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Development of scores to measure the effects of nutrition counselling on the overall diet: A pilot study in children and adolescents

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Summary An intervention study by documented dietary counselling was carried out in a sample of 9 children and adolescents (12–15 years) living in a full-time institution in Dortmund. Three weighed dietary records were collected over 3–7 days, one before and one after each of two individual nutrition counselling sessions, which were based on the recommended intake of food groups defined by the Optimized Mixed Diet (OMD), a quantitative preventive dietary conception for children and adolescents. As univariate dietary parameters (e.g., cholesterol intake), which are often used to show the effectiveness of nutrition counselling, do not take into account the multivariate complexity of nutrition, we developed 3 multivariate scores to measure the effectiveness of nutrition counselling. They are defined as:

Recommended Food group change Score (RFS): Average change in the amounts of the deviations (%) from the reference food groups values (OMD = 100 %) before and after counselling taking into account the aim (eat more/less) of the counselling session, exclusively based on the food groups addressed during counselling.

Total Food group change Score (TFS): Average change in the amounts of the deviations (%) from the reference food group values (OMD = 100 %) before and after

counselling based on all food groups consumed.

Nutrient Improvement Score (NIS): Average change in the negative deviations (%) of 8 vitamins and 8 minerals from the German reference values for nutrient intake (Deutsche Gesellschaft für Ernährung (DGE) = 100 %) before and after counselling.

On average, the intakes of the food groups mentioned during the first counselling session improved considerably (RFS = +36 %), the change in the intake of all food groups was small (TFS = +6 %) and the nutrient intakes did not improve (NIS = 0 %).

From the second counselling session the value of the RFS was +10 %, of the TFS was +6 % and of the NIS +3 %.

This means that the success of counselling on one dietary criterion does not guarantee success on others. Our food and nutrient based scores together with a detailed food intake assessment give an example of multivariate measurements of nutrition counselling outcomes.

Key words Children – adolescents – nutrition counselling – dietary evaluation – scores

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Introduction

It is widely recommended to start the prevention of nutrition related chronic diseases in childhood, especially with regard to arteriosclerosis and coronary heart disease (CHD) (6, 17). In the last 25 years, several intervention studies have been conducted to improve the diet of children and adolescents with regard to the prevention of CHD (12). Depending on the aims of these studies, the effects of counselling were mostly measured using univariate dietary parameters, e.g., the intake of fat (14), saturated fatty acids (22), cholesterol or sodium (23) or the intake of single food groups, e.g., whole fat milk products (15). However, the development of chronic nutrition related diseases, e.g., CHD, is not only associated with the intake of single nutrients or food groups. Recent research with respect to CHD showed that not only dietary fat and cholesterol, but also antioxidative vitamins and non-nutritive substances are involved (3, 13). Moreover, the diet itself is multivariate with interdependencies between foods and nutrients since each food itself is complex in its nutrient composition. A change in the intake of single foods is followed by a change of the intake of many nutrients. Therefore, the aim of nutrition counselling particularly with respect to prevention should be the improvement of the overall diet quality. To look at the effects of such an extensive counselling, new concepts for evaluation are needed. Therefore we have developed 3 different scores based on food intake as well as nutrient intake to get an insight into the complexity of changes in the overall diet quality after nutrition counselling by using a small group of healthy children and adolescents living in a full-time institution.

Subjects and methods

Subjects

In 1994/95 an intervention study by individual nutrition counselling was carried out involving healthy children and adolescents living in a full-time institution in Dortmund to investigate the all-day nutrition of children and adolescents in a family-like situation (2). Each of the 4 separate houses making up this institution comprised a group of about 10 children or adolescents and was looked after by 4 carers. The groups were self-responsible for house-keeping and diet.

Study design

The study comprised 3 individual weighed diet records from each subject and started with the first record in Feb/March 1994. One month before the second record (Aug/Sept 1994) and one month before the third record (Feb/March 1995) individual nutrition counselling sessions were held in the institution.

Nutrition survey

Each dietary survey comprised a weighed diet record over one week. Because some of the study participants were absent for single meals or days, not all records were complete of 7 days. A minimum of 3 days per subject and survey was accepted (mean number of days per record: 5.1).

Records were carried out using electronic food scales (WEDO Digi 2000 (0–2000 g), accuracy 1 g). The recording procedure was explained to carers and study participants. The study participants were asked to record the weighed amount of each food and drink during the record days. Different components of a dish, e.g., bread, butter, jam, were recorded separately. Semiquantitative amounts (household measures, numbers of portions) were allowed, particularly at school or in a restaurant. Recipes of composite meals, e.g., vegetable soup, were recorded during the preparation by the carers or study personnel.

Nutrient intakes were calculated using our continuously updated nutrient database LEBTAB (20).

