Family Dietary Coaching to Improve Nutritional Intakes and Body Weight Control

A Randomized Controlled Trial

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Objective: To test the hypothesis that family dietary coaching would improve nutritional intakes and weight control in free-living (noninstitutionalized) children and parents.

Design: Randomized controlled trial.

Setting: Fifty-four elementary schools in Paris, France.

Participants: One thousand thirteen children (mean age, 7.7 years) and 1013 parents (mean age, 40.5 years).

Intervention: Families were randomly assigned to group A (advised to reduce fat and to increase complex carbohydrate intake), group B (advised to reduce both fat and sugar and to increase complex carbohydrate intake), or a control group (given no advice). Groups A and B received monthly phone counseling and Internet-based monitoring for 8 months.

Outcome Measures: Changes in nutritional intake, body mass index (calculated as weight in kilograms divided by height in meters squared), fat mass, physical activity, blood indicators, and quality of life.

Results: Compared with controls, participants in the intervention groups achieved their nutritional targets for fat intake and to a smaller extent for sugar and complex carbohydrate intake, leading to a decrease in energy intake (children, \( P < .001 \); parents, \( P = .02 \)). Mean changes in body mass index were similar among children (group A, \( +0.05, 95% \text{ confidence interval (CI)}: −0.06 \text{ to } 0.16 \); group B, \( +0.10, 95\% \text{ CI}, −0.03 \text{ to } 0.23 \); control group, \( +0.13, 95\% \text{ CI}, 0.04-0.22; \ P = .45 \)), but differed in parents (group A, \( +0.13, 95\% \text{ CI}, −0.01 \to 0.27 \); group B, \( −0.02, 95\% \text{ CI}, −0.14 \to 0.11 \); control group, \( +0.24, 95\% \text{ CI}, 0.13-0.34; \ P = .001 \), with a significant difference between group B and the control group (\( P = .01 \)).

Conclusions: Family dietary coaching improves nutritional intake in free-living children and parents, with beneficial effects on weight control in parents.

Trial Registration: clinicaltrials.gov Identifier: NCT00456911


PUBLIC HEALTH STRATEGIES TO prevent obesity include nutritional recommendations to limit intake of fats and sugars and to increase intake of complex carbohydrates.1 Although these recommendations are widely used, insufficient evidence is available to support their feasibility, sustainability, or even their efficacy. If low-fat diets have often been associated with weight loss,2-4 long-term compliance with marked fat reductions is questionable, as fats enhance palatability.5,6 A lower consumption of sugar-sweetened soft drinks may help to prevent overweight,7,8 but high-carbohydrate diets have also been associated with better weight control.9,10 A significant increase in complex carbohydrates is difficult to sustain because it leads to major changes in food habits.11 Overall, available intervention studies on weight control are often short-term and concern small cohorts.12 They mostly investigate the effects of concurrent changes in diet, physical activity, and behavior, thus making causal inference between nutritional changes and clinical benefits impossible. In this context, well-designed studies targeting only dietary modifications are needed to better understand the acceptable levels of nutritional changes and their impacts on health.

As general messages have shown little efficacy in changing dietary habits,13 these studies should be based on specific meth-
ods, such as individualized coaching, Internet-based monitoring, and home food delivery. A family approach as well as actions in schools for children may also induce sustainable dietary changes. In the Etude Longitudinale Prospective Alimentation et Santé (EL-PAS) study, we hypothesize that family dietary coaching for one school year will allow a nutritional shift toward following recommendations and improve weight control in free-living (noninstitutionalized) children and parents.

**METHODS**

**PARTICIPANTS**

One thousand thirteen families were included in this 10-month, parallel, randomized intervention trial. In each family, one second- or third-grade pupil (aged 7-9 years) and one of his or her parents participated. This children’s age was chosen for 2 reasons: (1) this age corresponds to the period following the adiposity rebound, when overweight and obesity may appear, and (2) children of this age are receptive to dietary interventions, because they have passed the phase of dietary neophobia. Volunteers were recruited from 54 elementary schools in Paris, France, from March 2005 through June 2005. A mailing was performed in July 2005 to complete the recruitment with families from nonparticipating schools. All families were informed of the general nature of the intervention (a study on food and health) but were unaware of the primary hypothesis, eg, that nutritional changes would affect body mass index (BMI) (calculated as weight in kilograms divided by height in meters squared). Inclusion criteria were being a second- or third-grade pupil, having an affiliation with the French health care system, and providing written informed consent. Because our study was designed to test nutritional targets for the general population and to avoid discrimination between children, no exclusion criteria were based on pathologic, ethnic, or social/educative indicators. Ethical approval was given for the study by the ethics committee of Poissy St-Germain-en-Laye Hospital, St-Germain-en-Laye, France.

