrate, g	252.6	253.9	262.7[a]	276.3[a]
Potassium, mg	1972.1	2166.7[a]	2377.5[a]	2742.0[a]
Vitamin C, mg	60.3	86.1[a]	120.5[a]	180.2[a]
Total fat, g	69.6	69.1	64.3[a]	59.6[a]

100% juice consumption is a valuable contributor of nutrients

[a]Significantly different from zero consumption, $p < 0.0001$

[b]Significantly different from zero consumption, $p < 0.05$

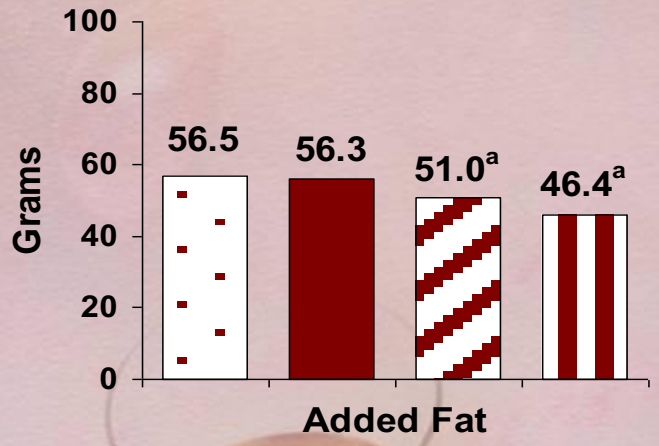
Nutrient Intake by 100% Juice Consumers

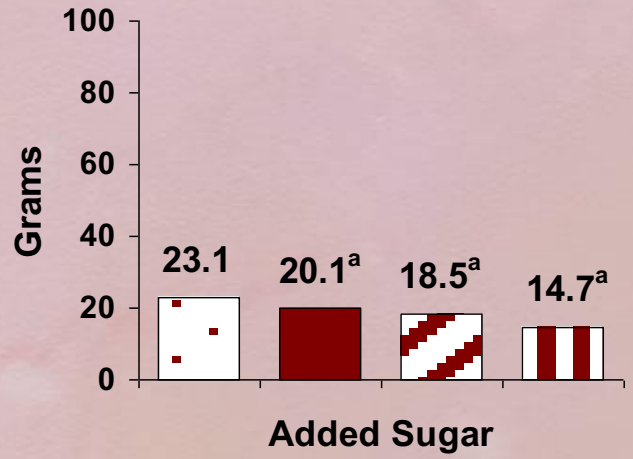
	100% Juice Consumption Groups (Oz/Day)			
	0 Oz	> 0 ≤ 6 Oz	> 6 ≤ 12 Oz	> than 12 Oz
Nutrients/Day	**Mean**	**Mean**	**Mean**	**Mean**
Magnesium, mg	205.4	212.5	223.7[a]	233.9[a]
Iron, mg	13.2	13.3	14.5[a]	14.6[a]
Vitamin B6, mg	1.5	1.5	1.6[a]	1.8[a]
Total folate, mcg	327.5	351.8	361.6[a]	385.4[a]
Sodium, mg	2904.3	2880.9	2893.2	2680.3[b]

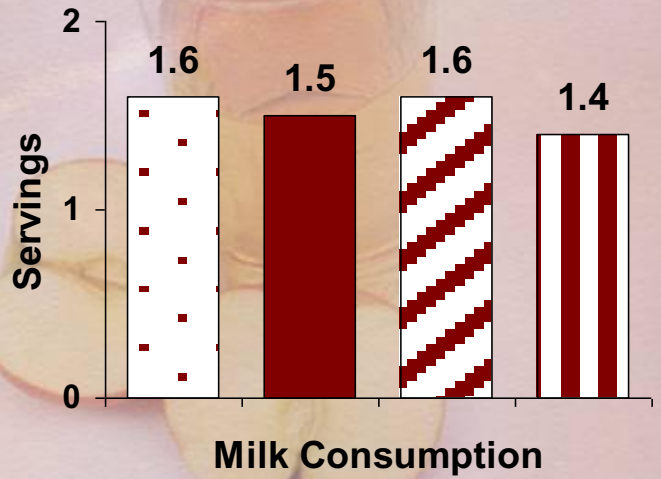
[a]Significantly different from zero consumption, $p < 0.0001$

