In adults, what is the relationship between the intake of vegetables and fruits, not including juice, and body weight?

Conclusion

The evidence for an association between increased fruit and vegetable intake and lower body weight is modest with a trend towards decreased weight gain over five or more years in middle adulthood. No conclusions can be drawn from the evidence on the efficacy of increased fruit and vegetable consumption in weight loss diets.

Grade: Moderate

Overall strength of the available supporting evidence: Strong; Moderate; Limited; Expert Opinion Only; Grade not assignable For additional information regarding how to interpret grades, click here.

Evidence Summary Overview

A modest association with decreased weight gain over five or more years in middle adulthood has been reported with increased vegetable and fruit. However, based on current studies, no conclusions can be drawn about the efficacy of increasing vegetable and fruit consumption in achieving weight loss, nor can any distinction be made about the relative influence of fruits vs. vegetables on weight status.

The review of evidence regarding weight gain and vegetable and fruit consumption was based on 11 studies (Bes-Rastrollo, 2006; Buijee, 2009; Davis, 2006; Fujioka, 2006; Goss, 2005; He, 2004; Ortega, 2006; Radhika, 2008; Tanumibardjo, 2009; Vioque, 2008; Xu, 2007). These studies were conducted around the globe and varied considerably in length of observation. Two of the randomized controlled trials (RCTs) (Fujioka, 2006; Ortega, 2006) collected data at an endpoint of only six weeks; a third RCT evaluated participants at three, 12 and 18 months. All indicated small, but significant, and non-sustainable weight loss over time with an intensive addition of vegetables and fruits to the diet. Similar results showing weak inverse relationships between vegetable and fruit consumption and weight gain were noted in the prospective (Buijsee, 2009; He, 2004; Vioque, 2008), case control (David, 2006) and cross-sectional studies (Bes-Rastrollo, 2006; Goss, 2005; Radhika, 2008) that followed participants over a longer time. The evidence is insufficient to ascertain the value of vegetable and fruit consumption in weight loss diets.

Relationship between Intake of Vegetables and Fruits and Body Weight

Study	Study Type	Association: Pos, Neg, None
Fujioka et al, 2006 **Quality rating:**	**RCT, consumption of various forms of grapefruit vs. placebo, US.**	**Fresh grapefruit associated with weight loss.**

Ortega et al, 2006 **Quality rating:**	**RCT, compared two weight loss programs promoting cereal or vegetable intake, Spain.**	**Both groups lost weight, but weight loss was greater in cereal group.**
Tanumihardjo et al, 2009 **Quality rating:**	**RCT, compared two weight loss programs - one with seven to eight servings of vegetables a day and the other with 3.5 to five servings of vegetables a day, US.**	**Both groups lost weight, but the moderate vegetable diet was more effective than high vegetable diet over the long term (18 months).**
Buijsse et al, 2009 **Quality rating:**	**Prospective cohort study, EPIC, UK and Europe.**	**Weight gain: (-) Vegetable and fruit.**
He et al, 2004 **Quality rating:**	**Prospective cohort study, Nurses' Health Study, US.**	**Weight gain: (-) Vegetable and/or fruit.**
Vioque et al, 2008 **Quality rating:**	**Prospective cohort study, Spain.**	**Weight gain: (-) Vegetable and/or fruit.**
Davis et al, 2006 **Quality rating:**	**Case-control, US.**	**Overweight or obese subjects consumed less fruit than normal-weight controls.**
Bes-Rastrollo et al, 2006 **Quality rating:**	**Cross-sectional analysis of prospective cohort, SUN Prospective Cohort, Spain.**	**Weight gain: (-) vegetable and fruit (men), Ø vegetable and fruit (women).**
Goss & Grubbs, 2005 **Quality rating:**	**Cross-sectional, US.**	**BMI: (-) Vegetable and fruit.**
Radhika et al, 2008 **Quality rating:**	**Cross-sectional, India.**	**BMI: (-) Vegetable and fruit.**
Xu et al, 2007 **Quality rating:**	**Cross-sectional, China.**	**Excess body weight: Ø Vegetables (fruit not examined).**