**RANDOMIZATION**

Families were randomly assigned to 1 of the following groups (Figure 1):

1. Group A (297 families) received advice on how to reduce dietary fats (<33% of total energy intake) and how to increase complex carbohydrates (>50% of total energy intake).
2. Group B (298 families) received advice on how to reduce both dietary fats (<35% of total energy intake) and sugars (<25% of initial crude intake) and how to increase complex carbohydrates (>50% of total energy intake).
3. The control group (418 families) received no dietary advice.

Groups A and B were given explanations on how to increase complex carbohydrate intake to maintain an isocaloric diet. In accordance with current nutritional recommendations, advice for fats targeted saturated fatty acids, and advice for sugars targeted extrinsic sugars.

We performed a school-based randomization to avoid contact between volunteers from different groups. Schools were stratified by district, status (school participating or not in the study), and number of participants in each school to ensure that all 3 groups would be homogeneous with regards to social/educative characteristics and recruitment methods. Randomization was performed according to a computer-generated randomization list (PROC SURVEYSELECT; SAS Institute Inc, Cary, North Carolina).

**INTERVENTION**

Computer-based interventions have proved efficient in previous trials. Therefore, to enhance participant motivation and monitoring, we developed a Web site dedicated to the study. The EL-PAS Web site gave personal access to the study’s self-administered questionnaires (diet, physical activity, meal preparation, and quality of life) along with updated information, an individual and interactive agenda, an email address, and various other functions. The online food questionnaire included 3425 food items and 700 portion-size pictures (NutriXpert; Medical Expert System, Paris, France); before initiation of the study, the families were instructed how to use the computer program. They then performed 3-day dietary records (2 weekdays including Wednesday, and one weekend day) monthly from September 2005 to June 2006. Energy and macronutrient intakes were calculated using computerized national food composition tables completed with additional food items. Adult underreporters were identified using the Schofield equation with the Goldberg cutoff limits (1.04 x basal metabolic rate). At baseline, these underreporters were called by the dietician who checked for omission and errors.

All families completed the baseline evaluation September 2005 through October 2005. From November 2005 through June 2006, families in the intervention groups received monthly telephone counseling by a trained dietician. The dietary intervention thus occurred for 8 months. Telephone calls, which were about 30 minutes long, were dedicated to analyzing food...
habs of the participants according to their last food records and determining pragmatic advice to reach their specific dietary targets. Advice included reduction in portions and/or frequency of consumption as well as food substitutions and meal preparation modifications. Prior to the study, dieticians were instructed by experts on how to optimize dietary advice by developing an original approach based on analysis of the subject’s social/educative and psychological characteristics. In addition to telephone counseling, children and parents received monthly newsletters. Families were also invited to a series of events (eg, conferences, museum visits), and 3 lessons on nutrition, but no individualized advice, to maintain motivation and to avoid a high dropout level. They were followed for 1 year.

Participants in the control group received general information about nutrition, but no individualized advice, to maintain motivation and to avoid a high dropout level. They were followed at the same intervals as participants in the intervention groups and were asked to record their diets in an identical fashion.

**OUTCOME MEASUREMENTS**

All anthropometric measurements were performed by trained staff, blinded to the experimental design, at baseline (September-October 2005) and at the end of the intervention (May-June 2006) in both children and parents. Height without shoes was measured to the nearest 0.1 cm using a portable stadiometer and weight in underwear was measured to the nearest 0.1 kg on a portable electronic scale. Body mass index was then calculated.