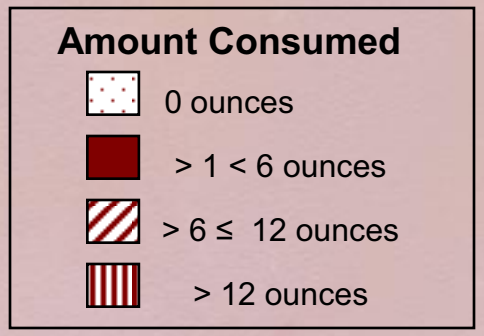
[b]Significantly different from zero consumption, $p < 0.05$

Impact of 100% Juice Consumption on Added Fat, Added Sugar and Milk Intake





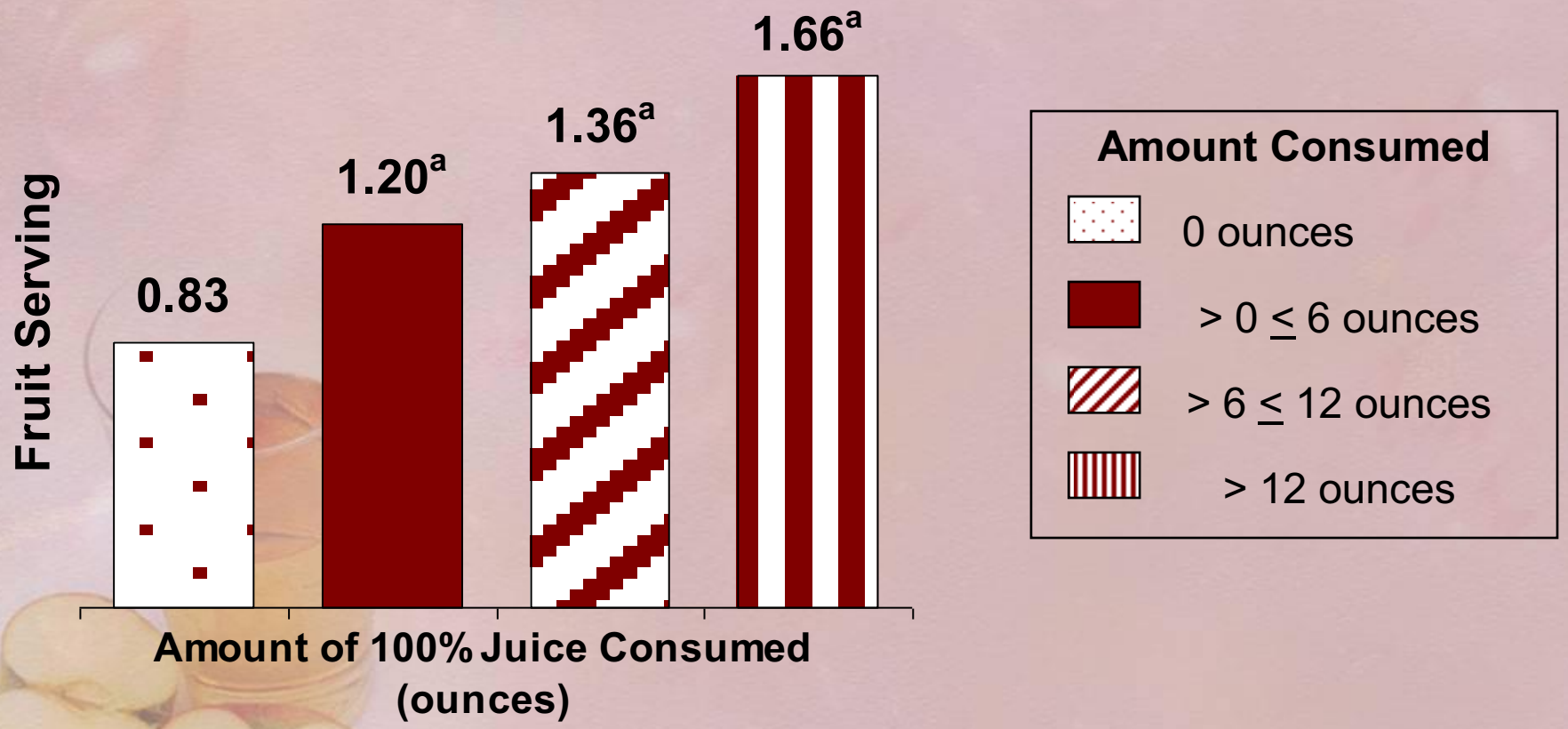




100% juice consumers have overall better diets

[a] *significantly different than zero consumption, p < 0.0001*

Whole Fruit Consumption by 100% Juice Consumers



[a] Significantly different from zero consumption, $p < 0.0001$

Impact of 100% Juice Consumption (oz/day) on Weight

Adiposity Measures	100% Juice Consumption Groups (Oz/Day)*			
	0 Oz	> 0 ≤ 6 Oz	> 6 ≤ 12 Oz	> than 12 Oz
	Mean	Mean	Mean	Mean
Body Mass Index, kg/m²	17.5	17.7	17.5	17.8
Waist Circumference, cm	59.6	60.1	59.5	60.7
Tricep Skinfold, mm	12.0	12.0	12.0	12.4
Percentile for Weight-For-Age	61.2	60.2	60.8	62.9
Z-Score for Body Mass Index-For-Age	0.40	0.32	0.33	0.36

100% juice consumption is not associated with overweight

