What does Skipping Breakfast do to the Metabolism?

Many research articles have been published concerning effects of eating versus skipping breakfast. I limited my search to those articles that focused on some aspect of metabolism, and not on other aspects, such as academic performance after eating or not eating breakfast.

My overall summary: Most of the small, short-term, lab-based research findings are more favorable for those who eat breakfast than for those who skip breakfast. In large population studies, associations have been found favoring eating breakfast, but no causality can be determined at this time for any body weight differences between those groups who eat breakfast and those who skip breakfast.

1. **Regarding body weight:**
   a. In short-term laboratory-based research studies studying body weight changes that compared eating breakfast with skipping breakfast, there was no significant effect on weight loss.
   b. In longitudinal studies following the same groups of teens over a period of years, frequency of eating breakfast was inversely associated with body mass index in a dose-response manner; and breakfast skipping increased during the transition of adolescence into adulthood and was associated with increased weight gain. However, in another longitudinal study of teens, the independent effect of breakfast was no longer significant after parental education, energy intake and physical activity were accounted for.
   c. Results of population-based studies linking higher body weight and risk for type 2 diabetes to breakfast skipping habits may not mean much, since many socio-economic factors play a role in whether a person eats breakfast and these same factors may influence body weight and chronic disease risk. These factors are hard to account for in population-based studies.
2. **Regarding other metabolic factors:**
   a. In short-term laboratory-based research studies studying specific metabolic factors and that compared eating breakfast with skipping breakfast, skipping breakfast was associated with more metabolic problems, including: higher blood sugar; higher blood pressure; the same or lower energy expenditure; impaired ability to do physical activity later that day, even after consuming lunch; increased sensations of hunger; and decreased energy metabolism.

Here are summaries of the findings of various studies, organized into two categories: body weight and other metabolic factors. The most recent studies are at the top of each list.

1. Body weight

- Family sociodemographic characteristics as correlates of children's breakfast habits and weight status in eight European countries. The ENERGY (EuropeaN Energy balance Research to prevent excessive weight Gain among Youth) project. Manios Y, Moschonis G, Androutsos O, Filippou C, Van Lippevelde W, Vik FN, te Velde SJ, Jan N, Dössegger A, Bere E, Molnar D, Moreno LA, Chinapaw MJ, De Bourdeaudhuij I, Brug J. Public Health Nutr.2015; 18(5):774-83

Kansas State University Agricultural Experiment Station and Cooperative Extension Service, Manhattan, KS.

Conclusion: Children of native parents, with both parents employed and with at least one parent having more than 14 years of education were more likely to consume breakfast daily and less likely to be overweight/ obese.

- Characterization of childhood obesity and behavioral factors. Olson J, Aldrich H, Callahan TJ, Matthews EE, Gance-Cleveland B. J Pediatric Health Care.2015;Nov 21. DOI: http://dx.doi.org/10.1016/j.pedhc.2015.10.009

Conclusion: The frequency of eating breakfast ($p = .04$) was a significant predictor of being overweight/obese in 105 school age children.

- The effectiveness of breakfast recommendations on weight loss: A randomized controlled trial. Dhurandhar EJ, Dawson J, Alcorn A, Larsen LH, Thomas EA, Cardel M, Bourland AC, Astrup A, St-Onge M-P, Hill JO, Apovian CM, Shikany JM, Allison DB. Am J Clin Nutr.2014;100:507–513.

We conducted a multisite, 16-wk, 3-parallel-arm randomized controlled trial in 283 otherwise healthy overweight and obese, free-living adults who were attempting to lose weight. We compared weight change in a control group with weight change in experimental groups told to either eat breakfast or to skip breakfast. Self-reported compliance with the recommendation was 93.6% for the breakfast group and 92.4% for the no breakfast group. Treatment assignment did not have a significant effect on weight loss, and there was no interaction between initial breakfast eating status and treatment.

- The causal role of breakfast in energy balance and health: A randomized controlled trial in lean adults. Betts JA, Richardson JD, Chowdhury EA, Holman GD, Tsintzas K, Thompson D. Am J Clin Nutr.2014;100:539–547.