Table 1. Baseline Characteristics of the 1013 Study Participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Children</th>
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<th>Parents</th>
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<td>Group A</td>
<td>Group B</td>
<td>Control</td>
<td>Group A</td>
<td>Group B</td>
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<tr>
<td>No. of participants</td>
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<td>298</td>
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<td>Age, y</td>
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<td>7.8 (0.6)</td>
<td>7.6 (0.6)</td>
<td>40.4 (5.3)</td>
<td>40.3 (5.4)</td>
<td>40.6 (5.4)</td>
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<td>Male sex, No. (%)</td>
<td>143 (48.1)</td>
<td>149 (50.0)</td>
<td>189 (45.2)</td>
<td>55 (18.5)</td>
<td>48 (16.1)</td>
<td>79 (18.9)</td>
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<td>Higher social/professional levels, %</td>
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<td>36</td>
<td>30</td>
<td>35</td>
<td>36</td>
<td>30</td>
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<td>Anthropometric</td>
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<td>Height, cm</td>
<td>127.4 (6.6)</td>
<td>127.5 (6.2)</td>
<td>126.8 (6.8)</td>
<td>166.1 (8.4)</td>
<td>165.3 (7.9)</td>
<td>166.5 (8.6)</td>
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<td>Weight, kg</td>
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<td>27.4 (5.3)</td>
<td>26.5 (4.9)</td>
<td>66.8 (13.5)</td>
<td>67.3 (16.0)</td>
<td>68.6 (14.1)</td>
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<td>Body mass index</td>
<td>17.7 (2.25)</td>
<td>16.8 (2.33)</td>
<td>16.3 (1.98)</td>
<td>24.21 (4.45)</td>
<td>24.64 (5.71)</td>
<td>24.04 (4.39)</td>
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<td>Body mass index</td>
<td>0.70 (1.35)</td>
<td>0.70 (1.38)</td>
<td>0.48 (1.25)</td>
<td>21.0 (7.9)</td>
<td>21.6 (9.4)</td>
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<td>Fat mass, kg</td>
<td>4.3 (2.8)</td>
<td>4.3 (2.7)</td>
<td>3.9 (2.4)</td>
<td>21.0 (7.9)</td>
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<td>Chest circumference, cm</td>
<td>62.3 (5.1)</td>
<td>63.3 (4.8)</td>
<td>62.3 (4.2)</td>
<td>93.3 (9.3)</td>
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<td>Waist circumference, cm</td>
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<td>56.7 (4.7)</td>
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<td>Hip circumference, cm</td>
<td>65.9 (6.0)</td>
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<td>97.9 (9.1)</td>
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<td>Knee circumference, cm</td>
<td>28.1 (2.3)</td>
<td>28.2 (2.3)</td>
<td>27.8 (2.1)</td>
<td>37.3 (3.0)</td>
<td>37.6 (3.9)</td>
<td>37.4 (3.2)</td>
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<tr>
<td>Dietary intake</td>
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<tr>
<td>Total energy intake, kcal/d</td>
<td>1679 (357)</td>
<td>1628 (390)</td>
<td>1633 (369)</td>
<td>1619 (480)</td>
<td>1606 (508)</td>
<td>1673 (508)</td>
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<tr>
<td>Fats, g/d</td>
<td>67.4 (18.2)</td>
<td>64.2 (20.0)</td>
<td>64.8 (19.3)</td>
<td>672.2 (24.5)</td>
<td>65.9 (24.7)</td>
<td>69.1 (25.4)</td>
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<tr>
<td>Sugars, g/d</td>
<td>99.8 (28.4)</td>
<td>97.3 (30.4)</td>
<td>99.3 (29.1)</td>
<td>72.9 (30.6)</td>
<td>71.0 (31.6)</td>
<td>75.9 (33.3)</td>
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<tr>
<td>Complex carbohydrates, g/d</td>
<td>98.0 (30.7)</td>
<td>98.1 (29.9)</td>
<td>98.1 (29.5)</td>
<td>97.9 (37.8)</td>
<td>101.8 (42.9)</td>
<td>102.1 (37.8)</td>
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<tr>
<td>Total carbohydrates, g/d</td>
<td>198.6 (47.7)</td>
<td>196.1 (51.1)</td>
<td>196.0 (48.9)</td>
<td>171.9 (58.7)</td>
<td>173.3 (64.5)</td>
<td>178.3 (61.0)</td>
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<tr>
<td>Protein, g/d</td>
<td>69.4 (17.0)</td>
<td>66.2 (19.0)</td>
<td>66.5 (17.5)</td>
<td>70.6 (22.9)</td>
<td>69.5 (23.3)</td>
<td>72.1 (21.9)</td>
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<tr>
<td>Fats, % of total energy intake</td>
<td>35.7 (5.2)</td>
<td>34.9 (6.0)</td>
<td>35.1 (5.5)</td>
<td>36.8 (6.5)</td>
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<td>36.3 (6.5)</td>
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<td>Sugars, % of total energy intake</td>
<td>23.9 (4.7)</td>
<td>24.0 (5.2)</td>
<td>24.6 (5.1)</td>
<td>18.4 (5.6)</td>
<td>18.1 (6.3)</td>
<td>18.2 (6.0)</td>
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<tr>
<td>Complex carbohydrates, % of total energy intake</td>
<td>23.4 (5.3)</td>
<td>24.4 (5.8)</td>
<td>23.5 (4.9)</td>
<td>24.4 (6.9)</td>
<td>25.4 (7.4)</td>
<td>24.8 (6.8)</td>
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<td>Total carbohydrates, % of total energy intake</td>
<td>47.5 (5.5)</td>
<td>48.6 (6.5)</td>
<td>48.3 (6.1)</td>
<td>43.0 (7.9)</td>
<td>43.7 (8.7)</td>
<td>43.2 (7.5)</td>
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<tr>
<td>Protein, % of total energy intake</td>
<td>16.7 (2.7)</td>
<td>16.4 (3.1)</td>
<td>16.4 (3.0)</td>
<td>17.7 (3.9)</td>
<td>17.8 (4.5)</td>
<td>17.7 (4.0)</td>
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</table>