[a]Significantly different from zero consumption, $p < 0.05$

Impact of 100% Juice Consumption (oz/day) on the Likelihood of Being Overweight or At Risk of Being Overweight

Age Groups	100% Juice Consumption Groups (Oz/Day)			
	0 oz	> 0 ≤ 6 oz	> 6 ≤ 12 oz	> 12 oz
	Odds Ratio (95% CI)			
2 – 3 Years				
Overweight	**2.79 (1.01, 7.75)**	1.21 (0.28, 5.20)	0.74 (0.31, 1.76)	**1.00 (1.00, 1.00)**
At Risk of Being Overweight	1.60 (0.60, 4.27)	1.22 (0.43, 3.47)	1.39 (0.57, 3.40)	1.00 (1.00, 1.00)
4 – 8 Years				
Overweight	0.81 (0.40, 1.63)	0.63 (0.25, 1.60)	0.90 (0.36, 2.22)	1.00 (1.00, 1.00)
At Risk of Being Overweight	1.06 (0.59, 1.90)	0.72 (0.34, 1.53)	1.09 (0.59, 2.00)	1.00 (1.00, 1.00)
9 – 11 Years				
Overweight	1.59 (0.84, 3.03)	2.87 (1.03, 7.94)	1.66 (0.69, 4.00)	1.00 (1.00, 1.00)
At Risk of Being Overweight	0.98 (0.51, 1.88)	1.22 (0.50, 2.98)	0.84 (0.39, 1.82)	1.00 (1.00, 1.00)

