A Role for Sweet Taste: Calorie Predictive Relations in Energy Regulation

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FROM ABSTRACT:

Animals may use sweet taste to predict the caloric contents of food.

Eating sweet non-caloric substances may degrade this predictive relationship, leading to positive energy balance through increased food intake.

These experiments were designed to test the hypothesis that experiences that reduce the validity of sweet taste as a predictor of the caloric or nutritive consequences of eating may contribute to deficits in the regulation of energy by reducing the ability of sweet-tasting foods that contain calories to evoke physiological responses that underlie tight regulation.

Adult rats were given differential experience with a sweet taste that either predicted increased caloric content (glucose) or did not predict increased calories (saccharin).

We found that reducing the correlation between sweet taste and the caloric content of foods using artificial sweeteners in rats resulted in increased caloric intake, increased body weight, and increased adiposity, as well as diminished caloric compensation and blunted thermic responses to sweet-tasting diets.

These results suggest that consumption of products containing artificial sweeteners may lead to increased body weight and obesity by interfering with fundamental homeostatic, physiological processes.

THESE AUTHORS ALSO NOTE:

“During the past 30 years, the incidence of people who are overweight or obese has increased dramatically both in the U.S. and throughout the rest of the world.”

“The rate of body-weight gain during this period suggests that the current obesity epidemic has environmental origins.”

“One change in the food environment that is correlated with current obesity trends is the wide scale introduction of non-caloric, high-intensity sweeteners.”
Sweetness is a salient orosensory stimulus that is a highly valid predictor of the post-ingestive caloric consequences of eating because naturally sweet foods are more calorically dense than less sweet foods.

"With the growing use of noncaloric sweeteners in the current food environment, millions of people are being exposed to sweet tastes that are not associated with caloric or nutritive consequences." On the basis of Pavlovian conditioning principles, a consequence of this type of exposure might be impaired energy regulation [over eating].

Orosensory cues such as the taste, flavor, and texture of foods are quickly and strongly associated with the post-ingestive consequences of eating [improves digestive cascade and suppression of hunger cues].

Consumption of non-caloric sweeteners can alter cephalic [brain] responses that change the efficiency of energy utilization, "leading to significant long-term increases in food intake and body weight." [Key Point]

In these animal experiments, the consumption of sweet foods with calories decreased subsequent food intake, whereas the consumption of non-caloric sweets increased subsequent food intake, resulting in weight gain and obesity. [Important]

"A number of researchers have suggested that Pavlovian conditioning may contribute to the control of energy intake."

These experiments also showed that animals fed non-caloric sweeteners experience measurably lower core body temperature, resulting in both reduced energy expenditure and impaired caloric compensation, both of which contribute to weight gain and obesity.

This analysis indicates that the ingestion of non-caloric sweeteners "could lead to excess food intake and body-weight gain."

Consumption of non-caloric sweeteners "increased body weight gain and adiposity result directly from altered physiological changes that reduce preprandial cephalic-phase energy expenditure as indexed by blunted thermic responses to food."

"The data clearly indicate that consuming a food sweetened with no-calorie saccharin can lead to greater body-weight gain and adiposity than would consuming the same food sweetened with high-calorie sugar."

"Such an outcome may seem counterintuitive to human clinical researchers and health care practitioners who have long recommended the use of low-and no-calorie sweeteners as a means of weight control."
“The number of Americans that consume products containing sugar-free sweeteners grew from fewer than 70 million in 1987 to about 160 million in 2000.”

Sugar-free sweeteners are commonly found in a wide variety of low-calorie foods, especially in diet soft drinks.

“Over the same period, the incidence of obesity in the United States increased from about 15% to 30% and continues to increase in the present day.”

This alarming weight gain is apparent across all age groups, ethnic groups, and social strata in all regions of the country.

Overweight or obese children tend to become overweight or obese adults.

“A common interpretation of the direct correlation between increased use of non-caloric sweeteners and increased incidence of obesity is that people have turned to calorie-free sweeteners as a means of reducing energy intake and controlling body weight. However, our findings and theoretical framework are in closer agreement with the possibility that increased intake of no-calorie sugar substitutes could promote increased intake and body weight gain, which is consistent with recent data from prospective human clinical studies that have documented increased risk for obesity and metabolic syndrome in individuals consuming beverages sweetened with high-intensity sweeteners.”

“The gradual increases in body weight shown by our rats [consuming non-caloric sweeteners] makes them more similar to the current U.S. human population, which has exhibited about a 10% increase in body weight over the past 10 years.”

The widespread use of non-caloric sweeteners in the food environment of humans may impair the normal ability of humans to control their caloric intake and body weight. [Important]

KEY POINTS FROM DAN MURPHY

1) Using artificial sweeteners in animals increases caloric intake, increases body weight, and increases adiposity.

2) “Consumption of products containing artificial sweeteners may lead to increased body weight and obesity by interfering with fundamental homeostatic, physiological processes.”

3) “During the past 30 years, the incidence of people who are overweight or obese has increased dramatically both in the U.S. and throughout the rest of the world.”

4) “One change in the food environment that is correlated with current obesity trends is the wide scale introduction of non-caloric, high-intensity sweeteners.”
5) “With the growing use of non-caloric sweeteners in the current food environment, millions of people are being exposed to sweet tastes that are not associated with caloric or nutritive consequences.” On the basis of Pavlovian conditioning principles, a consequence of this type of exposure might be over eating.

6) Consumption of non-caloric sweeteners can alter cephalic [brain] responses that change the efficiency of energy utilization, “leading to significant long-term increases in food intake and body weight.” [Key Point]

7) In these animal experiments, the consumption of sweet foods with calories decreased subsequent food intake, whereas the consumption of non-caloric sweets increased subsequent food intake, resulting in weight gain and obesity. [Important]

8) This analysis indicates that the ingestion of non-caloric sweeteners “could lead to excess food intake and body-weight gain.”

9) “The data clearly indicate that consuming a food sweetened with no-calorie saccharin can lead to greater body-weight gain and adiposity than would consuming the same food sweetened with high-calorie sugar.”

10) “Such an outcome may seem counterintuitive to human clinical researchers and health care practitioners who have long recommended the use of low-and no-calorie sweeteners as a means of weight control.” [Important]

11) “The number of Americans that consume products containing sugar-free sweeteners grew from fewer than 70 million in 1987 to about 160 million in 2000.” “Over the same period, the incidence of obesity in the United States increased from about 15% to 30% and continues to increase in the present day.”

12) Overweight or obese children tend to become overweight or obese adults.

13) “A common interpretation of the direct correlation between increased use of non-caloric sweeteners and increased incidence of obesity is that people have turned to calorie-free sweeteners as a means of reducing energy intake and controlling body weight. However, our findings and theoretical framework are in closer agreement with the possibility that increased intake of no-calorie sugar substitutes could promote increased intake and body weight gain, which is consistent with recent data from prospective human clinical studies that have documented increased risk for obesity and metabolic syndrome in individuals consuming beverages sweetened with high-intensity sweeteners.”

14) The widespread use of non-caloric sweeteners in the food environment of humans may impair the normal ability of humans to control their caloric intake and body weight. [Important]