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Research report

Laboratory eating behavior in obesity

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Abstract

The eating behavior of 49 obese and 47 normal weight controls of both sexes was compared in laboratory. A universal eating monitor according to the Kissileff-instrument was used to obtain cumulative intake curves with chocolate pudding as laboratory food. Compared to controls the obese had a significantly higher initial eating rate ($p < .002$), larger spoonfuls ($p < .005$), and a greater total intake ($p < .03$) for the laboratory food. For initial eating rate a significant sex × weight interaction was found ($p < .04$). Higher values for males emerged only for overweight, but not for normal weight subjects. On the one hand, these data suggest an eating behavior of obese, which will promote a high energy intake in the natural environment. On the other hand, the observed differences can also be interpreted as a consequence of cognitive factors, impacting the eating behavior of obese under specific conditions.

Keywords: Obesity; Eating rate; Cumulative food intake; Laboratory eating; Universal eating monitor; Treatment

Introduction

Current models of the aetiology and maintenance of obesity are complex and consider psychosocial, sociocultural, behavioral, and genetic factors (overview see Voegele, 2005).

Psychosocial factors, especially in family environment, have great influence on the development of eating habits with regard to quantity (calorie intake) but also with regard to quality (nutritional preferences). Important sociocultural factors are the easy access to high calorie food and the fact, that many labour and leisure activities can be carried out without any physical effort (Epstein, Myers, Raynor, & Saelens, 1998). Genetic factors explain up to 70% of the variability of the BMI (Stunkard, Harris, Pedersen, & McClearn, 1990). Genes do not only determine body composition (e.g. number of fat cells at birth) and energy metabolism (e.g. BMR), but may also be related to nutritional and activity preferences.

Eating behavior may be an important mediator between genetic predisposition and overt obesity. Eating behavior can be studied from a macro as well as from a microstructural perspective.

The macrostructural approach observes energy intake and eating patterns over longer periods of time (for example meal patterns over weeks) (de Castro, McCormick, Pedersen, & Kreitzman, 1986).

In studies of energy intake, obese recorded in food diaries to eat less than non-obese. This has been already found in an earlier study of Baudoin and Mayer (1953) in obese and normal weight women. However, these results have been interpreted due to measurement errors by underestimation of calorie consumption specifically in obese people (Black et al., 1993; Lansky & Brownell, 1982). Studies trying to measure the objective intake by feeding machines gave conflicting results, and did not uniformly reveal a higher intake in the obese. Campbell, Hashim, and Van Itallie (1971), using a machine-dispenser for a liquid diet, on the contrary found a lower calorie intake in obese subjects compared to lean controls. Also using a food dispenser for liquids, Meyer and Pudel (1972) found equal intake in lean and obese, although they concluded from a comparison of the shape of intake curves, that the obese show a tendency to linear curves, indicating probably a distorted perception of satiety.

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The microstructural approach (Guss & Kissileff, 2000) focuses on intake parameters within a single meal (e.g. eating rate), and allows to identify variables, which may promote excess calorie intake.

Studies in a laboratory setting obtaining cumulative intake curves by a universal eating monitor (UEM) showed a higher eating rate in obese for a meal consisting of industrially produced swedish hash (Barkeling, Rossner, & Sjoberg, 1995) and for pasta or yoghurt (Westerterp-Plantenga, Wouters, & ten Hoor, 1991).

However, eating rate was not significantly different between obese and non-obese in a study of Spiegel (2000), using solid food units as laboratory food.

Summarizing the available empirical literature it still seems unclear, whether there are differences in eating behavior between obese and non-obese at all, and, moreover, under which conditions possible differences can be found.

The present study therefore addressed the question:

Is the eating behavior in laboratory of obese and lean people different on the microstructural level, if a palatable dessert food is used to measure intake?

Method

Sample

All participants had been recruited by advertisement in local newspapers. One hundred and twenty subjects were examined for participation. Exclusion criteria for the study where: acute or chronical medical illnesses, clinical eating disorders according to DSM IV and being on a weight reduction diet at the time of the study. To check for these criteria, the possible participants were examined by a medical doctor, who excluded 24, so that a total sample of 96 subjects could be investigated. Basic data for the sample are depicted in Table 1. Weight and height were measured using a calibrated scales and stadiometer. Overweight was defined as a BMI of at least 27.5, which marks the 90th percentile in a reference sample for Germany (Hebebrand, Heseker, Himmelmann, Schaefer, & Remschmidt, 1994). The normal weight comparison group was classified according to a BMI between 17.5 and 25.

Age was not statistically different for the two comparison groups.

Table 1
Sample description

	Normal weight ($n = 47$)				Overweight ($n = 49$)			
	Male ($n = 23$)		Female ($n = 24$)		Male ($n = 24$)		Female ($n = 25$)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
BMI	22.9	1.8	21.4	1.3	32.7	4.4	32.8	3.0
Age	26.5	6.1	29.5	7.4	29.2	7.6	29.2	7.2

Measurement

The eating behavior was measured using a UEM, based on Kissileff, Klingsberg, and Van Itallie (1980). Our instrument is described in detail in Hubel, Laessle, Lehrke, and Jass (2006) and is of proven reliability.

We modified the original technical equipment with a more refined electronic scales and a desk which has been constructed to be free of any vibration. The electronic scales enables the recording of weight changes on the plate on the desk every 0.5 s. A special software to compute the signals from the scales produces raw data of cumulative intake curves, but also secondary measures (amount of intake, duration of intake, initial eating rate, change of eating rate, and mean size of spoonfuls), which can be used as descriptors of intake behavior. A spoonful represents the amount taken up with a spoon from the bowl and is defined as a step or decline in weight in the eating curve.

The investigation was declared as 'stress and taste' in connection with a newly developed pudding product, from which can be tested as much and as long one would like. It was assured by asking all participants, that they like chocolate pudding as a dessert food.

The laboratory food was chocolate pudding (energy/100 g: 577 kJ; fat%: 25.3, protein%: 10.3, carbohydrate%: 64.4). The initial quantity in a bowl on the balance was 325 g, but all participants were free to take further helpings.

Comparing the weight groups, no significant differences in the frequency of asking for a second helping emerged. This might be interpreted as a hint, that both groups were equally satisfied by the quantity of chocolate pudding initially provided.

However, when analysing these data considering sex, men asked more frequently for a second helping than women (44% vs 16%; $\chi^2 = 8.2$, $p < .005$).

Procedure

After 10 h of fasting overnight subjects arrived in laboratory between 9.00 and 10.00. a.m. and had to eat half of a ham sandwich to make stomach fullness equal for all participants. The energy of the sandwich half was about 627 kJ (fat%: 14, protein%: 18, carbohydrate%: 68). Before and after eating at the eating monitor, hunger ratings had to be given on 100 mm analogue scales.

Because the investigation was originally designed to detect stress effects on eating behavior, every subject was measured twice at the eating monitor. Measurement 1 included the presentation of a stressor before the taste test (Trier social stress test; Kirschbaum, Pirke, & Hellhammer, 1993). Measurement 2 included a neutral condition (reading newspapers). The order of the two conditions was balanced. Because no significant differences between stress and no-stress were found (Laessle, 2005), cumulative intake over the two conditions was averaged for each subject and used for the present analysis.