Validation of records

To check for underreporting, the ratio of reported energy intake (EI) and estimated basal metabolic rate (BMR), taking into account age, sex, body weight and height (19), was used. Records with an EI:BMR ratio <1.06 ("Cut-off 2", 95 % confidence limits) indicating a not plausible recorded individual actual 3 d energy intake (7) and were excluded from further analysis.

Nutrition counselling

Counselling was based on the Optimized Mixed Diet (OMD), which was developed by the Research Institute of Child Nutrition as a general preventive dietary concept for German children and adolescents. The nutrient intake of the OMD conforms to the German recommendations for the intake of micronutrients (vitamins and minerals) and the international paediatric recommendations for the intake of macronutrients (protein, fat, carbohydrates) which characterise a diet under preventive aspects (9, 10, 11, 24). From the practical point of view, the OMD is defined by the recommended intakes of 11 food groups in g/day for different age groups. Calculated as food group density (g/MJ) the recommended food group intake is the same for all age groups.

Based on the results of the preceded dietary record, each study participant received a leaflet with individual suggestions on how to improve his food intake (individual counselling). The written proposals were explained to each study participant by the study personnel. Carers, who were responsible for food purchase and preparation, received written and verbal informations on how to improve the food selection for the group as well as recipes for warm meals for a 1 week menu (group counselling).

Statistical methods

SAS procedures (Version 6.11) were used for data analysis. Food group intake was calculated as food group density (g/MJ), and nutrient intake was calculated as nutrient density (mg/MJ; µg/MJ). The German recommendations for nutrient intake (4) were used as references for the nutrient intake and the recommendations for food intake of the OMD were used as the reference for the food group intake. Using these parameters independent of age, sex and total food amount, the problems of the heterogeneous ages of the study participants and the variations in the average energy intake during the study period (Table 1) were overcome.

To investigate effects of nutrition counselling on the overall diet of each study participant 3 different scores were calculated:

Recommended Food group change Score (RFS): Average change in the amounts of the deviations (%) from the reference food group values (OMD = 100 %) before and after counselling taking into account the aim (eat more/less) of the counselling session, exclusively based on the food groups addressed during counselling.

Total Food group change Score (TFS): Average change in the amounts of the deviations (%) from the reference food group values (OMD = 100 %) before and after counselling based on all food groups consumed.

Nutrient Improvement Score (NIS): Average change in the negative deviations (%) of 8 vitamins and 8 minerals from the German reference values (DGE = 100 %) before and after counselling.

Results

From the 30 participants in the first survey 5 refused further participation, 5 left the institution and 5 changed their original group and were excluded from this analysis because each group was counselled individually.

From the 15 participants with 3 records, 9 children (2 boys, 7 girls, aged 10–15 years, mean: 12.6 years) had plausible energy intakes (EI:BMR ≥ 1.06) for all 3 records. These 27 records were analyzed and the results shown below.

After the first counselling sessions the individual RFS were in a range between -16 to +103 % (Table 2). On average, the RFS improved considerably (+36 %). The individual TFS (-19 to +32 %) and the average value (+6 %) were lower than the RFS. The individual changes in nutrient densities (NIS) were the lowest (-11 to +9 %), on average the NIS did not improve (0 %). After the second counselling session the mean RFS was markedly lower than after the first one (+10 %), the average TFS (+6 %) remained unchanged, and the NIS improved slightly (+3 %) (Table 2).

Example

Table 3 shows an example of the calculation of the RFS and TFS of a fictional subject based on the recorded intakes of 5 food groups before (a) and after (b) a nutrition counselling session. Here, only the food groups 1, 3 and 5 were addressed during counselling, because their deviations (%) from the reference intakes of the OMD were high before the counselling session. If an increased intake of a food group was advised, the direction of counselling was defined as +1, if a decreased intake of a food group was advised, the direction of counselling was defined as -1 (d).

The RFS was calculated as the mean value from the differences in the % deviations (c) multiplied with the intended directions of the 3 counselled food groups (d) respectively:

$$\text{RFS} = [30 + (-10) + 10]/3 = 10$$

The TFS was calculated as the difference in the mean values of amounts of the % deviations of all consumed food groups before and after counselling (c) without intended direction:

$$\text{TFS} = [(40 + 8 + 30 + 15 + 60)/5] - [(10 + 10 + 40 + 20 + 50)/5] = 4.6$$

Here the positive RFS indicates that the deviations of food groups addressed in the counselling session became smaller, i.e., this fictional individual had followed the advice given in the counselling session. The positive TFS indicates that the total food group intake had on average improved also, but the improvement was smaller than the improvement in counselled food groups alone.