This study was designed to examine mechanisms linking daily breakfast and components of energy balance in 33 free-living adults. Daily morning fasting for 6 weeks did not cause weight gain in this population. There was no metabolic adaptation (that is, no increased resting metabolism) to 6 weeks of daily breakfast of at least 700 kcals, nor any meaningful suppression of energy intake later in the day. Overall reported dietary energy intake was 539 kcal/d lower when fasting until 1200 than when consuming a breakfast of 700 kcal before 1100 daily, with no difference between treatments in terms of the frequency, timing, or composition of meals consumed from 1200 onward. The major factor that compensated for the difference in morning eating patterns in this study was that regular daily breakfast resulted in significantly higher physical activity thermogenesis than occurred with extended morning fasting. This difference in the energy expended via daily physical activities was partially attributable to a significant difference in light-intensity activities performed during the morning. Blood glucose data collected suggest that regularly skipping breakfast may elicit adaptations to progressively increase systemic glucose appearance and/or impair glucose disposal when the overnight fast remains unbroken until after 1200.

- Belief beyond the evidence: Using the proposed effect of breakfast on obesity to show 2 practices that distort scientific evidence. Brown AW, Bohan Brown MM, Allison DB. Am J Clin Nutr.2013;98:1298–1308.

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The belief in the proposed effect of breakfast on obesity exceeds the strength of scientific evidence. The scientific record is distorted by both biased research reporting, including improper use of causal language, and by research lacking probative value, which is a suboptimal use of collective scientific resources. The observational literature has gratuitously established the association, but not the causal relation, between skipping breakfast and obesity (our study's final cumulative meta analysis P value was $<10^{-42}$), which is evidence of research lacking probative value.

- Systematic review demonstrating that breakfast consumption influences body weight outcomes in children and adolescents in Europe. Szajewska H, Ruszczyński M. Critical Rev Food Sci & Nutr.2010;50(2):113-119.

There is uncertainty regarding whether breakfast consumption contributes to or protects against overweight or obesity. The results of this analysis of 16 studies suggest that eating breakfast is associated with a reduced risk of becoming overweight or obese and a reduction in the BMI in children and adolescents in Europe. Almost all of the data in this review were gathered from observational studies, thus, causality should not be assumed based on these findings.

- Benefits of breakfast for children and adolescents: update and recommendations for practitioners. Rampersaud GC. Am J Lifestyle Med.2009;3(2):86-103.

Cross-sectional studies support that eating breakfast more often may help children and adolescents maintain a healthful weight. However, the results from longitudinal studies are inconclusive and suggest that more research is needed to clarify this relationship, including understanding the mediating effects of initial weight status, dieting behavior, and physical activity levels.

- Breakfast eating and weight change in a 5-year prospective analysis of adolescents: Project EAT (Eating Among Teens). Timlin MT, Pereira MA, Story M, Neumark-Sztainer D. Pediatrics.2008; 121(3):e638-45.

This study was conducted to examine the association between breakfast frequency and 5-year body weight change in 2,216 adolescents. Multivariable linear regression was used to examine the association between breakfast frequency and change in BMI, with adjustment for age, socioeconomic status, race, physical activity, time 1 BMI and breakfast category, and time 1 dietary and weight-related variables. Conclusions: Inverse associations between breakfast frequency and BMI remained largely independent of all of the confounding and dietary factors. In prospective analyses, frequency of breakfast was inversely associated with BMI in a dose-response manner. Experimental studies are needed to verify whether the association between breakfast and body weight is of a causal nature.

- Fast food consumption and breakfast skipping: predictors of weight gain from adolescence to adulthood in a nationally representative sample. Niemeier HM, Raynor HA, Lloyd-Richardson EE Rogers ML, Wing RR. J Adolesc Health.2006;39(6):842-849.

This study investigated whether fast food consumption and breakfast skipping are associated with weight gain during the transition from adolescence to adulthood using a prospective study of 9,919 adolescents (age range 11–21 years at time 1 and age range 18–27 years at time 2). Conclusion: Fast food consumption and breakfast skipping increased during the transition to adulthood, and both dietary behaviors are associated with increased weight gain from adolescence to adulthood.