Executive Summary Paragraphs

Randomized Controlled Trials

Fujioka et al, 2006 (positive quality), a randomized, double-blind, placebo-controlled study compared the effects of fresh grapefruit, grapefruit juice, grapefruit capsules and placebo capsules on body weight and metabolic syndrome. Participants were 91 obese adults who were randomly assigned to four groups: 1) Placebo capsules and seven ounces of apple juice; 2) Grapefruit capsules with seven ounces of apple juice; 3) Eight ounces of grapefruit juice with placebo capsules; 4) Half of a fresh grapefruit (eaten before meals) with placebo capsules three times a day. Participants were asked to maintain their usual diet and were encouraged to walk 20 to 30 minutes, three to four times a week. Assessments were completed at baseline and 12 weeks; 77 participants completed the study. After 12 weeks, the fresh grapefruit group lost 1.6 kg, the grapefruit juice group lost 1.5kg, the grapefruit capsule group lost 1.1kg, and the placebo group lost 0.3kg. Weight loss in the fresh

grapefruit group (1.6kg) was significantly greater compared to placebo (0.3kg) after 12 weeks of treatment (P=0.048). In a secondary analysis of those with metabolic syndrome (34%), those in the grapefruit, grapefruit capsule and grapefruit juice groups demonstrated a significantly greater weight loss than those in the placebo group (P<0.02). The authors concluded that eating half a fresh grapefruit before each meal three times a day is associated with weight loss over three months in obese subjects.

Ortega et al, 2006 (positive quality), a randomized trial conducted in Spain, examined the effect of two hypocaloric diets promoting cereal or vegetable intake on weight loss in women. A total of 67 women began the study and 57 completed the six-week dietary intervention. Participants in the C group were encouraged to increase their consumption of cereal, especially breakfast cereal. Participants in the V group were encouraged to increase their consumption of greens and vegetables. At both two and six weeks, diet V was associated with an increase in the consumption of vegetables and diet C was associated with an increase in intake of cereals. Both diets led to a significant reduction in body weight and body mass index (BMI), both at week two and six. At six weeks, mean weight loss on diet C was significantly greater than diet V [mean (SD) = 2.8 (1.4) vs. 2.0 (1.3) kg, respectively; P<0.05]. The authors concluded that both diets were successful in reducing body weight and BMI, but diet C was significantly more effective than diet V.

Tanumihardjo et al, 2009 (positive quality), an RCT conducted in the US, investigated if encouraging high vegetable (eight servings) and moderate fruit (two to three servings) intake would result in weight reduction in obese individuals. Participants were 60 obese adults (73% female; 78% Caucasian; 21 to 50 years old) who were randomly assigned to High Vegetable Group or Reduction Group. Both groups received food (two meals and one snack a day, five days a week) and education (two group lessons a week plus individual consultation, as requested) for the first three months followed by a one-month transition that included food two days a week and limited education (no group sessions, but individual consultations, as requested). During month five to 18, participants were asked to maintain their dietary strategy, and support calls were provided with gradually decreasing frequency (from weekly to monthly). Both groups were taught to follow a healthy eating plan as described by the Food Guide Pyramid. The High Vegetable Group was provided seven to eight servings of vegetables and two servings of fruit a day, and they were asked not to eat potato chips, fried vegetables or fruit or vegetable juices to meet goals. The Reduction Group was provided 3.5 to four servings of vegetables and two servings of fruit a day and they were encouraged to reduce caloric intake by 500kcal a day from estimated kcal needed for weight maintenance and to consume less than 25% of kcal from fat. Assessments were completed at baseline, three, 12, and 18 months [dietary intake: three-day diet records; height, weight, and body composition (air displacement plethysmography) measured by study personnel]. Three-, 12-, and 18-month follow-up was completed by 93%, 75% and 53%, respectively. Both groups lost weight after three months, but only the Reduction Group maintained weight loss at 12 and 18 months. However, the High Vegetable Group did not regain weight above baseline. In the High Vegetable Group, weight and fat-mass were lower than baseline at three months (P=0.0087 and P=0.0002, respectively), while fat-free mass increased from baseline at three months (P=0.0075). Body mass index (BMI) was lower than baseline at only three months (P=0.014). The Reduction Group decreased weight at three (P<0.0001), 12 (P=0.0001), and 18 (P=0.019) months. Fat mass was lower than baseline at three (P<0.0001) and 12 (P=0.0032) months, and fat-free mass did not differ from baseline at any follow-up (P>0.058). Mean BMI was lower than baseline at all three follow-ups (P<0.045). Daily energy consumed did not differ between the groups long-term, but the Reduction Group consumed fewer kcals per day than the High Vegetable Group at three months (P=0.033). The Reduction Group also increased their physical activity relative to baseline, and the High Vegetable Group did not. At three months, only 39.1% of the High Vegetable Group consumed more than seven servings of

