



Adolescent emotions toward sweet food cues as a function of obesity and risky dieting practices



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ABSTRACT

This study examined whether poor health habits – those associated with a higher risk of developing eating disorders or obesity – modified adolescents' emotions toward sweet food cues. We aimed to answer the following questions: Is adolescent obesity accompanied by excessive enjoyment of sweets? Or is any risk habit, regardless its stronger association with obesity or disordered eating, associated with less food enjoyment? 552 Spanish adolescents (279 females) viewed pictures of sweets interspersed with emotional images as controls. Participants recorded their feelings of pleasure, activation, control, and food craving while looking at each picture; then answered questions on their general health, food intake, and physical activity; finally, their body mass index was estimated. We performed MANCOVAs on feelings during sweets, including individual risk habits as factors, and sex, age, and hunger as covariates. We performed the same analysis on emotional and neutral images. Results revealed that among risk habits, obesity and unhealthy dieting practices were accompanied by less enjoyment of sweets (mostly less pleasure and less food craving). On the contrary, risk habits had no effect on adolescents' feelings during emotional stimuli, unrelated to food. Thus, the presence of habits linked to obesity and disordered eating was associated with reduced reward value of sweet food cues, supporting the need to approach both disorders from an integrative perspective. Consistent with recent prevention strategies, the results suggest the potential role of food enjoyment as a protective factor.

1. Introduction

Food-related pathologies such as obesity and disordered eating are accompanied by severe health consequences that raise serious social, health, and economic concern (Brownell & Fairburn, 1995; Heymsfield & Wadden, 2017). Prevention programs worldwide aim at youth to separately address obesity and eating disorders (e.g., Ballesteros Arribas, Dal-Re Saavedra, Pérez-Farinós, & Villar Villalba, 2007; Shaw & Stice, 2016). However, some researchers (e.g., Brownell & Fairburn, 1995; Neumark-Sztainer, 2003) advocate the need for an integrated prevention of eating disorders and obesity. Several investigations that have reported an overlap between eating and weight-related disorders, overall put forward that unified prevention strategies can be more effective in the long term (e.g., Lebow, Sim, & Kransdorf, 2015; Neumark-Sztainer, 2003; Rancourt & McCullough, 2015; Stice, Presnell, Shaw, & Rohde, 2005).

In healthy human adults, food is a natural reward that prompts a

cascade of reactions that are subjectively experienced as pleasurable and physiologically coherent with the activation of a neural reward system (Kelley & Berridge, 2002). Subjective reactions to appetitive food cues are less straightforward in adults affected by disordered eating and obesity. For instance, patients diagnosed with bulimia nervosa tend to experience a decrease in food enjoyment (Rodríguez, Mata, Lameiras, Fernández-Santaella, & Vila, 2007), whereas adults with obesity tend to report excessive liking (Bartoshuk, Duffy, Hayes, Moskowitz, & Snyder, 2006). Only two studies have focused on adolescence and have observed that adolescents with obesity report less pleasure and less activation than healthy adolescents in response to appetizing food cues (Barthomeuf, Droit-Volet, & Rousset, 2009; Hofmann et al., 2016). Therefore, it remains to be investigated whether during adolescence self-imposed food restrictions are accompanied by reduced enjoyment of food. Moreover, for youth obesity, it is still not clear whether it is accompanied by increased food enjoyment, as reported in adulthood, or by decreased food enjoyment, as observed in

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the studies by [Barthomeuf et al. \(2009\)](#) and [Hofmann et al. \(2016\)](#). To our knowledge, no study have examined whether diverse risk habits modify the emotional value of food cues within an integrated perspective on eating disorders and obesity. The present work aims to investigate whether the presence of poor health habits – namely, habits associated with a higher risk of developing eating or weight-related disorders – leads to changes in adolescents' enjoyment of sweet food cues, even before the full development of food-related disorders.

For this purpose, we investigated various health habits that have been the target of Spanish obesity and eating disorder prevention strategies ([López-Guimerà & Sánchez-Carracedo, 2010](#); [Serra et al., 2007](#)). Our interest laid in diverse habits – related to overall well-being, food intake, and physical activity – that have been shown to expose adolescents to a higher risk of suffering from eating or weight-related disorders. Due to the lack of validated instruments in Spanish by the time the data were collected, we developed a set of questions so that the adolescents could quickly complete to provide self-reported health habits. We examined shared risk factors that increased the risk of both eating disorders and obesity: smoking, constantly being on a diet, being a picky-eater, having a higher body mass index, and reporting lower self-esteem (e.g., [Chiolero, Faeh, Paccaud, & Cornuz, 2008](#); [Croll, Neumark-Sztainer, Story, & Ireland, 2002](#); [French, Story, & Perry, 1995](#); [Lebow et al., 2015](#); [Neumark-Sztainer, Wall, Haines, Story, & Eisenberg, 2007](#)). However, we were particularly interested in risk habits that were more distinctly characteristic of obesity or eating disorders. For obesity we examined skipping breakfast, sleeping less, engaging in scarce physical activity and already being obese ([Ballesteros Arribas et al., 2007](#); [Heymisfield & Wadden, 2017](#); [Spiegel, Tasali, Penev, & Cauter, 2004](#)). For eating disorders we examined reducing the number of meals per day and reporting unhealthy ways to lose weight– i.e., fasting the whole day, self-induced vomiting/purging, skipping meals, eating very little, not seeking professional help, and smoking to lose weight ([Neumark-Sztainer, Story, Hannan, Perry, & Irving, 2002](#)). To serve as controls for unhealthy dieters, similarly to [Neumark-Sztainer et al. \(2002\)](#), we examined both adolescents who never dieted (and therefore never felt the urge to diet) and adolescents who reported healthy dieting practices (and therefore felt the urge but practiced safe dieting, such as engaging in moderate physical exercise and eating more fruits and vegetable).

