Satiety and obesity

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Although obesity can occur only as a result of caloric intake in excess of caloric use, we know that there are many factors that influence food intake and energy output. Age, somatic and emotional profiles, and social, economic, and genetic factors contribute to the intake and output relationship in each individual. Although we cannot assume that the reasons for one person’s obesity are the same as those for another, we believe that there is a necessary variable that differentiates the potentially obese from the normal-weight individual.

This investigation is an attempt to identify characteristics that are present in the obese and absent in the normal-weight, or underweight individual. We contend that the obese individual gains greater pleasure or tension reduction, or both, from eating than does the normal-weight individual, and that the sense of pleasure is sustained for a longer period of time. In other words, the obese individual takes longer to recognize a point of satiety and displeasure with continued eating.

Studies by Stunkard and Koch (1) have produced evidence in support of the proposition that the obese are less responsive to internal physiological cues indicative of hunger or satiety. These studies showed a high correlation between gastric motility and verbal reports of hunger from normal subjects and a smaller correlation from obese persons. Schachter et al. (2, 3) found that obese subjects ate no more after being deprived of food for several hours than they did after being fed recently.

Cabanae and Duclaux (4) also have shown a deficiency in satiation response to sucrose in obese subjects. A group of obese subjects and a normal-weight control group were given sucrose taste tests before and after glucose ingestion. The difference in the normal-weight subjects’ responses before and after glucose was significant. In obese subjects, the change in sucrose response after glucose was much less marked and the stimulus did not become unpleasant at any concentration.

Methods

In this study, we selected two groups of five subjects each. The subjects were classified either as obese or thin, utilizing Parnell’s (5) somatotyping technique and the height-weight ratio. Obese subjects were no less than 20% overweight and thin subjects were no less than 10% underweight. All subjects were given a battery of psychological tests, including the WAIS vocabulary, 16 PF, sensation-seeking scale, and embedded figures test.

During the experimental portion of the study, each subject was alone in a darkened room adjacent to a recording instrumentation room. Subjects were comfortably positioned on a contour couch with the upper part of the body raised slightly to facilitate viewing a projection screen positioned in front of the couch. Extraneous noise was masked by white noise through earphones.

From the instrument room, a DEC PDP-8/I computer controlled a slide projector that displayed to the subjects a series of slides of various foods. Each subject’s physiological reactions to the slides were recorded by measurement of heart rate, electrogastrinogram (EGG), log of skin conductance (GSR), and respiration, via a computer-coupled Sanborn polygraph.

Subjects also reported their subjective reactions to the food slides by rating each slide on five semantic differential scales. These scales were: pleasant-unpleasant; disgusting-appealing; big-small; full-empty; hungry-not hungry. Numerical values for the gradations, for example, from pleasant-unpleasant are as follows: 0, very much; 1, very; 2, slightly; 3, none; 4, slightly; 5, very; and 6, very much. The ratings were made for each slide by the subject utilizing a computer-coupled rating box. A group of four slides comprised each stimulus period.

When a subject had completed a stimulus period, he was asked to drink 6 oz of Nutrament (The Drackett Corp., Cincinnati, Ohio, distributor). This process was repeated until the subjects refused the beverage. The subjects were allowed one initial stimulus period (4 slides) without the Nutrament to provide practice and to establish a physiological baseline. Two independent experimental sessions were run for each subject at an interval of 1 week.
TABLE 1
Difference between thin and obese subjects in use of ratings

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Significance level</th>
<th>Thin group</th>
<th>Obese group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pleasant-unpleasant</td>
<td>0.005</td>
<td>Unpleasant</td>
<td>Pleasant, neutral</td>
</tr>
<tr>
<td>Appealing-disgusting</td>
<td>0.005</td>
<td>Disgusting</td>
<td>Appealing, neutral</td>
</tr>
<tr>
<td>Big-small</td>
<td>0.005</td>
<td>Small, neutral</td>
<td>Big</td>
</tr>
<tr>
<td>Empty-full</td>
<td>0.005</td>
<td>Empty</td>
<td>Full</td>
</tr>
<tr>
<td>Hungry-not hungry</td>
<td>0.005</td>
<td>Not hungry</td>
<td>Neutral</td>
</tr>
</tbody>
</table>

Results

Obese subjects saw an average of 28 stimuli per session (minimum 24, maximum 32), i.e., 7 stimulus periods and 6 doses of Nutrament (36 oz). Thin subjects averaged 20 stimuli per session (minimum 16, maximum 24), i.e., 5 stimulus periods and 4 doses of Nutrament (24 oz).

Table 1 shows a chi-square test of independence comparing the ratings used by the two groups on each of the five dimensions. The results indicate highly significant differences in the frequency of ratings used.

A close correspondence was found between the ratings a subject made on the pleasant-unpleasant and the appealing-disgusting dimensions in judging the same stimulus. The thin subjects used more ratings of unpleasant and disgusting, whereas the obese subjects used neutral, pleasant, and appealing. A similar correspondence between the empty-full and hungry-not hungry ratings was not found. The ratings used by the thin group on these two dimensions were not significantly different. The obese group differed significantly from themselves in the ratings they used and also from the thin group on both dimensions. The differences indicate that, for the obese, “full” and “not hungry” are not synonymous terms (Fig. 1).

None of the other measures, including psychological characteristics and physiological responses, were significantly different in the two groups.

Comments

Because of the associated problem with overeating, it seems very possible that the

obese individual has developed a number of mechanisms for use in dealing with his excessive food intake. He may attempt to eat only at certain times, select only very appealing foods, et cetera. At any rate, the inability to achieve the point of satiety may be the necessary variable that differentiates the obese from the normal-weight or thin individual.

References