vegetables a day. The increased vegetable and moderate amounts of fruit diet was not as effective for weight loss as the more traditional energy and fat restriction diet after three months of an intensive food and education intervention or for weight loss maintenance long-term.

Prospective Cohort Studies

Buijsse et al, 2009 (positive quality), the prospective European Prospective Investigation into Cancer and Nutrition (EPIC) study, assessed whether baseline fruit and vegetable intake was associated with subsequent changes in body weight. A total of 89,432 men and women from Denmark, Germany, United Kingdom, Italy and the Netherlands were included in the analysis. Over a mean follow-up of 6.5 years, men and women gained weight over time in all cohorts, with an overall mean weight change of 330g per year. Fruit and vegetable intake was weakly inversely associated with weight change; per 100g intake of fruit and vegetables, weight change was -14g per year (95% CI: -19, -9g per year).

He et al, 2004 (positive quality), a prospective cohort study (Nurses' Health Study) examined the changes in intake of fruits and vegetables with respect to the risk of obesity and weight gain among middle-aged women. The authors analyzed data from 74,063 female nurses aged 38 to 63 years [free of cardiovascular disease (CVD), cancer and diabetes at baseline] from 11 US states. Median daily intake of fruits was 1.9 servings and of vegetables was 3.2 servings. Participants with high fruit and vegetable intakes exercised more, smoked less and were more likely to use postmenopausal hormones. During the 12-year follow-up, participants tended to gain weight with aging, but those with the largest increase in fruit and vegetable intake had a 24% lower risk of becoming obese compared with those who had the largest decrease in intake after adjustment for age, physical activity, smoking, total energy intake and other lifestyle variables (RR=0.76; 95% CI: 0.69, 0.86; P<0.0001). For major weight gain (25kg or more), women with the largest increase in intake of fruits and vegetables had a 28% lower risk compared to those in the other extreme group (RR=0.72; 95% CI: 0.55, 0.93; P=0.01). Similar results were observed for changes in intake of fruits and vegetables when analyzed separately.

Vioque et al, 2008 (neutral quality), a cohort study conducted in Spain, investigated the association between the intake of fruits and vegetables and weight gain over a 10-year period in an adult Mediterranean population. A total of 89 men and 117 women were included in the analysis. The 10-year weight gain was significantly lower with increasing quartile of fruit and vegetable intake (P=0.0001). Compared to participants in the lowest quartile of fruit consumption (less than 149 g per day), participants in the third quartile (249 to 386g per day) reduced their risk of gaining more than 3.41 kg by 69% (OR=0.31, 95% CI: 0.11, 0.85; P=0.044). Concerning vegetable intake, the risk of weight gain was lowest in participants of the fourth quartile (more than 333g per day), which had an 82% reduced risk of gaining 3.41kg or more over the 10-year period (OR=0.18; 95% CI: 0.05, 0.66; P=0.017). When fruits and vegetables were combined, the risk of weight gain decreased across quartiles, with the lowest risk among those in the fourth quartile (OR=0.22; 95% CI: 0.06, 0.81; P=0.022).

Case-Control Study

Davis et al, 2006 (positive quality), a case-control study conducted in the US, assessed differences in dietary intake between overweight and obese subjects and normal weight controls matched for age, sex and height. A total of 138 subjects were initially included; the final sample consisted of 104 adults, 52 overweight or obese subjects and 52 normal weight controls. The overweight and obese group was 31 kg heavier and had 71% more body fat than their controls; they also consumed significantly more total fat, saturated fat and cholesterol and significantly less carbohydrate (CHO), complex CHO and dietary fiber per 1,000kcal (all P<0.01). On average, overweight or obese

subjects consumed one less fruit serving per day than their normal weight counterpart (P<0.01) and servings of fruit per day were negatively related to percent body fat (R=-0.40, P<0.01).

