Appetite 78 (2014) 147–155

Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

Research report

Association between intake of nutrients and food groups and liking for fat (The Nutrinet-Santé Study)☆

Caroline Méjean [a,*], Amélie Deglaire [b,c], Emmanuelle Kesse-Guyot [a], Serge Hercberg [a,d,e], Pascal Schlich [b], Katia Castetbon [e,f]

[a] Université Paris 13, Sorbonne Paris Cité, Equipe de Recherche en Epidémiologie Nutritionnelle (EREN), Centre d'Epidémiologie et Biostatistiques Paris Nord, Inserm (U1153), Inra (U1125), Cnam, Université Paris 5, Université Paris7, F-93017 Bobigny, France
[b] Centre des Sciences du Goût et de l'Alimentation, UMR6265 CNRS /UMR1324 INRA/Université de Bourgogne, F-21000 Dijon, France
[c] AGROCAMPUS OUEST – UMR1253 INRA Science et Technologie du Lait et de l'œuf, F 35000 Rennes, France
[d] Department of Public Health, Hôpital Avicenne, F-93017 Bobigny, France
[e] Unité de surveillance et d'épidémiologie nutritionnelle (USEN), Institut de veille sanitaire, F-94415 Saint-Maurice, France
[f] Unité de surveillance et d'épidémiologie nutritionnelle (USEN), Université Paris 13, Sorbonne Paris Cité, Centre d'Epidémiologie et Biostatistiques Paris Nord, F–93017 Bobigny, France

ARTICLE INFO

Article history:
Received 9 July 2013
Received in revised form 28 January 2014
Accepted 17 March 2014
Available online 27 March 2014

Keywords:
Liking
Dietary intake
Taste
Fat
Preference

ABSTRACT

Apart from the established association between liking for fat and fat intake, little is known about the association between liking for fat and intake of specific nutrients or food groups. We investigated the association between dietary intake and liking for fat, fat-and-sweet and fat-and-salt. Liking scores were constructed using a validated preference questionnaire administered to 41,595 French adults participating in the Nutrinet-Santé study. Dietary data were collected using web-based 24 h records. Relationships between liking and dietary intake were assessed using linear regression adjusted for age and energy intake. Results are expressed in percentage difference of intake between individuals with low liking and those with high liking. Compared with participants with low liking for fat, individuals with a strong liking for fat had higher intakes of total energy (+10.1% in women (W); +8.4% in men (M)), fats (W: +7.3%; M: +10.0%), saturated fats (W: +10.8%; M+15.4%), meat (W: +13.0%; M: +12.6%), butter (W: +34.0%; M: +48.1%), sweetened cream desserts (W: +14.8%; M: +21.1%) and croissant-like pastries (W: +27.2%; M: +36.9). They also consumed lower quantities of omega-3 fatty acids (W: –6.2%;M: –6.0%), fiber (W: –16.4%; M: –18.9%), fruits (W: –28.8%; M: –29.5%), vegetables (W: –16.4%; M: –19.7%) and yogurt (W: –12.1%; M: –14.8%). Participants with high liking for fat-and-salt had higher intakes of total energy, sodium and alcoholic beverages and lower consumption of total and simple carbohydrates and fruit and vegetables than persons with high liking for fat-and-sweet. Our study contributes to the understanding of liking as a determinant of dietary intake. It highlighted that increased liking for fat, especially fat-and-salt liking, was associated with a lower intake of healthy foods, such as fruit and vegetables.

Introduction

A large body of literature suggests the possible role of excessive fat consumption in the etiology of major chronic diseases, including cardiovascular diseases, colorectal cancer and obesity (American Institute for Cancer Research/World Cancer Research Fund, 2007; Getz & Reardon, 2007; World Health Organization, 2003). Restriction of total fat and saturated fat intake to reduce energy intake is therefore a key objective of most nutritional public health policies worldwide (Lachat et al., 2005; World Health Organization, 2003). However, fat content in food is linked to its sensory properties and strongly contributes to eating pleasure, which may promote its overconsumption (Drewnowski, 1997b; Mela & Sacchetti, 1991). Previous works using laboratory-based methods or population-based questionnaires, mostly in women and children, showed that liking for fat was associated with increased intake of total fat and high-fat foods (Cooling & Blundell, 1998; Drewnowski & Hann, 1999; Drewnowski, Hann, Henderson, & Gorenflo, 2000;

Abbreviations: M, men; PROP, 6-n-propylthiouracil; W, women.

☆ *Acknowledgments:* We thank all the scientists who helped carry out the study, the teams that assisted in the fieldwork and the dedicated and conscientious volunteers who participated in this study. We are grateful to Jerri Bram for English editing of the manuscript.

* Corresponding author.
E-mail address: c.mejean@uren.smbh.univ-paris13.fr (C. Méjean).

http://dx.doi.org/10.1016/j.appet.2014.03.017
0195-6663/

Duffy, Hayes, Sullivan, & Faghri, 2009; Duffy et al., 2007; Fisher & Birch, 1995; Geiselman et al., 1998; Lanfer et al., 2012; Ledikwe et al., 2007; Pangborn, Bos, & Stern, 1985; Raynor, Polley, Wing, & Jeffery, 2004; Ricketts, 1997).

