Relative Validity and Reproducibility of a Food Frequency Questionnaire for Identifying the Dietary Patterns of Toddlers in New Zealand

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ABSTRACT

Background Dietary patterns provide insight into relationships between diet and disease. Food frequency questionnaires (FFQs) can identify dietary patterns in adults, but similar analyses have not been performed for toddlers.

Objective The aim of the Eating Assessment in Toddlers study was to evaluate the relative validity and reproducibility of dietary patterns from an FFQ developed for toddlers aged 12 to 24 months.

Design/setting Participants were 160 toddlers aged 12 to 24 months and their primary caregiver who completed an FFQ twice, approximately 5 weeks apart (FFQ1 and FFQ2). A 5-day weighed food record was collected on nonconsecutive days between FFQ administrations.

Statistical analysis Principal component analysis identified three major dietary patterns similar across FFQ1, FFQ2, and the 5-day weighted food record.

Results The sweet foods and fries pattern was characterized by high intakes of sweet foods, fries and roast potato and kumara (sweet potato), butter and margarines, processed meat, sweet drinks, and fruit or milk drinks. The vegetables and meat pattern was characterized by high intakes of vegetables, meat, eggs and beans, and fruit. The milk and fruit pattern was characterized by high intakes of milk and milk products and fruit, and low intakes of breastmilk and infant and follow-up formula. The FFQ (FFQ1) correctly classified 43.1% to 51.0% of toddlers into the same quartile of pattern score as the 5-day weighted food record, and Pearson correlations ranged from 0.56 to 0.68 for the three patterns. Reliability coefficients ranged from 0.71 to 0.72 for all three dietary patterns.

Conclusions the Eating Assessment in Toddlers study FFQ shows acceptable relative validity and high reproducibility for identifying dietary patterns in toddlers.
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HIGHER BODY WEIGHT AND RAPID GROWTH BETWEEN birth and age 2 years are associated with an increased risk of obesity in childhood and adulthood.[1-3] Identifying dietary patterns contributing to weight and rapid growth in infancy is therefore essential. Although food frequency questionnaires (FFQs) are a cost-effective method for dietary assessment in large population groups,[4,5] the relative validity of each new FFQ requires testing.[4,6] Validation studies in young children are particularly important because assessing diet during growth presents unique challenges that are not present in older populations, including reliance on surrogate reporters and the presence of multiple caregivers who may provide food and drinks. Few FFQs have been validated for use in young children, particularly in those aged 12 to 24 months, and the focus of these has been food and nutrient intakes rather than dietary patterns.[7-18]

The analysis of dietary patterns that describe overall diets rather than individual nutrient intakes is an alternative, yet complementary, approach that can account for interactions between nutrients and food components eaten together, and allow relationships between dietary patterns and risk of disease to be explored.[19,20] Although several adult FFQs have been evaluated for their ability to determine dietary patterns using principal component analysis (PCA),[21-28] such research in young children is scarce. The aim of our study was to evaluate the relative validity and reproducibility of dietary patterns defined by PCA from the Eating Assessment in Toddlers (EAT) FFQ, an FFQ developed for use in toddlers aged 12 to 24 months.

SUBJECTS AND METHODS

Study Population

One hundred sixty parents of toddlers aged 12 to 24 months living in three regions of New Zealand were recruited from September 2011 to April 2012 by newspaper advertisements,

social media, flyers, and word of mouth. Parents were eligible to participate if their child was born ≥36 weeks gestation, had no diagnosed medical condition that affected feeding or growth, and was aged between 12 and 24 months. Ethical approval was obtained from the University of Otago Ethics Committee and all parent participants provided written informed consent.

Study Methods

Participants attended two appointments, held either at the child's home or at the University research clinics, approximately 5 weeks apart. At the first appointment, demographic data were collected from the parent–child pair, anthropometric measurements of the child were undertaken, and the FFQ was administered to the parent. The FFQ was repeated at the second appointment. Between appointments, parents completed a weighed food record (ie, the 5DWFR) for their child on 5 assigned randomized nonconsecutive days.

At the first appointment, measurements of weight were made to the nearest 0.1 kg (Alpha Model 770, Seca) and length to the nearest 0.1 cm (Rollameter 100, Harlow Healthcare) in duplicate with the infant wearing a dry, pre-weighed diaper, and a singlet.