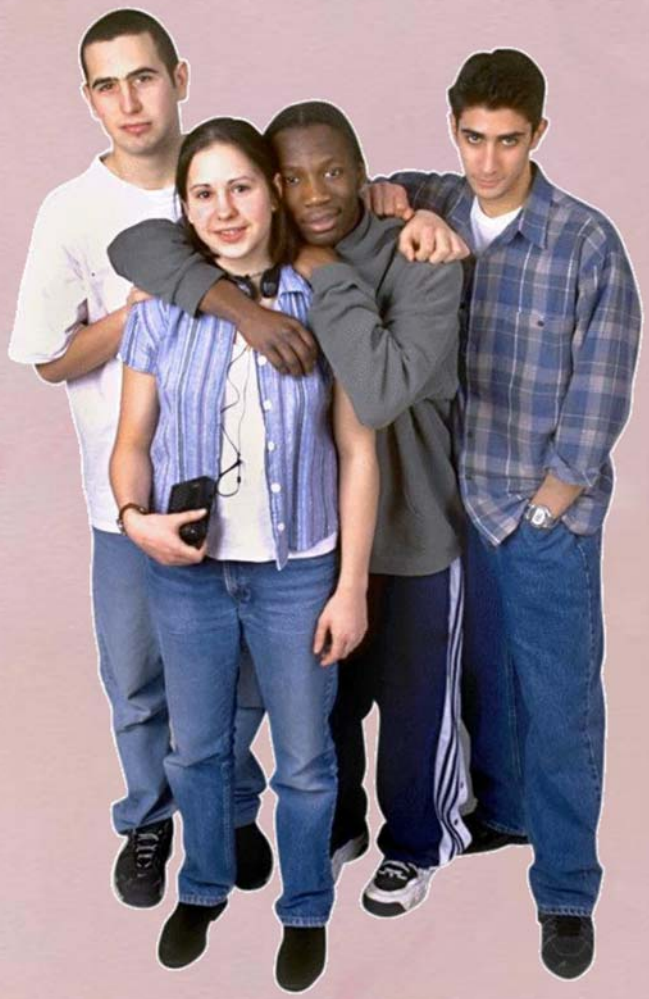
Summary of Results

- 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.

Adolescents 12-18



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.

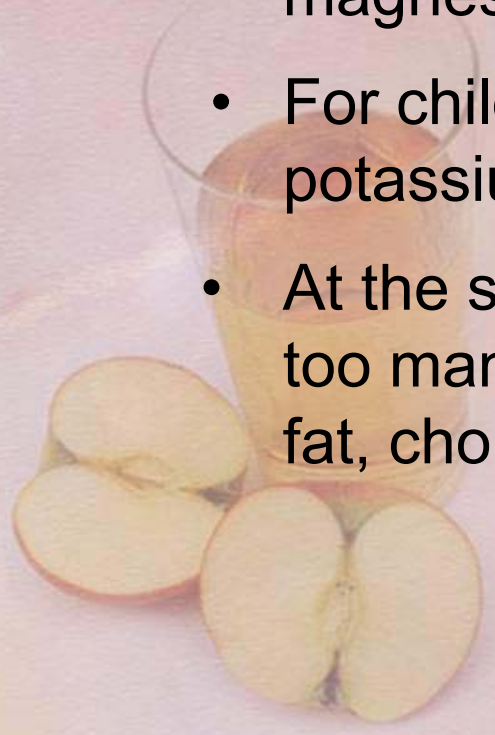
"Overweight, Yet Undernourished"

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.

What Nutrients Are Most Likely To Be Consumed by the General Public In Amounts Low Enough To Be of Concern?