**a**Values are mean (SD) unless otherwise indicated.

**b**Assigned to a usual diet.

**c**Assigned to a low-fat, low-sugar, high–complex carbohydrate diet.

**d**Assigned to a usual diet.

**e**P<.05 between intervention group and control group.

**f**Calculated as weight in kilograms divided by height in meters squared.

**g**Measured by a bioelectrical impedance analyzer.

**h**Includes underreporters.

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and insulin analysis was collected in tubes containing iced ethylenediaminetetraacetic acid prepared with sodium fluoride. Serum was separated and aliquots were frozen at −80°C in a deep-freeze system equipped with a central security alarm. Serum glucose, insulin, triglycerides, total cholesterol, and high-density lipoprotein cholesterol levels were analyzed with an automated instrument using standard kits. Low-density lipoprotein cholesterol and insulin resistance index were calculated according to methods by Friedewald et al.34 and Matthews et al.35 respectively. Aliquots were kept at −80°C for further analysis.

Overall physical activity was assessed at baseline and at the end of intervention using previously validated physical activity questionnaires (Modifiable Activity Questionnaire in children36,37 and the Multinational Monitoring of Trends and Determinants in Cardiovascular Disease Optional Study of Physical Activity in parents38). The children’s questionnaire was administered by trained staff, and the parent’s questionnaire was self-administered. In parents only, food-related quality of life was assessed at baseline, at the halfway point of the intervention, and at the end of the intervention using a specific self-administered questionnaire developed and validated for our study. This questionnaire was created from several existing scales39-42 and underwent linguistic and psychometric validation using the Rasch model.43 Socioeconomic indicators were collected at the end of the intervention using a self-administered questionnaire.44

STATISTICAL ANALYSIS

The sample size calculation for this study was based on the previously reported changes in BMI among French children45 and adults.46 We compared each intervention group with the control group to test 2 public health strategies to improve weight control. With a 2-sided .05 significance level (α = .05) and BMI change as the primary outcome measure, studying 236 children (162 adults) in each intervention group and 334 children (229 adults) in the control group makes it possible to detect a significant difference at 80% power. To account for an expected 20% dropout rate, we decided to recruit 295 families (total 1010 families). We intentionally allocated a higher number of families in the control group to maintain the global type 1 error (α) at the .05 level.

Statistical analyses were all conducted using the SAS statistical program, version 8.2 (SAS Institute). All analyses were completed on an intent-to-treat basis, excluding only subjects with no value for BMI neither at baseline nor at the end of intervention (Figure 1). We used adequate procedures for adjustment of a type 1 error, such as the Dunnet method for variance and covariance analyses.47 Missing data for BMI were imputed using the mean value in the whole cohort.

Baseline comparability of intervention and control groups was assessed using analysis of variance with one factor (group) for continuous variables and with χ² or Fisher exact tests for categorical variables. Differences between groups in changes from baseline to end of intervention (final value – initial value) were investigated using analysis of covariance with the baseline value as cofactor (PROC GLM; SAS Institute). When analysis of covariance indicated significant differences between the intervention groups and the control group (P < .05), comparisons were made between each intervention group and the control group. Nonparametric analyses of variance and covariance by ranks were performed when data showed abnormal distribution (Kolmogorov-Smirnov test) and/or nonhomogeneity of variances (Levene test). Baseline characteristics are reported as mean (SD). Changes throughout the study are reported as mean with 95% confidence intervals (CIs).

RESULTS

PARTICIPANT

Participant characteristics at baseline are presented in Table 1. More than 80% of the parents were women. At baseline, there were no significant differences between groups for anthropometric indicators. A difference was found for age in children between group B and controls (respectively, 7.83 [0.64] vs 7.69 [0.64] years, P = .01). The baseline prevalence of overweight (including obesity) was 18% in children and 33% in parents, with no differences between groups. These rates agree with available data from French observational studies.48,49 Of the baseline sample, 84.8% (859 families) completed the study, indicating a dropout rate of 15.2%, with no significant difference in the percentage of dropout between groups (P = .46). The main reason for dropout was lack of time to complete the dietary records and lack of motivation. Most dropouts occurred in the first 4 months of the study. Those who did and did not complete the study did not differ for sex or initial BMI. In parents, dropouts were statistically younger than study completers, but the difference was very limited (mean age, 39.4 vs 40.6 years, P = .02). After imputation, complete data for BMI were available for 949 children and 947 parents.

DIETARY UNDERREPORTING

In parents, a difference was found for percentages of underreporters at the end of intervention between group B and controls (respectively, 41% vs 27%; P < .001). We decided not to exclude underreporters from nutritional analysis because (1) dieticians found that low energy intake reporting was often explained by undereating in the study’s population and (2) the dietary interventions may result in a decrease in energy intake. These 2 reasons would wrongly classify participants as underreporters.

