



Research report

Food neophobia in German adolescents: Determinants and association with dietary habits

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ABSTRACT

Food neophobia (FN) is described as the rejection to eat unknown foods. Because only little is known about the role of FN in adolescence the aim of this study was to examine potential determinants of FN and associations with dietary habits of DONALD study participants. FN was measured with Pliner's and Hobden's Food Neophobia Scale (FN Score (FNS): range 10–70) in 166 10–18-year-old adolescents. Participants' age, sex, body weight status and duration of breast-feeding as well as parents' FN and educational status were considered as determinants. Energy intake, distribution of macronutrients and two variety scores were calculated from 3-day weighed dietary records. Multivariable general linear models were performed for data analyses. Boys and girls did not differ in their FNS (median (Min–Max): boys 31 (10–58), girls 32 (14–59)). Increasing age ($p = 0.010$) and duration of total breast-feeding ($p = 0.006$) were associated with decreasing FNS in girls only. FN was further positively associated with parental FN in the total sample ($p = 0.004$). FN was negatively associated with protein intake in the total sample ($p = 0.017$). The overall low level of FN in the DONALD study can be ascribed to the low level of FN in adolescence in general. Congruently with other studies, age and breast-feeding duration were identified as determinants of girls' FN and parental FN was identified as determinant of FN in the total sample. Further, our results indicate that FN leads to reduced protein intakes. Dietary variety was not strongly affected, possibly because of a broad variety of food supply in Germany.

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1. Introduction

Dietary behavior is not only determined by hunger and satiety, the availability of food and cultural influences, but also by patterns like food neophobia (FN) or picky eating. FN is described as the rejection to eat unknown foods (Pliner & Hobden, 1992), whereas picky eaters also reject familiar foods (Dovey, Staples, Gibson, & Halford, 2008). FN is assumed to be an evolutionary mechanism to protect humans from eating potential toxic food. On the other hand, humans as omnivores have to exploit novel foods to find additional food sources (neophilia) (Rozin & Vollmecke, 1986).

While in childhood this pattern has a protective impact, adolescents' food repertoire grows continuously (Nu, MacLeod, & Barthelemy, 1996) and they are already aware which foods are safe to eat and which cause harm.

This is also reflected by the decrease of FN with age. During early childhood, children younger than 24 months show very low levels of FN (Cashdan, 1994). When children become mobile and more independent from their parents, FN increases sharply with a peak between 2 and 6 years and decreases thereafter until adulthood (Dovey et al. 2008). In adolescents, Nicklaus et al. observed a decrease in FN between the ages of 8–12 and 13–16 years, while between the ages of 13–16 and 17–22 years FN remained fairly stable (Nicklaus, Boggio, Chabanet, & Issanchou, 2005).

Beside age, other determinants of adolescents' FN are only rarely studied. During adolescence, the perception of the own physical appearance and body weight play an important role, especially in girls (Story, Neumark-Sztainer, & French, 2002). As the fear of gaining weight could explain the rejection to eat unknown foods, also body weight status should be discussed as a potential determinant of adolescents' FN. Studies in preschoolers showed

Abbreviations: FN, Food Neophobia; DONALD, Dortmund Nutritional and Anthropometric Longitudinally Designed; FNS, Food Neophobia Score; EI/BMR, Energy Intake/Basal Metabolic Rate; OFVS, Overall Food Variety Score; CFVS, Core Food Variety Score.

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associations of FN with overweight (Finistrella et al. 2012) as well as underweight (Ekstein, Laniado, & Glick, 2010). But, to the authors' knowledge, up to now no studies examined body weight status as a potential determinant of adolescents' FN.

Due to sex differences in the importance of dieting (Story et al. 2002) and variety seeking during adolescence (Nicklaus et al. 2005), sex might also be an important determinant of adolescents' FN. While Koivisto Hursti and Sjöden showed higher FN in 9-year-old boys than girls as well as higher FN in children's fathers than mothers (Koivisto Hursti & Sjöden, 1997), Cooke and Wardle did not observe sex differences in adolescents' FN (Cooke & Wardle, 2005).

Another potential determinant of adolescents' FN that has already been examined in children is the duration of breast-feeding. A potential association might be explained by the fact that breast-fed infants are exposed to several different flavors that are transmitted via breast milk already during infancy (Sullivan & Birch, 1994). Thus, the duration of total breast-feeding might be important since children are exposed to flavors in the breast milk (Beauchamp & Mennella, 2009) for a longer time period and therefore, are probably more open towards novel foods. Regarding this, children, who were breast-fed for at least six months, showed lower levels of FN than children, who were breast-fed for a shorter period (Shim, Kim, & Mathai, 2011; Galloway, Lee, & Birch, 2003). Moreover, the duration of full breast-feeding (breast milk only) might be associated with FN, since an early introduction of complementary food could lead to higher FN in consequence of an increased likelihood of gastrointestinal discomfort and food allergies (Shim et al. 2011). Nevertheless, it remains unclear if these influences are still relevant in adolescence.