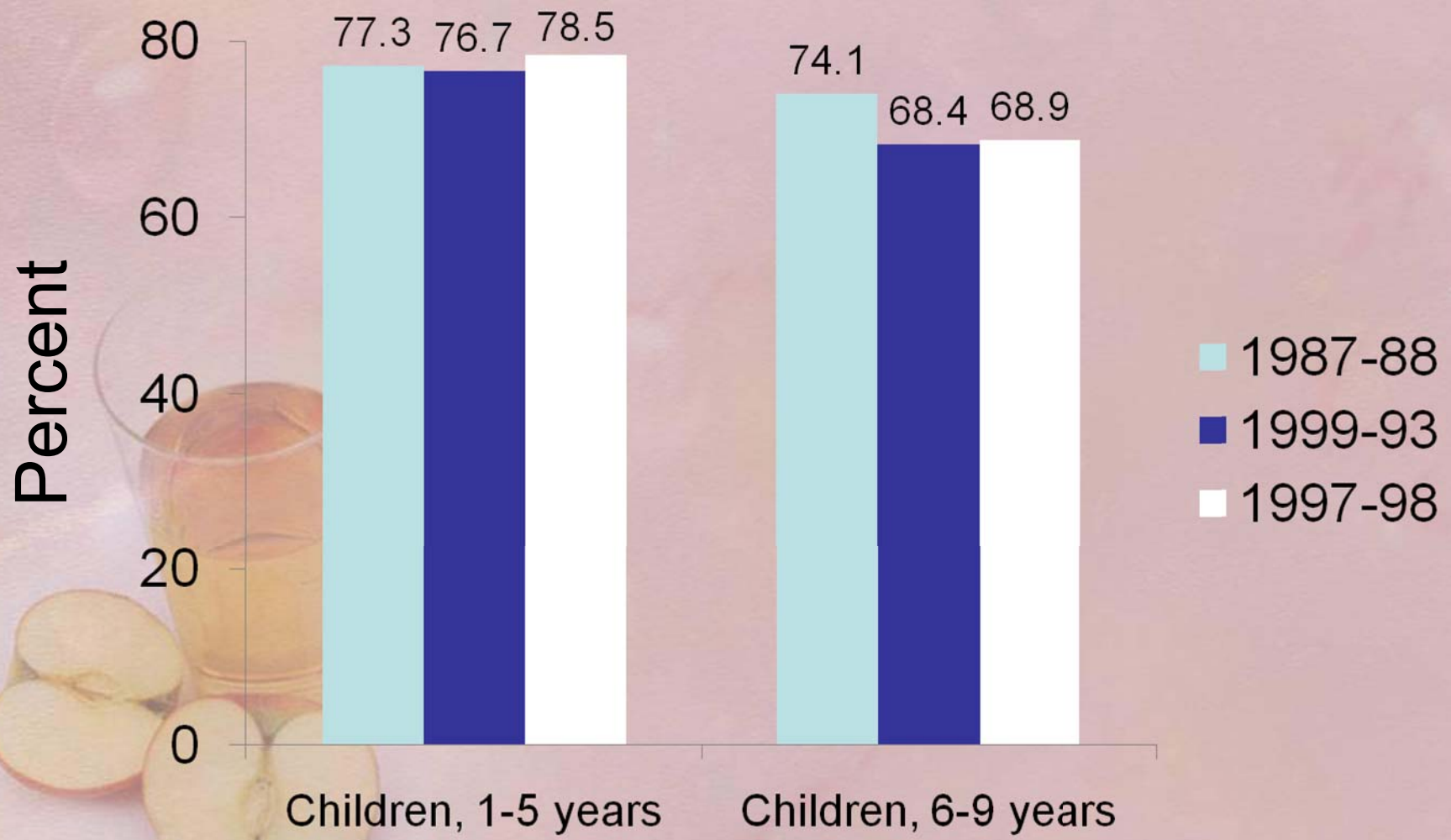
Reported dietary intakes of the following nutrients are low enough to be of concern:

- 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.