NUTRITIONAL CHANGES

Changes in nutritional intakes from baseline to the end of intervention are presented in Table 2 (children) and Table 3 (parents); changes in nutrition were expressed as crude intake (grams) and percentage of total energy intake. Similar results were obtained in parents when excluding underreporters (Table 4). The nutritional target was achieved for fats in the intervention groups. The intake of sugars decreased only in group B and the intake of complex carbohydrates increased only in group A. The interventions led to total carbohydrate decreases exceeding 50% of total energy intake in children and about 46% in parents. Compared with controls, total energy intake decreased in children (groups A and B) and in parents (group B).

CLINICAL EFFECTS

Changes in anthropometric measures are presented in Table 2 (children) and Table 3 (parents). As expected for children of this age, all anthropometric indicators in-
In parents, BMI and FM increased in the control group ($P = .01; \text{FM}, P = .001$; FM, $P = .04$). Similar results were found for hip circumference (group B vs controls, $P = .04$). Differences between groups were found for hip circumference (group B vs controls, $P = .04$). Similar results were found for hip circumference (group B vs controls, $P = .04$). In parents, food-related quality of life did not change differently between groups throughout the study ($P = .94$), irrespective of the dimension of quality of life (eating pleasure, $P = .65$; social relations, $P = .94$; psychological dimension, $P = .73$; physical capacity, $P = .30$).

**EFFECTS ON PHYSICAL ACTIVITY AND FOOD-RELATED QUALITY OF LIFE**

At baseline, participants reported moderate activities, with no differences between groups. In children, changes in physical activity throughout the study did not differ between groups, either for daily screen viewing (group A vs controls, $P = .47$; group B vs controls, $P = .10$) or for activities in clubs (group A vs controls, $P = .71$; group B vs controls, $P = .85$). Identical results were found in parents (group A vs controls, $P = .19$; group B vs controls, $P = .54$). In parents, food-related quality of life did not change differently between groups throughout the study ($P = .94$), irrespective of the dimension of quality of life (eating pleasure, $P = .65$; social relations, $P = .94$; psychological dimension, $P = .73$; physical capacity, $P = .30$).

**COMMENT**

Our primary aims were to investigate to what extent family dietary coaching would cause nutritional changes and improve weight control in free-living children and parents. To our knowledge, this is the first time that an intervention study based on family dietary coaching and targeting only dietary changes has been carried out on a large cohort of free-living families for one school year. Groups were comparable at baseline on almost all indicators; the difference observed for age in children was too limited to have any effect on the outcome measurements. Our results are therefore probably not because of differences in the groups that were unrelated to the intervention. Moreover, because no difference in the evolution of physical activity levels was found between...
were sustainable in the context of the study (until the end of intervention, suggesting that such changes in other groups.

As a result, the efficacy of family dietary coaching in this population, which is relevant to test family dietary coaching in this population as a whole. Higher percentages of adult underreporters agreed with previous findings in adults. Nutritional targets were achieved for fats and to a smaller extent for sugars. However, advice on sugars was based only on extrinsic sugars, limiting the opportunities to decrease them. Based on studies in normal to moderately overweight men, Drummond and Kirk found that free-living populations may find it hard to maintain concurrent reductions in fats and sugars, mainly for palatability reasons. However, in our study, we obtained concurrent reductions in fats and sugars in group B. A trend toward a decrease in the intake of sugars was even observed in group A (−5 g/d in children, P = .08; −7 g/d in parents, P = .07), though this group received advice only on fats. We also observed that the increase in complex carbohydrates was insufficient to counterbalance the energy deficit due to decrease in fats and sugars, especially in group B. The lower compliance regarding complex carbohydrates in group B compared with groups, a causal inference may be made between nutritional changes and clinical evolution.

The ELPAS adult cohort is a group of educated, mostly female volunteers, and therefore it is not representative of the French population as a whole. Higher social/professional categories accounted for about half of the parents, which is about 5 times greater than in the general French population. As a result, the efficacy of family dietary coaching in this population might not have been observed in less educated participants. However, it is relevant to test family dietary coaching in this population, which is theoretically more compliant to nutrition education, before implementing adapted methods in other groups.

Nutritional changes mainly occurred in the first 3 months of the intervention and were then maintained until the end of intervention, suggesting that such changes were sustainable in the context of the study (Figure 2).