Dietary Assessment

Food Frequency Questionnaire. The EAT FFQ is an interviewer-administered questionnaire with 91 food items. It is designed to describe dietary intake over the previous 4 weeks and to rank toddlers aged 12 to 24 months by nutrient intake[29] and dietary pattern score (the subject of this article). The questionnaire exhibits good validity and high reproducibility for intake of macronutrients and key micronutrients in New Zealand toddlers.[29] It contains 10 frequency response options: zero times per month; less than once a week; one, two, three, four, five, six, or seven times a week; plus an open-ended category for recording frequencies greater than once per day. Portion size data were collected to enable the relative validity of the FFQ for determining nutrient intake to be evaluated.[29] The frequency data alone were used to determine dietary patterns in the present study. The use of frequency data (rather than grams of intake) allowed inclusion of breastmilk, the portion size for which could neither be estimated by parents, nor measured by weighed diet record.

The EAT FFQ was adapted from the Southampton Women's Survey FFQ, which was designed to assess dietary intakes of UK children aged 12 months over the previous 28 days.[14] The food list was tailored to New Zealand toddlers by including foods that at least 10% of New Zealand toddlers eat,[30] replacing UK infant foods with comparable New Zealand foods, replacing UK food names with New Zealand equivalents (eg, the drink "squash" was changed to "cordial," a nonalcoholic sweetened fruit drink), and removing foods not commonly eaten in New Zealand (eg, "gammon").

The EAT FFQ was administered twice: at the first appointment (FFQ1) before food record completion, and at the second appointment (FFQ2), after food record completion. An online interface to enter the FFQ data was created using the LimeSurvey open-source survey application (version 1.90+, 2010, LimeSurvey.org). The data entry interface was duplicated so that each FFQ was entered twice and errors

identified and corrected. Data were the daily frequency with which each food item was eaten.

Food Record. Participants completed a 5DWFR for their child over a 5-week period.[31] Nonconsecutive days were randomly assigned to account for day-of-the-week effects, including weekdays and weekend days. Participants were shown how to complete the food record and provided with calibrated Salter Vista electronic kitchen scales. Additional instructions were provided specifically for early childhood education staff, or other caregivers, to use when the child was away from his or her parents. The researchers reviewed completed food records and clarified any illegible or incomplete data with the participants. Food records were entered into dietary assessment software Kai-culator (version 0.85, 2013, University of Otago). Data were entered by qualified nutritionists and checked for accuracy by a single qualified dietitian, and corrections made where necessary. The daily frequency of food group intake for each participant was obtained from Kai-culator, and weighted so that weekdays made up five-sevenths of the contribution to weekly intake to account for variation in dietary intake between weekdays and weekend days.

Food Groupings. The FFQ contained 91 food items that were collapsed into 16 food groups. The sample size of 160 allowed for examination of 16 food groups using PCA, because 10 participants per variable are required for robust results.[32] Foods were allocated to the food groups based on nutrient profile and similarity of use (see the Figure). The same 16 food groups were created for the 5DWFR data. In total, 1,480 different food items were entered into Kai-culator from the food records. Of these, 1,339 (90.5%) were matched to the 16 food groups. The remaining items were excluded from the analysis (eg, herbs, dressings, and baking ingredients such as flour).

Statistical Analysis

To identify dietary patterns, separate PCAs were conducted using Stata (version 12.1, 2013, StataCorp) on the FFQ1, FFQ2, and 5DWFR frequency data for the 16 food groups using orthogonal varimax rotation. Eigenvalues >1, the elbow of scree plots, and the component interpretability were considered when identifying the number of components retained in the solution. The percentage variation explained by each component depends on the number of variables analyzed, so this was not used as a decision criterion.[33] As recommended by Newby and Tucker,[20] dietary patterns were named quantitatively, with patterns named based on the first two food groups that loaded highly and positively on each component. Factor loadings of ±0.3 were considered significant.[20]

The relative validity of the dietary patterns was determined by comparing FFQ1 dietary pattern scores to those from the 5DWFR. This was to avoid potential memory effects associated with FFQ2 because it was administered after the 5DWFR had been completed. Cross-classification, Pearson's correlation coefficients, and intraclass correlation coefficients were used to assess the relative validity of the FFQ. For cross-classification, the dietary pattern scores were categorized into quartiles separately for FFQ1 and for the 5DWFR. The