

## Alcohol intake and body weight: a paradox<sup>1,2</sup>

Eric Jéquier

The relation between alcohol consumption and body weight remains an enigma for nutritionists. This is an important problem, because the average alcohol intake in adults is  $\approx 10\%$  of the total daily energy intake in several developed countries. The role of alcohol energy in body weight control has been studied by using 3 different approaches: epidemiology (alcohol intake and body weight), psychophysiologic investigations (alcohol and appetite regulation), and metabolic studies (effects of alcohol intake on energy expenditure and substrate oxidation). Epidemiologic evidence does not show a clear relation between daily alcohol energy intake and body weight. However, most studies report that people do not compensate for the alcohol energy by decreasing nonalcohol food energy intake. Except in alcoholics, alcohol energy is usually added to total food energy intake. Therefore, moderate alcohol drinkers tend to consume more energy than nondrinkers.


In this issue of the Journal, Westerterp-Plantenga and Verwegen (1) present an elegant study in 52 men and women on the effects on energy intake of an alcohol preload (1 MJ) ingested 30 min before lunch, in comparison with an isoenergetic carbohydrate, fat, or protein drink. The alcohol preload was followed by a greater energy intake at lunch than the other isoenergetic drinks. After the alcohol preload, there was no compensation for energy intake over the whole day. The alcohol preload also induced a higher eating rate and a longer meal duration at lunch than the other preloads. This study illustrates the short-term stimulatory effect of alcohol on appetite and food intake; alcohol did not induce any satiating effect.

Whereas the alcohol preload significantly increased energy intake at lunch, the total energy intake for the day was not significantly altered in comparison with the other isoenergetic preloads. It was only when no preload was given (or an isovolumetric water preload) that the subjects consumed less energy than with the isoenergetic preloads. Other studies (2, 3) confirm that alcohol intake induces no or minimal dietary compensation. Therefore, both psychophysiologic studies on food intake regulation and epidemiologic investigations consistently show that in most individuals, the energy of alcohol is added to the energy of carbohydrate, fat, and protein of the daily diet.

The paradox of increased alcohol-induced energy intake with no clear correlation between alcohol intake and body weight has led to the curious concept that alcohol energy has a low biological value (4–6). This hypothesis has not been confirmed by recent metabolic investigations on the effect of alcohol intake on energy expenditure and substrates oxidation in humans. Several studies carried out by using whole-body indirect calorimeters (7–9) clearly showed that ethanol energy is used efficiently by

the body and that alcohol energy does count! Ethanol-induced thermogenesis has been studied by several groups of investigators; a mean value of  $\approx 15\%$  for ethanol-induced thermogenesis has been obtained (8–10). After ethanol ingestion, the stimulation of energy expenditure induced by ethanol metabolism represents 15% of the ethanol energy; thus, 85% of ethanol energy is available as metabolizable energy for other metabolic processes. Ethanol-induced thermogenesis is smaller than protein-induced thermogenesis ( $\approx 25\%$ ) and larger than carbohydrate-induced thermogenesis ( $\approx 8\%$ ) and lipid-induced thermogenesis ( $\approx 3\%$ ).

There is another way by which alcohol intake may alter body weight regulation. Ethanol is not stored in the body, but it is oxidized in preference over other fuels. The addition of ethanol to a diet reduces lipid oxidation measured over 24 h whereas oxidation of carbohydrate and protein are much less inhibited (7). Other studies confirm that alcohol ingestion reduces fat oxidation and favors a positive fat balance (9, 10). In summary, metabolic studies show that ethanol energy is used with an efficiency comparable with that of a carbohydrate + protein meal and that it reduces fat oxidation. There is no reason to claim that ethanol energy does not play a role in energy balance regulation.

How can we resolve the above-mentioned paradox? Is it really true that alcohol intake is associated with increased energy intake in daily life? Have we sufficiently taken into account the influence of confounding factors such as underreporting of energy intake in obese subjects and the frequent association between smoking and alcohol intake? Clearly, the complex relation between alcohol intake and body weight regulation needs to be studied further by using a combined approach of epidemiology, psychophysiology, and metabolic investigations. Ideally, the effect of alcohol on energy intake and expenditure should be studied over several weeks or months. 

### REFERENCES

1. Westerterp-Plantenga MS, Verwegen CRT. The appetizing effect of an aperitif in overweight and normal-weight humans. *Am J Clin Nutr* 1999;69:205–12.
2. Tremblay A, Wouters E, Wenker M, St-Pierre S, Bouchard C, Després JP. Alcohol and a high-fat diet: a combination favoring overfeeding. *Am J Clin Nutr* 1995;62:639–44.
3. Foltin RW, Kelly TH, Fischman MW. Ethanol as an energy source in humans: comparison with dextrose-containing beverages. *Appetite* 1993;20:95–110.

<sup>1</sup>From the Institute of Physiology, University of Lausanne, Switzerland.

<sup>2</sup>Address reprint requests to E Jéquier, Institut de physiologie, 7 rue du Bugnon, 1005 Lausanne, Switzerland. E-mail: Eric.Jequier@iphysiol.unil.ch.

4. Pirola RC, Lieber CS. Hypothesis: energy wastage in alcoholism and drug abuse: possible role of hepatic microsomal enzymes. *Am J Clin Nutr* 1976;29:90-3.
5. Lands WE, Zakhari S. The case of the missing calories. *Am J Clin Nutr* 1991;54:47-8.
6. Lieber CS. Perspectives: do alcohol calories count? *Am J Clin Nutr* 1991;54:976-82.
7. Suter PM, Schutz Y, Jéquier E. The effect of ethanol on fat storage in healthy subjects. *N Engl J Med* 1992;326:983-7.
8. Suter PM, Jéquier E, Schutz Y. Effect of ethanol on energy expenditure. *Am J Physiol* 1994;266:R1204-12.
9. Murgatroyd PR, Van de Ven MLHM, Goldberg GR, Prentice AM. Alcohol and the regulation of energy balance: overnight effects on diet-induced thermogenesis and fuel storage. *Br J Nutr* 1996;75:33-45.
10. Sonko BJ, Prentice AM, Murgatroyd PR, Goldberg GR, van de Ven ML, Coward WA. Effect of alcohol on postmeal fat storage. *Am J Clin Nutr* 1994;59:619-25.