Table 3. Parents’ Changes in Anthropometric, Dietary, and Biologic Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Group A</th>
<th>Group B</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Change (95% Confidence Interval)a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Anthropometric</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight, kg</td>
<td>0.4 (0.0 to 0.8)</td>
<td>0.0 (−0.4 to 0.3)</td>
<td>0.6 (0.3 to 0.9)</td>
</tr>
<tr>
<td>Body mass index</td>
<td>0.13 (−0.01 to 0.27)</td>
<td>−0.02 (−0.14 to 0.11)</td>
<td>0.24 (0.13 to 0.34)</td>
</tr>
<tr>
<td>Fat mass, kg</td>
<td>0.3 (−0.0 to 0.7)</td>
<td>−0.2 (−0.5 to 0.1)</td>
<td>0.4 (0.0 to 0.7)</td>
</tr>
<tr>
<td>Fat-free mass, kg</td>
<td>0.1 (−0.1 to 0.4)</td>
<td>0.0 (−0.1 to 0.3)</td>
<td>0.1 (−0.1 to 0.4)</td>
</tr>
<tr>
<td>Chest circumference, cm</td>
<td>−0.4 (−0.8 to 0.0)</td>
<td>−0.4 (−0.7 to 0.0)</td>
<td>−0.6 (−0.9 to −0.2)</td>
</tr>
<tr>
<td>Waist circumference, cm</td>
<td>0.2 (−1.0 to 0.5)</td>
<td>0.5 (−0.1 to 1.1)</td>
<td>0.7 (0.1 to 1.3)</td>
</tr>
<tr>
<td>Hip circumference, cm</td>
<td>0.0 (−0.5 to 0.6)</td>
<td>0.8 (0.2 to 1.3)</td>
<td>1.2 (0.7 to 1.7)</td>
</tr>
<tr>
<td>Knee circumference, cm</td>
<td>0.0 (−0.3 to 0.2)</td>
<td>0.1 (−0.1 to 0.4)</td>
<td>0.1 (0.0 to 0.2)</td>
</tr>
</tbody>
</table>

**Dietary intake**

- Total energy, kcal/d                     | −107 (−162 to −52) | −153 (−208 to −96) | −62 (−106 to −18) |
- Fats, g/d                                | −12.0 (−15.0 to −8.9) | −11.7 (−14.6 to −8.7) | −3.5 (−5.8 to −1.1) |
- Sugars, g/d                              | −7.3 (−13.0 to −6.2) | 9.6 (−6.2 to 0.6) | −3.4 (−6.2 to 0.6) |
- Complex carbohydrates, g/d              | 9.2 (4.2 to 14.2) | 0.6 (−4.3 to 5.7) | −0.4 (−4.2 to 3.3) |
- Total carbohydrates, g/d                | 1.8 (−4.9 to 8.5) | −8.6 (−15.3 to −2.0) | −4.1 (−9.5 to 1.2) |
- Protein, g/d                             | −0.7 (−3.4 to 1.9) | −1.3 (−4.2 to 1.5) | −2.0 (−4.0 to 0.0) |
- Fats, % of total energy intake           | −4.4 (−5.3 to −3.5) | −3.1 (−4.0 to −2.1) | −0.7 (−1.4 to 0.0) |
- Sugars, % of total energy intake         | −0.7 (−1.4 to 0.0) | −1.1 (−1.9 to −0.3) | 0.0 (−0.6 to 0.5) |
- Complex carbohydrates, % of total energy intake | 4.1 (3.1 to 5.1) | 2.7 (1.7 to 3.7) | 0.7 (0.0 to 1.4) |
- Total carbohydrates, % of total energy intake | 3.4 (2.3 to 4.4) | 1.6 (0.6 to 2.7) | 0.6 (−0.1 to 1.3) |
- Protein, % of total energy intake        | 1.1 (0.6 to 1.5) | 1.5 (0.9 to 2.1) | 0.3 (−0.1 to 0.8) |

**Blood indicators**

- Serum glucose, mg/dL                    | −4.7 (−6.3 to −2.9) | −4.7 (−7.0 to −2.5) | −3.2 (−4.5 to −2.0) |
- Insulin, µU/mL                          | −0.26 (−2.20 to 1.67) | 0.18 (−1.58 to 1.94) | −0.09 (−1.43 to 1.25) |
- Insulin resistance index                | −0.13 (−0.62 to 0.37) | −0.22 (−0.63 to 0.19) | −0.10 (−0.43 to 0.22) |
- Triglycerides, mg/dL                    | −14.2 (−18.6 to −9.7) | −20.4 (−25.7 to −15.0) | −17.7 (−22.12 to −12.4) |
- Low-density lipoprotein cholesterol, mg/dL | −23.9 (−28.2 to −19.7) | −24.7 (−30.5 to −18.9) | −19.3 (−23.2 to −15.4) |
- High-density lipoprotein cholesterol, mg/dL | −10.4 (−12.4 to −8.9) | −9.7 (−11.2 to −8.1) | −9.3 (−10.8 to −7.7) |
- Total cholesterol, mg/dL                | −38.2 (−43.2 to −32.8) | −34.7 (−40.5 to −28.6) | −34.0 (−38.2 to −29.7) |

