Is intake of dietary fiber related to adiposity in children?

Conclusion

There is insufficient evidence that dietary fiber is associated with adiposity in children.

Grade: Limited

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 literature search conducted during the Nutrition Evidence Library (NEL) review of this research question yielded six studies for the final review: Two randomized clinical trials (RCT) (Ventura, 2009; Vido, 1993) and four longitudinal studies (Berkey, 2000; Cheng, 2009; Davis, 2009; Newby, 2003). Studies with a cross-sectional design were excluded.

Of the two RCTs included in the review, one by Ventura et al, (2009) found an inverse protective effect of dietary fiber on adiposity. In this 16-week trial, overweight Latino adolescents (mean age 15 years) who increased dietary fiber intake, had an improvement in body mass index (BMI) (-2% vs. +2%; P=0.01) and visceral adipose tissue (-10% vs. no change; P=0.03), compared with controls. A second study by Vido et al, (1993) compared the effects of a dietary fiber supplement (glucomannan, 1g twice a day) vs. placebo, on weight change in 60 overweight, Italian children (mean age 11.2 years). At the end of the intervention, weight decreased significantly in both treatment groups (P<0.01). However, the difference between the groups was not significant (NS).

One of the four longitudinal studies found an inverse, protective association between dietary fiber intake and adiposity in children. Davis et al, (2009) conducted a longitudinal study of dietary intake on metabolic risk factors in 85 overweight Latino youth, 11-17 years of age. They assessed the relation between changes in dietary intake, specifically dietary fiber and sugar intakes, with changes in adiposity and risk factors for type 2 diabetes (T2D). Overweight Latino youth (N=85, ages 11-17 years) were followed for two years and data collected included dietary intake by two-day diet recalls, body composition by dual-energy X-ray absorptiometry (DEXA) and magnetic resonance imaging and glucose and insulin indexes by oral- and intravenous-glucose-tolerance tests. Results showed that increases in total dietary fiber (grams per 1,000kcal) and insoluble fiber (grams per 1,000kcal) were associated with decreases in visceral adipose tissue (VAT) (r= -0.29; P=0.02 and r= -0.27; P=0.03, for total dietary fiber and insoluble fiber, respectively. In addition, participants who decreased their total fiber intake during the study (mean decrease approximately 3 grams per day) had significant increases in VAT compared to subjects who had increased dietary fiber (21% compared with -4%; P=0.02). No relationship was found between other dietary variables, including sugar and visceral adiposity.

Three other longitudinal studies found no association between dietary fiber intake and adiposity in children. Berkey et al, (2000) studied dietary intake, physical activity and inactivity among 10,769 US children, ages nine to 14 years, and concluded that there were no significant associations between energy-adjusted dietary fiber or dietary fat and BMI. Cheng et al, (2009) assessed dietary

intake and adiposity in a cohort of 215 German adolescents from puberty onset until four years later. They found that neither dietary fiber intake, whole grain intake, dietary glycemic index, nor glycemic load were associated with changes in percent body fat or BMI z-score throughout puberty. Newby et al, (2003) measured dietary intake and adiposity at baseline and again six to 12 months later in a cohort of 1,379 low-income US preschool children enrolled in the Womens, Infants and Children (WIC) program. In this population, intake of total dietary fiber was not associated with weight change. However, intake of breads and grains was associated with a lower weight change per year ($P<0.01$).

In summary, the NEL systematic review identified few prospective studies and clinical trials that examined the relationship between dietary fiber and adiposity in children, and evidence from these studies was mixed. Thus, the review led to the conclusion that there is insufficient evidence at present to support the hypothesis that dietary fiber is protective against obesity in children. Regardless of evidence for or against a role for dietary fiber in regulating adiposity in children, the health benefits of adequate dietary fiber in childhood are significant. Children should be encouraged to consume greater amounts and varieties of high fiber foods in order to increase nutrient density, promote healthy lipid profiles, glucose tolerance and normal gastrointestinal function. Currently, dietary fiber is under-consumed by US children, whose intake is far less than the recommended adequate intake (AI) of 14 grams of per 1,000 kcal. Thus, public health strategies to increase consumption of dietary fiber are vitally important to promote the health of US children.

Evidence Summary Paragraphs

Randomized Controlled Trials (2)

Ventura E et al, 2009 (positive quality) conducted an RCT in the US to examine if increases in dietary fiber or reductions in added sugar during a 16-week dietary intervention were related to improvements in T2D risk. Subjects were randomized to one of two groups; the nutrition group, which emphasized decreasing sugar consumption and increasing fiber consumption, or the nutrition plus strength training group, which also included strength training two times per week. Dietary intake was measured by three-day records, body composition by DEXA, and visceral adipose tissue by MRI, with measurements being taken at baseline and 16 weeks. The final sample included 54 overweight Latino children (mean age=15 years). Subjects were divided in categories based on whether the decreased sugar or increased fiber intake. Results showed that 59% of subjects increased fiber intake (mean increase 5 g per day), and 55% of subjects decreased added sugar intake (mean decrease, 47g per day). Those who increased fiber intake had an improvement in BMI (-2% vs. + 2%; $P=0.01$) and visceral adipose tissue (-10% vs. no change; $P=0.03$). Thus, in this study, increasing dietary fiber intake by 5g a day was associated with decreased adiposity.