Methodologically, as control stimuli for sweet food cues we included emotional non-food pictures. Research on the psychophysics of taste ([Bartoshuk et al., 2006](#)) and on the neuroscience of obesity ([Versace, Kyriotakis, Basen-enguist, & Schembre, 2016](#)) advocate the inclusion of motivationally salient stimuli, unrelated to food, as control cues. Several sets of food images provide subjective emotions prompted by food cues ([Blechert, Meule, Busch, & Ohla, 2014](#); [Foroni, Pergola, Argiris, & Rumiati, 2013](#)). Recently, our laboratory created a database of original food pictures (the Open Library of Affective Foods, OLAF) that included emotional images as controls and assessed how a large group of adolescents ([Miccoli et al., 2014](#)) and adults ([Miccoli et al., 2016](#)) felt while looking at diverse food pictures. In the original adolescent normative study, our goal was to collect and report affective ratings for the OLAF, describing in detail how food pictures were created, selected, and evaluated using the affective dimensions of pleasure/valence, activation/arousal, control/dominance, and food craving. In the current study, instead, we examined whether the affective dimensions were modulated by adolescents' risky health habits. Here, the inclusion of emotional and neutral control stimuli allowed us to infer whether adolescents' reactions were specific to food or extended to other motivationally relevant stimuli.

In summary, our goal was to investigate these alternative hypotheses: Do adolescent emotions toward sweet food cues support a unified prevention of eating disorders and obesity, so that any risk habit leads to reduced enjoyment of food cues, regardless its stronger association with obesity or disordered eating? Or do emotions toward sweet food cues diverge, so that unhealthy dieting practices are associated

with reduced food enjoyment whereas habits related to obesity are accompanied by excessive enjoyment of appetizing food cues? The results, pointing out that diverse risk habits were accompanied by reduced enjoyment of sweets, are discussed in the light of the importance of approaching eating and weight-related disorders from an integrated perspective, and in the light of the possible role of food enjoyment as a protective factor.

2. Materials and methods

Data presented here were part of a study that provided adolescents' normative affective ratings of pleasure, activation, control, and food craving for a set of original food pictures ([Miccoli et al., 2014](#)). Accordingly, the procedure reported here reproduces partially the information of the normative study. The interested reader is referred to the original study for full details on food pictures creation, selection, and evaluation.

2.1. Participants

A total of 612 adolescents (11–18 years) participated in the study between October 2012 and January 2013. Data were collected by members of the research team at three public high schools, located in different neighborhoods of downtown Granada (Spain). Self-reported data were not included for 60 adolescents (9.8%) who 1) did not rate any picture in one of the affective scales; 2) rated all pictures with the same value in any of the scales; 3) withdrew from the study; 4) exceeded the age limits; or 5) were statistical outliers (see Statistical Analyses). The final sample consisted of 552 adolescents (279 females) aged 11.1 to 17.3 years (mean age 14.3 years, SD 1.4). Using G*Power 3 ([Faul, Erdfelder, Lang, & Buchner, 2007](#)), a sample size of N 552 was deemed sufficient to detect small effects (Cohen's $d = 0.20$, $\eta^2 = 0.01$) at an alpha level of 0.05. The University of Granada Institutional Review Board approved the study (IRB# 699). All participants and their parents provided written informed consent and were informed that their responses were confidential.

2.2. Materials

2.2.1. Food and affective pictures

Each participant saw one of 4 randomized picture orders. Each order consisted of 60 pictures: 36 emotional IAPS images that were always the same and 24 OLAF food pictures that changed across orders. In each order, six out of 24 food images were sweet food cues. The 36 affective images displayed age-appropriate pleasant, neutral, and unpleasant contents and were selected from the International Affective Picture System/IAPS ([Lang, Bradley, & Cuthbert, 2008](#)). Food cues in the original normative study ([Miccoli et al., 2014](#)) consisted of low-calorie fruits and vegetables and high-calorie sweet and savory foods. The different food categories were identified after consulting with members of the Department of Nutrition and Bromatology from the University of Granada. On one extreme we identified food whose recommended frequency of consumption is high (low-calorie foods), with the further distinction between fruits and vegetables; on the other extreme, food whose recommended frequency of consumption is low (high-calorie foods), with the further distinction between sweet high-fat and salty high-fat foods. In the current investigation we focused on adolescents' emotional reactions to the images of sweet high-calorie foods (see some examples in [Fig. 1](#)), based on the greater motivational relevance of sugary food cues especially during development ([Avena, Rada, & Hoebel, 2009](#); [Birch, 1992](#)).

2.2.2. Self-reported picture evaluations

We used the Self-Assessment Manikin/SAM ([Bradley & Lang, 1994](#)) to assess the basic affective dimensions of pleasure/valence, activation/arousal, and control/dominance. The SAM is a nonverbal pictorial scale

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