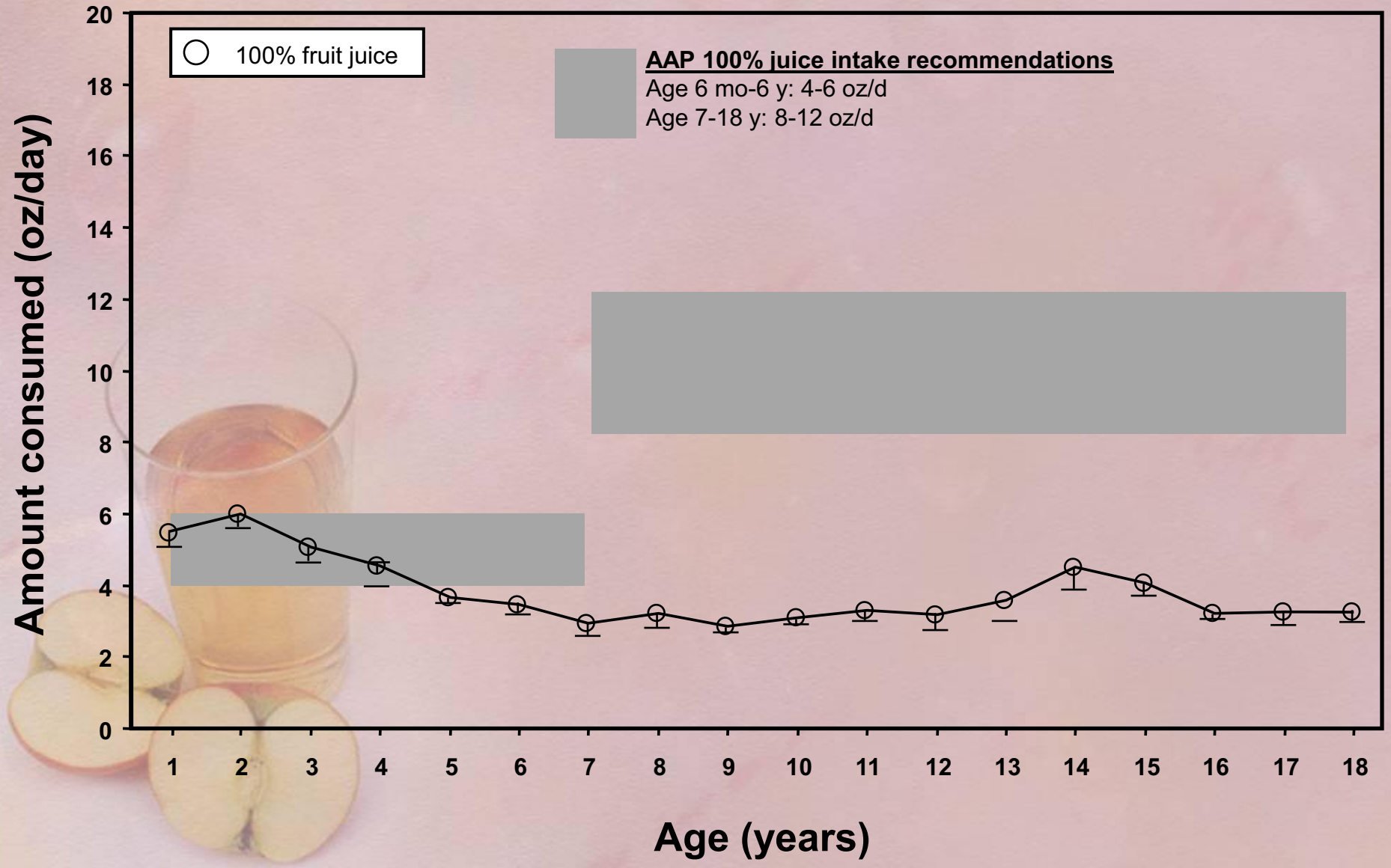
2005 Dietary Guidelines Advisory Committee Report

Percentage of Children Drinking Fruit Juice (1987-1998)