Table 1 Energy intake of the 9 study participants during the study course

Energy intake	First survey			Second survey			Third survey		
	Mean	s ¹⁾	Median	Mean	s ¹⁾	Median	Mean	s ¹⁾	Median
MJ/d	10.1	2.4	10.1	8.7	1.4	8.7	9.0	1.2	9.1
MJ/kg/d ²⁾	0.21	0.03	0.20	0.17	0.04	0.18	0.17	0.04	0.15

¹⁾ Standard deviation

²⁾ Friedman-Test (p < 0.05)

Table 2 Individual and average values of the 3 different scores (RFS, TFS, NIS) to show the effects of the first and second nutrition counselling session on the overall diet

Participants	First counselling			Second counselling		
	RFS	TFS	NIS	RFS	TFS	NIS
1	+ 32	+ 2	+ 3	- 2	+ 8	+ 1
2	+ 38	+ 2	- 0	+ 2	+11	+12
3	- 16	-19	+ 3	+20	+18	+21
4	+ 20	+ 2	+ 9	+25	+13	+ 9
5	- 1	+ 3	-11	+ 7	+ 6	+ 6
6	+ 48	+32	+ 2	+ 3	-17	-12
7	+ 86	+ 9	- 4	-12	-12	-16
8	+103	+10	+ 2	+19	+11	- 8
9	+ 17	+10	- 5	+24	+15	+16
Mean	+ 36	+ 6	0	+10	+ 6	+ 3
s ¹⁾	+ 38	+13	+ 6	+13	+12	+13
Median	+ 32	+ 3	+ 2	+ 7	+22	+ 6

¹⁾ Standard deviation

Table 3 Deviations of recorded food group intakes (%) from reference intakes of the OMD before and after counselling using a fictional subject as an example

Food group	Deviation before counselling (%) (a)	Deviation after counselling (%) (b)	Difference without intended direction (after) – (before) (%) (b - a = c)	Direction of counselling (d)	Difference with intended direction (%) (c * d)
1	+40	+10	+10 - (+40) = -30	-1	+30
2	+ 8	-10	-10 - (+ 8) = -18		
3	-30	-40	-40 - (-30) = -10	+1	-10
4	-15	-20	-20 - (-15) = - 5		
5	-60	-50	-50 - (-60) = +10	+1	+10

Discussion

Evaluation is an essential aspect of nutrition counselling. However, up to now no standardised procedures to measure the positive or negative effects of nutrition counselling exist. This could be expected, given the complex interactions of foods and nutrients in the overall diet.

Changes in the intake of one food group may influence the intake of other food groups. Moreover, food intake changes are not automatically energy indifferent, e.g., the recommended decreased consumption of high fat foods is often not made up by a recommended increase in foods with a high proportion of complex carbohydrates.

In most intervention studies, the effectiveness of nutrition counselling was measured by comparing defined single parameters before and after counselling. However,

in some studies with children and adolescents, scores were calculated by combining several parameters. In the “Go for Health” Study the portion of “Go Foods” as percentage of total food consumption was calculated to evaluate nutrition counselling (18). In the “San Diego Family Health Project” a score was calculated using results of a 36 item food frequency questionnaire aiming at low fat, low sodium and high fat, high sodium foods (16). In the “North Karelia Youth Project II” a “dietary habit index” was defined, based on a questionnaire, containing several parameters, e.g., using margarine, drinking skimmed milk, eating berries (21). But in no study was a score calculated covering the overall diet. One reason for this may be the costs assessing children’s total diet not only once but at least twice (before and after counselling).

Up to now dietary quality scores based on food groups were calculated only on a qualitative basis using dietary variety (number of different food groups consumed) or counting portions without consideration of portion size (8). This may be due to the fact that quantitative food based recommendations, comparable to recommended nutrient intakes of national and international committees, are almost not existent. Most dietary guidelines, e.g. the Food Guide Pyramid used in the USA (1) or the Nutrition Wheel ("Ernährungskreis") used in Germany (5) are defined only qualitatively (e.g. numbers of portions per day/per week). In contrast to this, the quantitative recommendations of food groups in the OMD allow the quantitative calculation of the overall food based dietary quality of children and adolescents.

In this study, the primary success of nutrition counselling (single food group recommendations) did not necessarily improve the whole diet. The same applies to nutrient intake. Every food contains an individual combination

of nutrients, therefore food based nutrition counselling does not change the intake of only one isolated nutrient. If selection of foods within a food group changes, nutrient intake could also be altered.

Our scoring procedure needs exact dietary intake measurements and nutrition counselling documentations and may be practical only for studies with small groups. However, it has the advantage of measuring the success of counselling with multiple parameters, describing the overall diet. By using 3 different scores, possible interactions between food groups and interactions between food groups and nutrients were taken into account. Additionally the intended direction of the dietary modification was also considered.

Our results show that the success of counselling on one dietary criterion (food intake or nutrient intake) does not guarantee success on others. Therefore our results confirm that it is mandatory to assess the effects of nutrition counselling on various criteria.

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