Vido L et al, 1993 (neutral quality) conducted an RCT in Italy to evaluate the efficacy of glucomannan for child obesity management. In this double-blind randomized controlled trial (RCT), children were randomly assigned to either a glucomannan supplement (1 g twice a day for two months) or placebo. Dietary intake was assessed every two weeks by a diet record book. The final sample included 60 overweight children (mean age 11.2 years). At the end of the two-month intervention, mean percent overweight for the fiber-supplemented group had decreased from 49.5% to 46.1% and that of the placebo group from 43.9% to 41.7%. Both decreases were significant ($P<0.01$), however, the difference between groups was not statistically significant (NS).

Cohort Studies (4)

Berkey CS et al, 2000 (positive quality) examined the role of physical activity, inactivity, and dietary patterns on annual weight changes among US pre-adolescents and adolescents, taking growth

and development into account. Each child provided his or her current height and weight and a detailed assessment of typical past-year dietary intakes [food frequency questionnaire (FFQ)], physical activities, recreational inactivities (TV, videos/VCR and video/computer games) and follow-up occurred one year later. Subjects consisted of a cohort of 6,149 girls and 4,620 boys, age nine- to 14-years-old at baseline in 1996. There were NS associations between energy-adjusted dietary fiber intake and BMI changes over the one-year study period.

Cheng G et al, 2009 (positive quality) prospectively examined whether change in dietary glycemic index (GI), glycemic load (GL), fiber intake or whole grain intake during puberty is associated with concurrent change in percentage of body fat (%BF) or BMI. Subjects were participants from the Dortmund Nutritional and Anthropometric Longitudinally Designed (DONALD) Study (Dortmund, Germany) who completed weighed three-day dietary records and anthropometric data at puberty onset (defined by age at takeoff) and over the subsequent four years. The final sample included 215 adolescents (99 boys, 116 girls; mean age=9.4 years at baseline). Changes in fiber intake was not associated with changes in %BF throughout puberty. Similarly, no concurrent associations were observed between dietary fiber intake and BMI.

Davis et al, 2009 (positive quality) analyzed prospective cohort data from the US to assess the relationship between longitudinal changes in dietary intake and metabolic risk factors in Latino youth. Subjects were assessed at baseline and annually for two years. Body mass index was determined using measured height and weight, DEXA was used to assess body fat, and dietary intake was assessed from two 24-hour diet recalls. The final sample included 85 children (48 boys, 37 girls; mean age=14 years at baseline). Increases in total dietary fiber intake and insoluble fiber intake were associated with decreases in visceral adipose tissue ($P<0.05$). Participants who decreased fiber intake had significant increases in visceral adipose tissue compared to those who increased fiber intake (21% vs. -4%; $P=0.02$). The authors concluded that small reductions in dietary fiber intake were associated with decreased adiposity over a two-year period.

Newby PK et al, 2003 (positive quality) examined the relationship between dietary composition and weight change in a prospective study of low-income children participating in the North Dakota WIC Program. Dietary intake (FFQ completed by parent for child), anthropometric measures (height, weight, BMI) and sociodemographic data was obtained for children on two visits ranging from six to 12 months apart. The final sample included 1,379 children (age two to five years). Results showed NS associations between total intake of dietary fiber and weight change. The authors note that although fiber intake was not related to weight change, intake of WIC program-defined breads and grains was the strongest predictor of weight change in the study. In this case, there was a 0.16kg weight loss per year (95% CI, -0.20 to -0.12kg; $P<0.01$) with each additional daily serving of WIC program-defined breads and grains. The WIC program-defined breads and grains, however, included foods with widely differing macronutrient and fiber content, such as macaroni and cheese, spaghetti with tomato sauce, cereals and rice. The authors conclude that intake of WIC program-defined breads and grains, but not fiber per se, was associated with lower weight gain per year.