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- Breakfast consumption by African-American and white adolescent girls correlates positively with calcium and fiber intake and negatively with body mass index. Affenito SG, Thompson DR, Barton BA, Franko DL, Daniels NV, Obarzanek E, Schreiber GB, Striegel-Moore RH. J Amer Dietetic Assoc.2005;105(6):938-945.

The goal was to describe age-and race-related differences in breakfast consumption and to examine the association of breakfast intake with dietary calcium and fiber and body mass index. Data were from the National Heart, Lung, and Blood Institute Growth and Health Study, a 9-year, longitudinal biracial cohort study with annual 3-day food records. They adjusted for potentially confounding effects of site, age, race, parental education, physical activity and total energy intake. Frequency of breakfast eating declined with age, white girls reported more frequent breakfast consumption than African-American girls, and the racial difference decreased with increasing age. Days eating breakfast were predictive of lower body mass index in models that adjusted for site, age and race, but the independent effect of breakfast was no longer significant after parental education, energy intake and physical activity were added to the model.

- Breakfast habits, nutritional status, body weight, and academic performance in children and adolescents. Rampersaud GC, Pereira MA, Girard BL, Adams J, Metzl JD. J Amer Dietetic Assoc.2005;105(5):743-760.

Summary: We summarized 16 studies examining the association of breakfast consumption with body weight in children and adolescents. Breakfast skipping is highly prevalent in the United States and Europe (10% to 30%), depending on age group, population, and definition. Breakfast eaters generally consumed more daily calories yet were less likely to be overweight, although not all studies associated breakfast skipping with overweight.

- Long-term weight loss and breakfast in subjects in the National Weight Control Registry. Wyatt HR, Grunwald GK, Mosca CL, Klem ML, Wing RR, Hill JO. Obes Res.2002;10(2):78-82.

Results: A large proportion of subjects (2,313 or 78%) reported regularly eating breakfast every day of the week. Only 114 subjects (4%) reported never eating breakfast. There was no difference in reported energy intake between breakfast eaters and non-eaters, but breakfast eaters reported slightly more physical activity than non-breakfast eaters (p= 0.05). Discussion: Eating breakfast is a characteristic common to successful weight loss maintainers and may be a factor in their success.

2. Other metabolic factors

- Breakfast skipping and the risk of type 2 diabetes: a meta-analysis of observational studies. Bi H, Gan Y, Yang C, Chen Y, Tong X, Lu Z. Public Health Nutr.2015;18(16):3013-3019.

Conclusion: Breakfast skipping is associated with a significantly increased risk of Type 2 Diabetes. Eight studies involving 106,935 participants and 7,419 patients with Type 2 Diabetes were included in the meta-analysis. A pooled adjusted relative risk for the association between exposure to breakfast skipping and T2D risk was 1·21 (95 % CI 1·12, 1·31; P=0·984; I2=0·0 %) in cohort studies and the pooled OR was 1·15 (95 % CI, 1·05, 1·24; P=0·770; I2=0·0 %) in cross-sectional studies.

- Fasting until noon triggers increased postprandial hyperglycemia and impaired insulin response after lunch and dinner in individuals with Type 2 diabetes: A randomized clinical trial. Jakubowicz D, Wainstein J, Ahren B, Landau Z, Bar-Dayan Y, Froy O. Diabetes Care.2015;38(10):1820-1826.

22 participants. Skipping breakfast increases high blood sugar after lunch and dinner in association with lower intact glucagon-like peptide-1 and impaired insulin response. This study shows a long-term influence of breakfast on blood sugar regulation that persists throughout the day.

- Female breakfast skippers display a disrupted cortisol rhythm and elevated blood pressure. Witbracht M, Keim NL, Forester S, Widaman A, Laugero K. Physiology & Behavior.2015;140:215–221.

Studied 65 adult women. Habitually skipping breakfast is associated with stress-independent overactivity in the hypothalamic–pituitary–adrenal axis which, if prolonged, may increase risk (e.g., elevated blood pressure) for cardiometabolic disease in some people.

