Cluster analysis of individuals with similar trends of fat intake during childhood and adolescence: a new approach to analyzing dietary data

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Abstract

To determine the age at which dietary habits emerge, it is necessary to document the changes in dietary intake, beginning early in life and continuing through late adolescence, of an individual. We examined fat intake as a percentage of energy intake in 228 participants of the Dortmund Nutritional and Anthropometric Longitudinally Designed Study with at least ten 3-day dietary records collected yearly between 1985 and 2002 between the ages of 2 and 18 years. After defining a distance matrix with 3 criteria to measure similarity between individual fat intake trends during childhood and adolescence (=fat intake pattern), cluster analysis was used to identify groups with similar individual fat intake pattern. Cluster analysis resulted in 4 clusters consisting of 35 to 81 subjects with differences in (1) mean fat intake, (2) standard deviation of intraindividual fat intake, and (3) fat intake trends over time. No differences of sex, age, or study participation characteristics were found between clusters. Our analysis shows that cluster analysis is an appropriate tool to identify different fat intake patterns during childhood and adolescence, starting early in life.
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1. Introduction

It is commonly known that present-day dietary habits of adults, as well as of children and adolescents, are not in accordance with expert recommendations. Especially the macronu-

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trient patterns are disproportionate, that is, intake of fat is too high, whereas carbohydrate intake is lower than recommended [1-6]. A reduction of fat intake would be desirable with particular respect to the prevention of obesity and atherosclerosic cardiovascular diseases [7]. Therefore, a fat-reduced and fat-modified diet with more complex carbohydrates as a population-based preventive strategy is recommended starting as soon as in "early childhood" [7] or from the age of 2 years [8,9], whereas others call for specific dietary guidelines for young children [10,11]. In this context, the age of emerging dietary habits is of important interest. Several studies indicate tracking of dietary habits during childhood and adolescence [12–16], that is, the maintenance of relative position in rank of behavior over time [17]. To determine whether changes over time are due to aging, repeated measurements are required of the nutrient intake for the same individuals at several points in time starting in early life [12]. The Dortmund Nutritional and Anthropometric Longitudinally Designed (DONALD) Study, which started in 1985, gives the unique opportunity to evaluate the individual development of dietary habits during childhood and adolescence. For that purpose, we examined the individual trend in fat intake from the age of 2 to 18 years (individual fat intake pattern) in 228 participants with at least 10 dietary measurements using cluster analysis as an innovative method in dietary intake analysis.

2. Methods and materials

The DONALD Study is an ongoing longitudinal (open cohort) study (which started in 1985) collecting detailed data on diet, growth, development, and metabolism between infancy and adulthood (once a year for subjects older than 2 years). Details have been described elsewhere [18].

The starting study sample (n ≈ 470) included infants, children, and adolescents recruited from earlier cross-sectional studies in schools and kindergartens. After 1989, predominantly infants are recruited (≈ 40 per year) and were followed until the ages of 20 (women) and 23 years (men).

Study participants are recruited in the city of Dortmund and in the surrounding communities via personal contacts, maternity wards, or pediatric practices. Eligible are healthy German babies (age 3-6 months) whose mothers and/or fathers are willing to participate in a long-term study [18]. This convenient sample scheme results in a selected, nonrepresentative study sample with a higher educational attainment and higher socioeconomic status of the study participant parents compared with the general population [18]. Dropout rates were small and vary by the age of the child, with the highest dropout rate during puberty.

The regular assessments (quarterly for infants, biannual for toddlers, else yearly) include records of dietary intake and behavior, anthropometry, urine sampling, interviews on lifestyle and health-related issues, and medical examination [18].

The Scientific Committee of the Research Institute of Child Nutrition approved the study, which is exclusively observational and noninvasive. All examinations and assessments were performed with parental consent and later on with the subject's consent.

A 3-day weighed dietary record is collected yearly from the study participants after the age of 2 years. Hereto, parents of the children or the older subjects themselves were