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Author, Year, Study Design, Class, Rating	Participants	Methods	Outcomes

Berkey CS, Rockett HRH, et al 2000 Study Design: Prospective Cohort Study Class: B Rating:	N=6,149 girls and 4,620 boys. Age: Nine to 14 years.	Each child provided his or her current height and weight and a detailed assessment of typical past-year dietary intakes (FFQ), physical activities, recreational inactivities (TV, videos/VCR and video/computer games) and follow-up occurred one year later.	There were NS associations between energy-adjusted dietary fiber intake and BMI Δs over the one-year study period.
Cheng G et al 2009 Study Design: Prospective Cohort Study Class: B Rating:	N=215 (99 boys, 116 girls). Mean age: 9.4 years at baseline. The DONALD study.	Subjects completed weighed three-day dietary records and anthropometric data at puberty onset and over the subsequent four years.	Δs in fiber intake was not associated with Δs in %BF or BMI.
Davis JN, Alexander KE et al, 2009 Study Design: Cross-Sectional Study Class: D Rating:	N=85 (48 boys, 37 girls). Mean age: 14 years at baseline.	Subjects were assessed at baseline and annually for two years. BMI was determined using measured height and weight, DEXA was used to assess body fat and dietary intake was assessed from two 24-hour diet recalls.	↑ in total dietary fiber intake and insoluble fiber intake were associated with ↓ in visceral adipose tissue ($P<0.05$). Participants who ↓ fiber intake had significant ↑ in visceral adipose tissue, compared to those who ↑ fiber intake (21% vs. -4%; $P=0.02$).
Newby PK, Peterson KE et al, 2003 Study Design: Cohort study (longitudinal, prospective) Class: B	N=1,379. Age: Two to five years.	Dietary intake (FFQ completed by parent for child), anthropometric measures (height, weight, BMI), and sociodemographic data was obtained for children on two visits ranging from six to 12 months apart.	Results showed NS associations between total intake of dietary fiber and weight Δ. Intake of WIC program-defined breads and grains was the strongest predictor of weight Δ in the study (0.16kg weight loss per year (95% CI -0.20 to -0.12kg;

Rating: 			P<0.01) with each additional daily serving of WIC program-defined breads and grains. WIC program-defined breads and grains, however, included foods with widely differing macronutrient and fiber content, such as macaroni and cheese, spaghetti with tomato sauce, cereals and rice.
Ventura E et al 2009 Study Design: Randomized controlled trial Class: A Rating: 	N=54 Latino adolescents. Age: 15.5 years.	Subjects were in a 16-week intervention with three groups: Control, nutrition or nutrition plus strength training. Nutrition classes, held once per week, focused on ↓ added sugar and ↑ fiber. Main outcome measures included body composition (measured by DEXA) and dietary intake (measured using three-day records).	55% of subjects ↓ sugar intake (-47g per day) and 59% ↑ fiber intake (+5g per day), with similar percentages in all intervention groups, including controls. Those who ↑ fiber intake had an improvement in BMI (-2% vs. + 2%; P=0.01) and visceral adipose tissue (-10% vs. no Δ; P=0.03).
Vido L et al 1993 Study Design: Randomized Controlled Trial Class: A Rating: 	N=60 overweight children. Mean age: 11.2 years.	In this double-blind RCT, children were randomly assigned to either a glucomannan supplement (1 gram twice a day for two months) or placebo. Dietary intake was assessed every two weeks by a diet record book.	At the end of the two month intervention, mean percent overweight for the fiber-supplemented group had ↓ from 49.5% to 46.1% and that of the placebo group from 43.9% to 41.7%. Both ↓ were significant (P<0.01), however, the difference between groups was NS.

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

Worksheets

Berkey CS, Rockett HRH, Field AE, Gillman MW, Frazier AL, Camargo CA, Colditz GA. Activity, dietary intake, and weight changes in a longitudinal study of preadolescent and adolescent boys and girls. *Pediatrics* 2000; 105: 1-9.

Cheng G, Karaolis-Danckert N, Libuda L, Bolzenius K, Remer T, Buyken AE. Relation of dietary glycemic index, glycemic load, and fiber and whole-grain intakes during puberty to the concurrent development of percent body fat and body mass index. *Am J Epidemiol.* 2009 Mar 15;169(6):667-77.

Davis JN, Alexander KE, Ventura EE, Toledo-Corral CM, Goran MI. Inverse relation between dietary fiber intake and visceral adiposity in overweight Latino youth. *Am J Clin Nutr.* 2009; 90: 1,160-1,166.

Newby PK, Peterson KE, Berkey CS, Leppert J, Willett WC, Colditz GA. Dietary composition and weight change among low-income preschool children. *Arch Pediatr Adolesc Med.* August 2003;157(8):759-64.

Ventura E, Davis J, Byrd-Williams C, Alexander K, McClain A, Lane CJ, Spruijt-Metz D, Weigensberg M, Goran M. Reduction in risk factors for type 2 diabetes mellitus in response to a low-sugar, high-fiber dietary intervention in overweight Latino adolescents. *Arch Pediatr Adolesc Med.* 2009 Apr;163(4):320-7.

Vido L, Facchin P, Antonello I, Gobber D, Rigon F. Childhood obesity treatment: double blinded trial on dietary fibres (glucomannan) versus placebo. *Padiatr Padol.* 1993;28(5):133-6.