

When to eat and how often?^{1,2}

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The effect of the timing of food intake on metabolism has been the subject of active investigation for >40 y. Indeed, whether it is “better” to eat many small meals a day is one of the questions most frequently posed by the lay public. Comparing the potential benefits of nibbling and of gorging has been the focus of much animal and human research, but no clear consensus has emerged (1–7). Simply put, the question of whether there is a health benefit from the consumption of multiple small meals will ultimately depend on how much energy is consumed, as opposed to how often or how regularly one eats. This possibility raises 2 questions. First, is it easier to overeat under a regimen of frequent, irregular meals? Second, how does the pattern of meal consumption affect metabolic health? These critical issues begin to be addressed in an article by Farshchi et al (8) in this issue of the Journal. Those authors investigated whether an irregular meal pattern (ie, irregular eating frequency) led to changes in daily energy intake and negative metabolic effects that could contribute to obesity and insulin resistance.

In their study, 10 obese but otherwise healthy women participated in 2 free-living dietary phases, each 2 wk in duration, in a randomized crossover design. In one phase of the study, subjects were asked to consume their usual diet on 6 occasions/d, and, in the other phase, subjects were asked to consume their usual diet in a prescribed, yet chaotic fashion (ie, 7, 4, 9, 3, 5, 8, 6, 5, 9, 8, 3, 4, 7, and 6 occasions on days 1–14 of the study, respectively). This elegant study design ensured that the average number of prescribed eating occasions per day was the same in the 2 phases. A standardized test meal, consumed at the beginning and end of each phase, was of constant composition at each feeding. As a result, differences in postprandial responses between the 2 phases reflected the influence of chronic changes in the background pattern of food intakes. As shown by Farshchi et al, the regular eating frequency was associated with lower reported ad libitum energy intakes and lower fasting total and LDL-cholesterol concentrations. In addition, they concluded that the irregular eating frequency may have reduced insulin sensitivity because that pattern was associated with a lower thermic effect of food (TEF), a higher peak insulin concentration, and a larger 3-h area under the curve of postprandial insulin concentrations. One practical limitation of the work by Farshchi et al is that each dietary phase was only 14 d long and thus did not result in large effects (eg, an ≈9% greater peak postprandial insulin concentration and an 8% lower TEF). However, it has long been recognized that the TEF provides a satiety signal (9), and, therefore, when TEF is reduced in persons who are eating irregularly, an increase in body weight may result. Of note, the changes in

metabolism observed in the obese subjects studied by Farshchi et al were nearly identical to those previously found in lean women by the same investigators with the use of the same study design (10).

The authors’ interpretation of negative metabolic changes resulting from the irregular timing of food intake raises several questions that are extremely important to clinical nutrition today. First, what are the characteristics of persons who eat irregularly, and what proportion of the general population do they make up? The answers to these questions are not yet known, and Farshchi et al (8, 10) did not report the usual eating patterns of their subjects. Second, if irregular eating frequency is indeed prevalent, how much does that irregular frequency contribute to obesity compared with other eating behaviors that may also influence energy intake (11)? Third, is the specific time of day that food is eaten important? With respect to this question, the potential for breakfast food consumption to reduce total daily intake (12) and the capacity for smaller evening meals to aid in weight loss (13) have both drawn renewed interest of late.

A major hurdle to overcome before these 3 important questions can be answered is that of the poor validity of energy intake records, particularly those from overweight persons (14, 15). This problem is illustrated nicely by carefully examining the energy intakes reported by Farshchi et al for obese (8) and lean (10) women: these intakes were approximately the same at baseline (8.37 MJ/d in the lean women and 8.47 MJ/d in the obese women), even though the obese women clearly had higher energy requirements (15, 16). A comparison of those reported intakes with the energy requirements for women of average height (1.65 m) who are in the same body mass index range and who have a low physical activity level (1.4–1.6; see Table 5-30 in reference 16) shows that the average underreporting by the obese women may have been 22–27%. Farshchi et al suggest that the obese women may have consistently underreported their energy intakes in both phases of the study. However, the degree of underreporting is known to increase with energy requirements (15, 17) and, possibly, with eating frequency (7). Thus, the implication is that the effect of an irregular eating frequency on ad libitum energy intake may have been underestimated by Farshchi et al (8, 10), particularly in the obese women, because there was

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a small increase in energy intake with increased eating frequency during the irregular eating protocol. In addition, whereas irregular eating frequency was associated with a significant increase in energy intake in the obese but not the lean women studied earlier, the group differences in reported energy intakes between the 2 eating regimens were similar (0.40 MJ/d in the lean women and 0.34 MJ/d in the obese women). The significance of the findings in one study but not of those in the other may have been due to the fact that the reported energy intake variances differed between the 2 samples, which reflects the difficulty of obtaining consistently valid self-reports of energy intakes. This problem is not by any means unique to the studies of Farshchi et al but instead is found among nearly all studies in which free-living energy intakes are measured (18).

Two last issues raised by Farshchi et al (8) are whether the effects on metabolism of eating regularity are independent of or mediated by energy intake, and, if there are independent effects, what mechanisms contribute to these effects. With respect to insulin resistance, endocrinologists have long known that, when diabetics are hospitalized for observation, they have significant improvements in blood glucose and insulin concentrations—an effect partially caused by the consumption of regular balanced meals (19). Yet the exact mechanism supporting improved insulin response is unknown.

The increase in obesity over the past decade requires a better understanding of meal timing and eating frequency. The study by Farshchi et al raises key issues of body weight and food consumption and, once again, highlights the urgent need to improve the methods of obtaining valid energy intake records. Whether some persons may be more susceptible than others to increasing their energy intake amid the hustle and bustle of today's lifestyle is key. Future studies directed toward ascertaining the importance of the timing of eating, as compared with other dietary factors, to energy intake and metabolism will aid immensely in the formulation of innovative therapeutic and preventive strategies for weight control and chronic disease. 

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