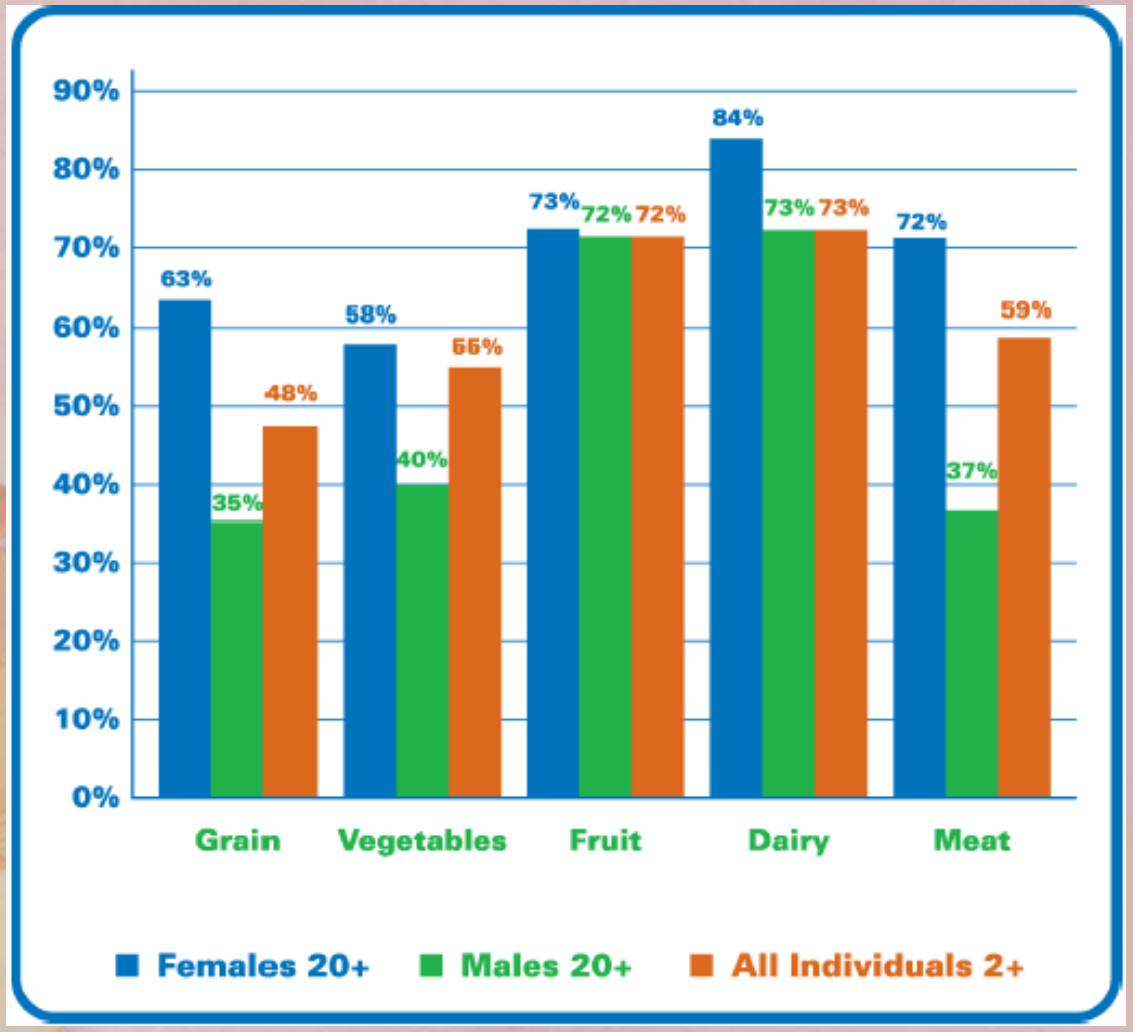


Park YK, et al. 2002 Fam Econ Nutr Rev 14(2):69-79

Daily Intake of 100% Fruit Juice of US Children and Adolescents (1994-1996, 1998)