However, children's and adolescents' FN might not only be determined by individual, but also by parental characteristics. Although independence and autonomy grow in adolescence, the family is still a major influence on eating behavior (Story et al. 2002). In children, FN has been shown to correlate with parental FN (Galloway et al. 2003; Koivisto & Sjöden, 1996; Pliner & Loewen, 1997). Meaning that similarities in the diet of parents and their children (Pliner, 1983; Pliner & Pelchat, 1986) can not only be ascribed to parents providing family meals and acting as role models (Savage, Fisher, & Birch, 2007), but also to the shared level of FN. According to twin studies FN might even be a heritable trait (Cooke, Haworth, & Wardle, 2007; Knaapila et al. 2007). In addition, parental educational status has been shown to influence children's and adolescents' FN (Flight, Leppard, & Cox, 2003; Mustonen, Oerlemans, & Tuorila, 2012). A high parental educational status might be associated with a wider knowledge about cuisines of different cultures as well as a higher income, which allows offering their children a wider variety of foods (Flight et al. 2003).

Given that adolescence is marked by rapid physical growth and therefore an increased demand for energy and nutrients (Story et al. 2002), the effect of adolescents' FN on dietary habits is of importance. But, there is a lack of literature examining associations of FN with dietary habits in adolescents. In children, high levels of FN were associated with reduced dietary variety (Falciglia, Couch, Gribble, Pabst, & Frank, 2000; Russell & Worsley, 2008). Furthermore, several studies observed an inverse relationship between FN and fruit and vegetable intakes (Galloway et al. 2003; Cooke et al. 2004) and a preference for high energy dense and low nutrient dense foods in food neophobic children (Howard, Mallan, Byrne, Magarey, & Daniels, 2012; Russell & Worsley, 2008). Contrary to the preference for energy dense foods, several studies showed lower energy intakes in food neophobic children and adults (Cooke, Carnell, & Wardle, 2006; Capiola & Raudenbush, 2012). Altogether, a high level of FN seems to affect the overall food quality negatively (Falciglia et al. 2000; Russell & Worsley, 2008).

Therefore, the aim of the present study was to investigate potential determinants of FN and associations between FN and dietary habits of German adolescents using data from the Dortmund Nutritional and Anthropometric Longitudinally Designed (DONALD) study. In particular, we examined adolescents' age, sex, body weight status and duration of breast-feeding as well as parents' FN and educational status as determinants of adolescents' FN. In addition, associations with adolescents' energy and macronutrient intake as well as dietary variety were investigated.

2. Methods

2.1. Study population

The DONALD study is an ongoing open cohort study, which collects information about diet, growth, development, and metabolism of healthy participants between infancy and adulthood. Since 1985 about 40 infants are recruited every year. In the first year of life, infants are examined four times, in the second year two times and later on annually until young adulthood. The DONALD study is exclusively observational and non-invasive. Examinations include 3-day weighed dietary records, anthropometric measurements, collection of 24 h urine samples, interviews on lifestyle, and medical examinations. Further details of the DONALD study design have been published previously (Kroke et al. 2004). The study was approved by the Ethics Committee of the University of Bonn and all examinations are performed with parental and later on children's written consent.

In the DONALD study, FN is measured since 2012 with a German version of Pliner's and Hobden's Food Neophobia Scale (Pliner & Hobden, 1992) in participants between 10 and 18 years and their parents. This questionnaire is used to measure participants' FN as well as parents' own FN. Usually, it is assessed when participants are 10, 12, 15 and 18 years old. If a participant or parent fails to appear at these visits, he will be interviewed at the next visit one year later. Between 2012 and 2014 400 questionnaires have been answered by 195 adolescents and 134 parents. Two questionnaires of parents whose children had not yet answered the questionnaire were excluded. 43 adolescents and 28 parents already answered twice at different time points. As their scores showed a high intra-individual correlation (Pearson correlation coefficient: participants: 0.73, $p < 0.0001$; parents: 0.80, $p < 0.0001$), the mean of the two measurements was calculated. If both a maternal and a paternal questionnaire of one participant were available, the maternal questionnaire was used ($n = 3$). As siblings were included in this evaluation (36 families with 2 children, 3 families with 3 children), parental data of 166 adolescents were available. Thus, the final sample included 166 adolescents and 129 parents.

2.2. Food neophobia

The Food Neophobia Scale is a questionnaire, in which the study participants have to indicate their agreement to ten statements concerning their willingness to try novel foods on a 7-point scale. Five of the statements indicate a low FN. The coding of these questions was reversed and after that a score was calculated by summing up the individual scores for each statement (possible range: 10 to 70). A high Food Neophobia Score (FNS) indicates a high level of FN. For missing values of a single statement in the questionnaire the respective median of the total sample for this statement was used ($n = 5$).

2.3. Dietary assessment

Dietary intake in the DONALD study is measured using 3-day

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