**Percentages of adult underreporters agreed with previous findings in adults. Nutritional targets were achieved for fats and to a smaller extent for sugars. However, advice on sugars was based only on extrinsic sugars, limiting the opportunities to decrease them. Based on studies in normal to moderately overweight men, Drummond and Kirk found that free-living populations may find it hard to maintain concurrent reductions in fats and sugars, mainly for palatability reasons. However, in our study, we obtained concurrent reductions in fats and sugars in group B. A trend toward a decrease in the intake of sugars was even observed in group A (−5 g/d in children, P = .08; −7 g/d in parents, P = .07), though this group received advice only on fats. We also observed that the increase in complex carbohydrates was insufficient to counterbalance the energy deficit due to decrease in fats and sugars, especially in group B. The lower compliance regarding complex carbohydrates in group B compared with...**
group A may be because of (1) a specific decrease in consumption of food containing sugars and complex carbohydrates in group B, (2) some difficulty in achieving 3 vs 2 nutritional targets, or (3) a more restrictive attitude toward food in group B. In parents, the decrease in energy intake was associated with an increase in body weight in 2 groups (group A and control group), suggesting that final energy intakes were still higher than requirements and/or that underreporting increased throughout the study. Similar observations were made in children in groups A and B. Overall, family dietary coaching leads to an improvement of the macronutrient repartition in the diet, with final values close to current recommendations. Further analysis will be performed to assess the effects of the dietary advice on micronutrient intake and food habits.

In children, the interventions had no effect on the clinical indicators. This result was expected in growing children, as previously studied approaches focusing on diet alone in this population were found ineffective except when they targeted soft drinks. However, we initially hypothesized that a longer intervention based on family dietary coaching would induce clinical benefits, even in free-living, mostly healthy children. Given that effective studies in nonobese children aged 6 to 10 years include a combination of actions toward screen viewing, activity, and diet, our study confirms that primary prevention of childhood obesity should not be limited to dietary intervention, though nutritional education may improve dietary habits in the long run.

In parents, participants in the control group showed an increase in clinical indicators (BMI, FM, and body weight), as expected for this population. These indicators were improved in the intervention groups, especially in group B (decrease in BMI and FM compared with controls), showing that family dietary coaching was effective in improving weight control in this population. The changes in clinical indicators and the decrease in fat intake are positive outcomes of the inter-

Table 4. Parents’ Changes in Dietary Intake, Excluding Underreporters

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Group A</th>
<th>Group B</th>
<th>Control</th>
<th>Group A</th>
<th>Group B</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of acceptable reporters</td>
<td>172</td>
<td>162</td>
<td>256</td>
<td>116</td>
<td>98</td>
<td>186</td>
</tr>
<tr>
<td>Total energy intake, kcal/d</td>
<td>1893 (385)</td>
<td>1903 (389)</td>
<td>1918 (399)</td>
<td>-70.4 (137.7 to -3.2)</td>
<td>-149 (218.2 to -80.7)</td>
<td>-44.5 (94.2 to 51.1)</td>
</tr>
<tr>
<td>Fat intake, g/d</td>
<td>79.5 (22.5)</td>
<td>77.9 (21.9)</td>
<td>80.6 (21.6)</td>
<td>-12.4 (16.5 to -8.0)</td>
<td>-12.2 (16.5 to -8.0)</td>
<td>-2.3 (5.3 to -0.6)</td>
</tr>
<tr>
<td>Sugar intake, g/d</td>
<td>85.8 (29.2)</td>
<td>84.2 (31.0)</td>
<td>86.2 (32.4)</td>
<td>-5.7 (10.4 to -1.0)</td>
<td>-9.5 (15.5 to -3.6)</td>
<td>-1.8 (5.6 to 1.9)</td>
</tr>
<tr>
<td>Complex carbohydrate intake, g/d</td>
<td>113.5 (36.3)</td>
<td>121.4 (37.1)</td>
<td>115.7 (34.6)</td>
<td>14.3 (7.4 to 21.1)</td>
<td>0.5 (6.2 to 7.4)</td>
<td>-1.0 (5.5 to 3.3)</td>
</tr>
<tr>
<td>Total carbohydrate intake, g/d</td>
<td>200.5 (53.3)</td>
<td>206.2 (54.6)</td>
<td>202.7 (54.2)</td>
<td>8.4 (0.5 to 17.4)</td>
<td>-8.7 (17.5 to 0.1)</td>
<td>-3.0 (9.2 to 3.1)</td>
</tr>
<tr>
<td>Protein intake, g/d</td>
<td>80.5 (21.5)</td>
<td>80.4 (23.6)</td>
<td>80.1 (18.7)</td>
<td>0.8 (2.7 to 4.3)</td>
<td>-0.2 (3.9 to 3.5)</td>
<td>-1.9 (4.4 to 0.5)</td>
</tr>
<tr>
<td>Fats, % of total energy intake</td>
<td>37.3 (6.4)</td>
<td>36.3 (6.5)</td>
<td>37.4 (5.9)</td>
<td>-4.5 (5.9 to -3.2)</td>
<td>-2.8 (4.1 to -1.4)</td>
<td>-0.5 (1.3 to 0.3)</td>
</tr>
<tr>
<td>Sugars, % of total energy intake</td>
<td>18.2 (4.9)</td>
<td>18.0 (5.5)</td>
<td>17.9 (5.1)</td>
<td>-0.6 (1.4 to 0.2)</td>
<td>-0.8 (1.8 to 0.1)</td>
<td>0.2 (0.3 to 0.9)</td>
</tr>
<tr>
<td>Complex carbohydrates, % of total energy intake</td>
<td>24.2 (5.9)</td>
<td>25.8 (6.4)</td>
<td>24.3 (5.7)</td>
<td>4.0 (2.8 to 5.3)</td>
<td>2.1 (0.7 to 3.6)</td>
<td>0.4 (0.3 to 1.2)</td>
</tr>
<tr>
<td>Total carbohydrates, % of total energy intake</td>
<td>42.8 (7.1)</td>
<td>43.9 (7.7)</td>
<td>42.5 (6.8)</td>
<td>3.4 (2.0 to 4.8)</td>
<td>1.4 (0.0 to 2.7)</td>
<td>0.7 (-0.1 to 1.6)</td>
</tr>
<tr>
<td>Protein, % of total energy intake</td>
<td>17.2 (3.5)</td>
<td>17.1 (4.2)</td>
<td>17.0 (3.3)</td>
<td>0.8 (0.2 to 1.4)</td>
<td>1.1 (0.5 to 1.8)</td>
<td>0.0 (-0.5 to 0.3)</td>
</tr>
</tbody>
</table>