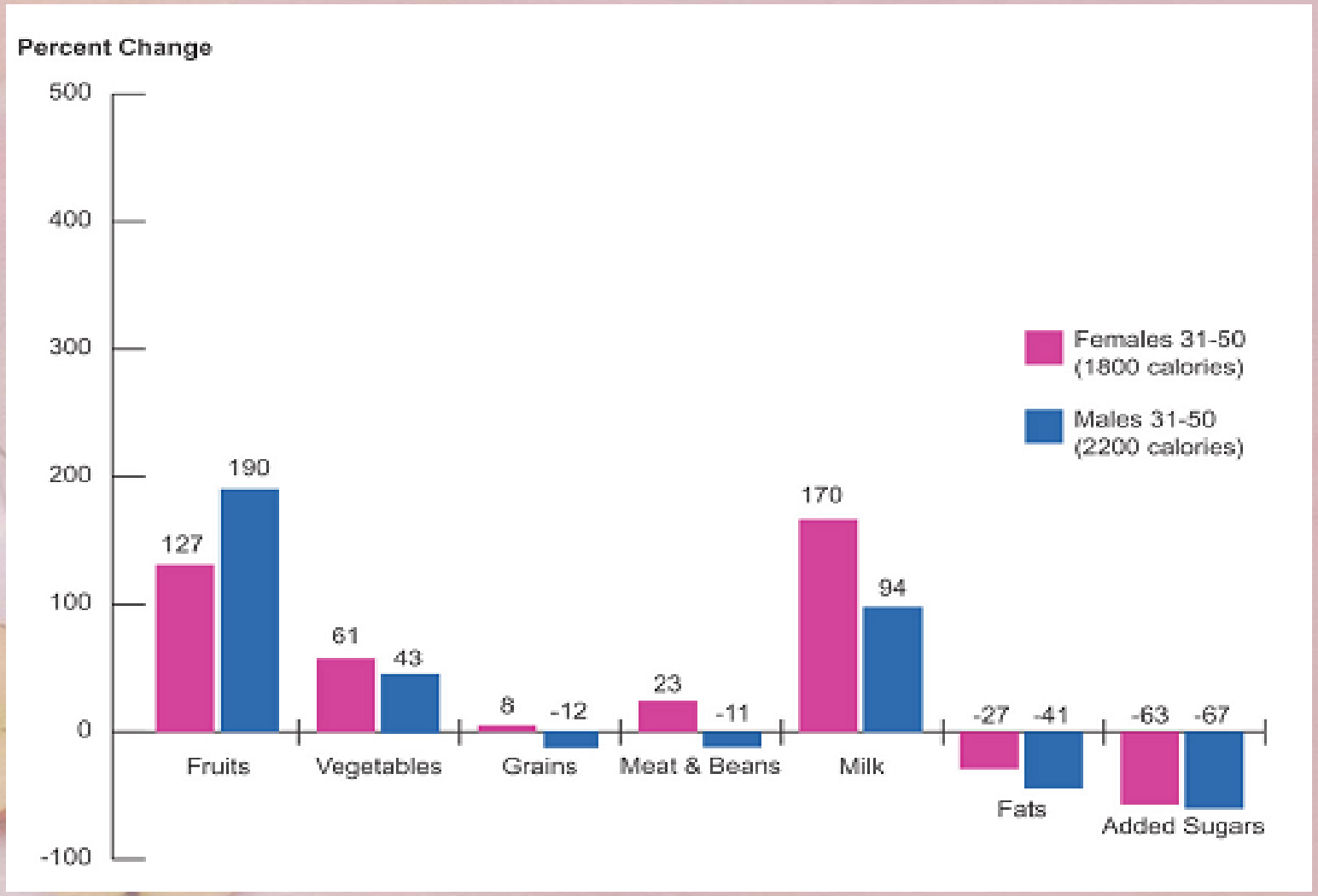


Percentage of Individuals Not Consuming the Recommended Number of Pyramid Servings Per Day



Zelman et al. 2006 Nutr Today 40(2):60-68

Proposed Changes in Food Group Consumption



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.

2005 Dietary Guidelines Advisory Committee Report

Changes in the Nutrient Profile of the Fruit Group with All Juices Replaced with Fruits

Nutrient	Original Nutrient Profile (fruit plus Juice)	Modified Nutrient Profile with Fruit Replacing Juices	Percentage Change
Vitamin A (mcg RAE)	18.7	33.38	+78.2%
Vitamin C (mg)	29.76	21.88	**-26.5%**
Folate (mcg)	28.30	14.02	**-50.5%**
Thiamin (mg)	0.066	0.040	**-39.6%**
Magnesium (mg)	14.559	13.289	**-8.7%**
Potassium (mg)	252.93	210.87	**-16.6%**
Calories	69.75	54.77	-21.5%
Fiber (g)	1.339	1.828	+36.6%

Amounts of Vitamin C in the Food Pattern with Fruit Intake Modified

Age/Sex Group (food pattern)	Vitamin C in Original Food Pattern (% RDA)	Vitamin C in Pattern without Fruit Juice (% RDA)	Vitamin C in Pattern with Fruit Replacing Juice (% RDA)
Females 51-70 (1600 calories)	123%	**74%**	102%
Females 31-50 (1800 calories)	141%	**92%**	120%
Males 51-70 (2000 calories)	151%	**89%**	125%
Males 31-50 (2200 calories)	151%	**90%**	125%

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.
- FJ are not nutritionally inferior to whole fruit and vegetables, in relation to chronic disease risk reduction (*Ruxton CHS, et al. Int J Food Sci Nutr. 2006;57(3/4):249-272).*

Consumption of Fruit is Protective Against Chronic Diseases

He FJ, Nowson CA, MacGregor GA. Fruit and vegetable consumption and stroke: meta-analysis of cohort studies. Lancet. 2006; 367(9507):320-326.

Hamer M, Chida Y. Intake of fruit, vegetables, and antioxidants and risk of type 2 diabetes: systematic review and meta-analysis. J Hypertens. 2007; 25(12):2361-2369.

Vainio H, Weiderpass E. Fruit and vegetables in cancer prevention. Nutr Cancer. 2006; 54(1):111-142.

Lunet N, Lacerda-Vieira A, Barros H. Fruit and vegetables consumption and gastric cancer: a systematic review and meta-analysis of cohort studies. Nutr Cancer. 2005; 53(1):1-10.

Nothing Captivates Like Juice