Cross-Sectional Studies

Bes-Rastrollo et al, 2006 (neutral quality), a cross-sectional analysis of the Seguimiento Universidad de Navarra (SUN) prospective cohort study conducted in Spain, determined the association between fiber intake and fruit and vegetable consumption with the likelihood of weight gain in the previous five years in a Mediterranean population. A total of 5,094 men and 6,613 women were included in the analysis. Multivariate-adjusted OR for self-reported weight gain across quintiles of fiber intake were 1.00 (reference), 0.86, 0.86, 0.70 and 0.52 (P<0.001) among men and 1.00 (reference), 0.99, 1.08, 1.05 and 0.72 (P=0.005) among women. There was a significant inverse association between total fruit and vegetable consumption and weight gain, but only among men (adjusted OR across quintiles: 1.00, 0.78, 0.89, 0.70, and 0.54, P<0.001).

Goss et al, 2005 (neutral quality), a cross-sectional study compared BMI, consumption of fruits and vegetables, smoking and physical activity in residents of the seven Florida counties with the highest reported BMI (N=3,559) and the seven Florida counties with the lowest reported BMI (N=3,501). The authors utilized the 2002 data from the Florida Department of Health Behavioral Risk Factor Surveillance System. In counties with the highest mean BMI, 40.5% ate three or less fruits and vegetables per day, compared to 30.3% in counties with the lowest mean BMI. Similarly, 59.6% in the counties with the highest mean BMI ate three or more fruits and vegetables per day, compared with 69.6% of respondents from counties with the lowest mean BMI. Pearson chi-square analyses showed a significant difference for fruit and vegetable consumption between the seven highest and lowest mean BMI counties $\chi 2$ (3, N=7,054) = 89.0, P<0.001. A positive relationship between mean BMI and consumption of fruits and vegetables remained when controlled for physical activity, but not for smoking.

Radhika et al, 2008 (positive quality), a population-based cross-sectional study, evaluated the association of fruit and vegetable intake with cardiovascular risk factors such as obesity, hypertension (HTN), fasting plasma glucose and dyslipidemia in urban Asian Indians living in southern India. A total of 983 adults were included in the analysis. After adjusting for potential confounders, the highest quartile of fruit and vegetable intake (g per day) showed a significant inverse association with BMI (β=-2.3kg/m^2; 95% CI: -2.96, -1.57, P<0.0001) and waist circumference (WC) (β=-2.6cm; 95% CI: -3.69, -1.46, P<0.0001) when compared with the lowest quartile.

Xu et al, 2007 (neutral quality), a cross-sectional study examined the association of red meat and vegetable consumption with excess body weight. Data (N=23,316) from a large-scale population-based cross sectional study from Nanjing municipality (three urban districts and two rural counties) was used to evaluate meat and vegetable consumption as well as anthropometrics. Results showed that 95.3% of participants consumed more than 100g of vegetable per day. Urban residents consumed more red meat (OR=3.96; 95% CI: 3.79, 4.13) and fewer vegetables (OR=0.84; 95% CI: 0.80, 0.88). Excess body weight was not statistically associated with consumption of vegetables (OR=1.05; 95% CI: 0.91, 1.21).

Research Design and Implementation Rating Summary
For a summary of the Research Design and Implementation Rating results, click here.

Worksheets

Bes-Rastrollo M, Martinez-Gonzalez MA, Sanchez-Villegas A, de la Fuente Arrillaga C, Martinez JA. Assocation of fiber intake and fruit/vegetable consumption with weight gain in a Mediterranean population. *Nutrition* 2006;22(5):504-11.

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Xu F, Yin XM, Tong SL. Association between excess bodyweight and intake of red meat and vegetables among urban and rural adult Chinese in Nanjing, China. Asia *Pac J Public Health.* 2007; 19(3): 3-9.