a For each group, change estimates and 95% confidence intervals are the mean difference from baseline to end of intervention (final value – initial value). Comparisons are made between the intervention group and the control group.

b Assigned to a low-fat, high–complex carbohydrate diet.
c Assigned to a low-fat, low-sugar, high–complex carbohydrate diet.
d Assigned to a usual diet.
e Defined as nonunderreporters. For each group, the number of acceptable reporters is presented at baseline and from baseline to end of intervention (change).
f
\[ P < .01 \]
g
\[ P < .05 \]
vvention with regards to prevention of obesity and cardiovascular diseases. Regarding blood indicators, no differences were found between groups in our study, as expected in subjects with normal values for blood indicators at baseline.

Although the sample size was insufficient to formally test for effects within subgroups, it was desirable to further characterize the effects of the intervention on participants with varying initial BMI with an exploratory analysis (Table 5). Intervention and control groups were compared within strata defined by BMI status (normal weight or overweight). In overweight children, BMI was stabilized throughout the study, irrespective of their group. This finding is interesting, because BMIs of 27 overweight children not participating in the study but attending the same schools increased during the school year (+0.36, 95% CI, 0.08-0.65, P = .004). This result might indicate that participating in an educational program may improve BMI in overweight children, whatever the intensity of dietary coaching (general information in the control group vs family dietary coaching in the intervention groups). Previous studies suggested that interventions may be effective in overweight children but not in children with a healthy BMI. In parents, we found that nonoverweight participants in group B had the smallest mean increase in BMI, while overweight participants in both intervention groups showed a mean decrease in BMI throughout the study, as already reported by Astrup et al. From a public health perspective, general messages seem to have little efficacy in inducing nutritional changes in the general population. In our study, we used family dietary coaching to modulate nutritional intakes toward recommendations, with beneficial effects on weight control in parents. This approach makes it possible to account for individual characteristics that influence food habits, such as socioeconomic status and education. Family dietary coaching has an individual cost of around 1 €/d/person (US $1.42/d/person), which should be compared with the cost implications of obesity for health care and society. In our study, we found that compliance with advice on complex carbohydrates was lower than compliance with advice on fats and sugars, suggesting that current recommendations on complex carbohydrates are hard to achieve in the general population. No differences were found between groups for food-related quality of life, showing that interventions were well accepted.

Further studies should be conducted to better assess the sustainability of the dietary changes. The few available long-term studies found a decreasing efficacy of nutritional interventions over time, especially when several dietary goals are defined, such as a reduction in both fats and sugars. Two studies in children showed maintenance of the favorable changes observed 1 to 4 years after the intervention had ended.

Overall, family dietary coaching may be a promising approach to induce sustainable nutritional changes in a free-living population. Further studies with more socio-demographically diverse samples are needed to evaluate the generalizability of these findings.

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