Apart from the focus on the association of liking for fat with fat intake, only three studies explored the relationship between a liking for fat and consumption of other nutrients and food groups, especially healthy food groups (Drewnowski & Hann, 1999; Drewnowski et al., 2000; Nagata, Sugiyama, & Shimizu, 1998). Moreover, those studies presented limitations such as the poor reliability in the assessment of liking, the small sample sizes and the lack of demographic heterogeneity of the study populations that may have restricted variability in terms of liking and dietary intake. Indeed, the two studies of Drewnowski & Hann (1999) and Drewnowski et al. (2000) were conducted in small samples of selected women (n = 87 and 339) and focused on the relationship of liking for fat with intake of vitamin C, fiber and fat only. The study by Nagata et al. was conducted in a more diversified sample (n = 3170), but measurement of liking was not reliable, since simple questions were asked of individuals concerning their preferences for salty, greasy and sweet foods (Nagata et al., 1998). Consideration of intake of all food groups is nevertheless essential to understand the role of individual liking in eating behaviors and to outline feasible public health actions, such as sensory education interventions advocating the substitution of high-fat foods, particularly rich in saturated fats by less fatty ones.

Lipid content notwithstanding, combining salt or sugar with fat may further promote fat consumption by increasing palatability (Emmett & Heaton, 1995; Kanarek, Ryu, & Przypek, 1995), thus creating an additional risk factor for obesity and health-related problems (Yeomans, Blundell, & Leshem, 2004). Hence, study of the individual effects of a liking for fat-and-salt or fat-and-sweet upon dietary intake could affect public health decisions, by determining priorities for improving either fatty salted or fatty sweetened products. However, no study has separately investigated the specific issue of liking for fat-and-salt and liking for fat-and-sweet.

In this context, the aim of the present study was to investigate the association of liking for fat with intake of nutrients and food groups in a large heterogeneous sample of participants residing in France. Furthermore, we compared dietary profiles of participants with a high liking score for either the fat-and-sweet sensation or the fat-and-salt sensation.

Subjects and methods

Study population

We used data from the Nutrinet-Santé Study (Hercberg et al., 2010), a large web-based observational cohort launched in France in May 2009, through a recruitment planned over a 5-year period and with a scheduled follow-up of 10 years. The study was designed to investigate the relationship between nutrition and health (incidence of ischemic heart disease, cancer, all-cause mortality), as well as determinants of dietary behavior and nutritional status. The design, methods and rationale have been described elsewhere (Hercberg et al., 2010). Briefly, adults 18 years or older with access to the Internet were targeted to be volunteers. Eligible participants were recruited by different means. At launching, a vast multimedia campaign (television, radio, national and regional newspapers, posters, and Internet) called for volunteers for participation to a national study regarding nutrition and provided details on the study's specific website (http://www.etude-nutrinet-sante.fr). Then, multimedia campaigns were repeated every 6 months. Further information is being disseminated on a large number of websites (national institutions, city councils, private firms, web organizations). A billboard advertising campaign is regularly updated via professional channels (doctors, pharmacists, dentists, business partners, municipalities, etc.). In order to be included in the cohort, participants had to complete an initial set of questionnaires assessing dietary intake, physical activity, anthropometry, lifestyle, socioeconomic conditions and health status. As part of their follow-up, participants complete the same set of questionnaires every year. Moreover, each month they are invited to fill out complementary questionnaires related to determinants of food behavior, nutritional and health status. This study was conducted according to guidelines laid down in the Declaration of Helsinki and all procedures were approved by the International Review Board of the French Institute for Health and Medical Research (International Review Board Inserm n°0000388FWA00005831) and the French Data Protection Authority (Commission Nationale Informatique et Libertés n°908450 and n°909216). Electronic informed consents were obtained from all participants.

Data collection

Assessment of liking for fat, fat-and-salt and fat-and-sweet sensations

Overall liking for sensations of fat, fat-and-salt, and fat-and-sweet was assessed using a web-based questionnaire referred to as PrefQuest which was internally validated using factor analyses (Deglaire et al., 2012). This questionnaire also permitted evaluation of liking for salt and sweet sensations. In May 2010, 65,286 persons were invited by e-mail to complete this questionnaire on the "Nutrinet-Santé" website (https://www.etude-nutrinet-sante.fr/). The e-mail briefly explained that the questionnaire focused on their food preferences, that it had no commercial purpose and it was part of a public health research program that aimed to better understand the dietary behaviors by studying the relationship between diet and preferences. The development and validation of the questionnaire has been described elsewhere (Deglaire et al., 2012). Briefly, 83 relevant items were divided into liking for salt (11 items), sweet (21 items), fat-and-salt (31 items) and fat-and-sweet (20 items) sensations. The questionnaire included items in the following four domains: (i) liking for sweets, fatty sweetened or fatty salted foods, rated on a 9-point hedonic scale; (ii) liking for the intensity of salt, sweets, fat-and-salt or fat-and-sweet seasoning, measured on a 5- or 6-point scale; (iii) preferred drinks (sweet/sweetened or unsweetened) on a restaurant menu; and (iv) eating behavior regarding sweet, salty and fatty food, measured on a 5- or 9-point scale (Fig. 1). For most items, participants also had the option of checking a nonapplicable answer, such as "I have never tasted [this food]" or "I do not like [this food]."

Dietary intake assessment

Dietary data were collected using web-based 24 h dietary records. At enrollment and after 1 year, participants were invited to provide three 24 h records (1 weekend day and 2 weekdays) (Hercberg et al., 2010). These records were randomly assigned over a 2-week period. The dietary record is completed via an interactive interface and is designed for self-administration on the Internet (Touvier et al., 2011). The web-based dietary assessment method relies on a meal-based approach, recording all foods and beverages (type and quantity) consumed at breakfast, lunch, dinner and all other eating occasions. First, the participant fills in the names of all food items eaten. Next, he/she estimates portion sizes for each reported food and beverage item according to standard measurements (e.g. home containers, grams indicated on the package) or using images available via the interactive interface. These photographs, taken from a validated picture booklet (Le Moullec et al., 1996), represent more than 250 foods (corresponding to 1000 generic foods) served in seven different portion sizes. The values for energy, macronutrients and main micronutri-