- Effect of breakfast omission on subjective appetite, metabolism, acylated ghrelin and active GLP-1. Clayton DJ, Stensel DJ, James LJ. Appetite.2015;August:91; DOI: 10.1016/j.appet.2015.04.020. A very similar study was published, Effect of breakfast omission on subjective appetite, metabolism, acylated ghrelin and GLP-1 7-36 during rest and exercise. Clayton DJ, Stensel DJ, James LJ. J Nutr.2015; DOI: http://dx.doi.org/10.1016/j.nut.2015.06.013

The results of this small laboratory-controlled study with eight men, all habitual breakfast eaters, suggest that the effects of breakfast omission are transient and do not extend beyond lunch, even when the negative energy balance created by breakfast omission is sustained via standardized feeding and exercise. Lunch and dinner intake were standardized. Subjective appetite was not different between trials after lunch. Results: Hunger, desire to eat, and prospective food consumption were greater, and fullness lower, during breakfast omission ($P < 0.05$) between breakfast and lunch, with no differences after lunch ($P > 0.193$). Resting energy expenditure was greater at 2.5 h during breakfast consumption ($P < 0.05$), with no other differences between trials ($P > 0.156$). Active glucogon-like peptide-1 (GLP-17-36) and acylated ghrelin were not different between trials after lunch.

- Effect of breakfast omission on energy intake and evening exercise performance. Clayton DJ, Barutcu A, Machin C, Stensel DJ, James LJ. Med Sci Sports Exerc.2015;47(12):2645-2652.

This study assessed the effect of omitting breakfast on evening exercise performance and within-day energy intake. Ten men, all habitual breakfast eaters, completed two trials in a randomized, counterbalanced order. Subjects arrived at the laboratory in an overnight-fasted state and either consumed or omitted a 733 ± 46 kcal breakfast. Ad libitum energy intake was assessed at 4.5 h (lunch) and 11 h (supper). At 9 h, subjects completed a 30-min cycling exercise at approximately 60% $\dot{V}O_2$peak, followed by a 30-min maximal cycling performance test. Food was not permitted for subjects once they left the laboratory after dinner until 0800 h the following morning. Acylated ghrelin, GLP-1(7-36), glucose, and insulin were assessed at 0, 4.5, and 9 h. Subjective appetite sensations were recorded throughout. Energy intake was 199 ± 151 kcal greater at lunch ($P < 0.01$) after breakfast omission compared with that after breakfast consumption and tended to be greater at dinner after consuming

breakfast (P = 0.052). Consequently, total ad libitum energy intake was similar between trials (P = 0.196), with 24-h energy intake 19% ± 5% greater after consuming breakfast (P < 0.001). Total work completed during the exercise performance test was 4.5% greater after breakfast (314 ± 53 vs 300 ± 56 kJ; P < 0.05). Insulin was greater during breakfast consumption at 4.5 h (P < 0.05), with no other interaction effect for hormone concentrations. Breakfast omission might be an effective means of reducing daily energy intake but may impair performance later that day, even after consuming lunch.

- Breakfasts higher in protein increase postprandial energy metabolism in overweight, breakfast skipping women. Dunn A, Neumann B, Johnson D, Adams J, Baum J - The FASEB J.2015;29(1):Supplement270.1.

The objective of this small pilot study was to determine if breakfast consumption and breakfast composition improve energy metabolism in 12 overweight/obese women (ages 18-36) who skip breakfast. Subjects were placed into one of three groups: breakfast skipping (SKP; n=4), carbohydrate (CHO; n=3) or protein (PRO; n=5) and were instructed to either continue skipping breakfast or consume a CHO or PRO breakfast for 7 days. All food was provided. On days 1 and 7 energy expenditure (EE), glucose and satiety were measured at 0, 15, 30, 60, 90 and 120 min postprandial (pp), or after the meal. Consuming breakfast decreased ($P < 0.01$) hunger and the desire to eat and increased fullness compared to SKP. There was a trend for PRO to be more satiating than CHO. Consumption of PRO decreased ($P < 0.01$) the desire for sweet. There was no difference in pp glucose response between PRO and CHO. Consuming breakfast for one week increased ($P < 0.05$) pp energy metabolism and PRO had higher ($P < 0.05$) pp energy metabolism compared to CHO and SKP. There was no change in REE. These preliminary data suggest that eating breakfast decreases postprandial hunger and increases postprandial energy metabolism compared to breakfast skipping. However, the effects seem to be greater when a PRO versus a CHO breakfast is consumed.

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