Mother–adult offspring resemblance in dietary intake: a community-based cohort study in Australia[1–3]

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ABSTRACT

Background: It has been widely recognized that parental dietary intake is an important and consistent factor influencing children's food intake. However, there are conflicting results with regard to the strength of the parental-child resemblance in dietary intake. Moreover, this association has rarely been investigated in young adult offspring.

Objectives: The aims of this study were to describe the dietary intake and food consumption of middle-aged women and their female and male adult offspring (aged 18–23 y) and to examine the association in dietary intake between sex-specific mother-child dyads.

Design: We used cross-sectional dietary data for 2017 mother-child pairs from the 21-y follow-up of the Mater-University of Queensland Study of Pregnancy, a birth cohort study. Dietary information was obtained with the use of a 74-item food-frequency questionnaire. We assessed multivariate-adjusted mother-offspring correlations in selected nutrients and food groups and performed correlational analysis while stratifying by living arrangements.

Results: Both sons and daughters had a significantly lower percentage of energy from protein than did their mothers. Sons had a significantly higher percentage of energy from fat and a lower percentage of energy from carbohydrates than did their mothers, whereas there was no difference between daughters and mothers. The mother-offspring correlations were weak (r = 0.12–0.29) for most dietary factors and tended to be slightly higher in mother-daughter dyads than in mother-son dyads. Overall, correlations appeared to be stronger in offspring still living with their parents than with their counterparts not living at home, specifically the correlations for consumption of vegetables and rice.

Conclusions: Mother–adult offspring dietary resemblance in this Australian cohort was only weak and varied by nutrients, food groups, and the offspring's sex and living arrangements. Factors other than parental dietary habits and home environment seem to have a stronger influence on the diets of young adults. *Am J Clin Nutr* 2017;105:185–93.

Keywords: diet, food intake, nutrients, food group, mother, child, family resemblance, birth cohort

INTRODUCTION

Parents or caregivers are believed to strongly influence the health behavior of their children (1). They are gatekeepers and function as important role models for the development of food preference in their children (2–4). It is a common perception that parent-child food intake is highly correlated and that dietary behaviors that are developed in adolescence tend to be maintained into adulthood (5–7). However, studies that have quantified the relation between parent and child food intake and behaviors have found conflicting results. Some reported no association (8, 9), whereas others found a weak-to-moderate positive association (2, 10–17). It is also perceived that the parent-child association for food intake is becoming weaker in modern societies.

Two previous systematic reviews and meta-analyses indicated that the association between parent and child food intake or food preferences is weak and varies considerably across studies with regard to nutrients, foods, parent-child pairs, dietary assessment, and countries (1, 18). In 15 studies that included parent-child pairs, correlations ranged between 0.20 and 0.33 for key dietary measures (1). Most relevant studies included children and adolescents <18 y. We identified only 2 studies from Netherlands that investigated similarities in dietary intake between parents and young adult offspring (19, 20). One study examined the associations in intake of energy, fat, fatty acids, and cholesterol in offspring aged 1–30 y (19), showing that correlations for these dietary factors between mothers and children ranged from 0.09 to 0.55 when examining absolute and relative intake. The other Dutch study investigated family resemblance in energy, fat, and cholesterol intake in 3 generations of women with mean ages of 25, 49, and 76 y for the younger, middle, and older generations, respectively (20). Findings indicated weak correlations (0.19–0.26) between energy and fat intake of the younger and middle generations.

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[3] Supplemental Table 1 and Supplemental Figure 1 are available from the "Online Supporting Material" link in the online posting of the article and from the same link in the online table of contents at http://ajcn.nutrition.org.

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Most previous studies on the resemblance of parent-child food intake were based on small sample sizes, predominantly conducted in the United States, and primarily focused on offspring <18 y of age. It is likely that the parental or family influence on the dietary intake of young adults weakens when children leave their parental home and live by themselves. To our knowledge, the resemblance in dietary intake in mother–young adult offspring pairs by living arrangements (living compared with not living at the parental home) has not been studied.

The aims of this study were *1*) to describe the dietary intake and food consumption of middle-aged women and their female and male adult offspring, and *2*) to examine the association in dietary intake between mother-child dyads in a large community-based study in Australia. Furthermore, we investigated whether resemblance in child and maternal dietary intake differed by the offspring's living arrangements.

METHODS

Study design and participants

Participants were from the Mater-University of Queensland Study of Pregnancy (MUSP), an Australian prebirth cohort study of women and their children (21–23). Between 1981 and 1983, all women who presented for their first antenatal visit at the Mater Misericordiae Hospital in Brisbane were asked to participate in the study; 98% were enrolled. The women were followed up at the birth of their child and again when the child was aged 6 mo and 5, 14 and 21 y of age. At the 14- and 21-y follow-ups, the offspring completed health, social, and lifestyle questionnaires. Women were, on average, at 18 wk of gestation when recruited at their first antenatal visit, and their ages ranged between 14 and 46 y. Data were collected on 7223 pregnant woman–child pairs (22). Full details of the study participants and measurements have been previously reported (21, 23).

Written informed consent from the mothers was obtained during all data collection phases of the study, and, at 21 y, informed consent was obtained from the offspring. Ethics committees at the Mater Hospital and the University of Queensland approved each phase of the study. This study focused on the 21-y follow-up (2001–2003) of both mothers and offspring. A total of 3692 (51%) mothers and 3775 (52%) offspring were surveyed at 21 y with the use of self-administered questionnaires (**Supplemental Figure 1**).

Dietary assessment

Dietary information was obtained with the use of the Cancer Council of Victoria's self-administered food-frequency questionnaire (FFQ), full details of which have been published previously (24, 25). Relative validity of nutrient intake for this 74-item FFQ has been documented, and the FFQ was found to be useful in the assessment of habitual intake in the Australian population (24). Correlation coefficients for energy-adjusted nutrient intake between 7-d weighed food records and the FFQ ranged from 0.28 (vitamin A) to 0.78 (carbohydrate). Study participants were asked to report on how often they usually consumed a specified food item (on a 10-point scale from "never" to "3 or more times per day") over the previous 12 mo, including 6 items on consumption of alcoholic beverages. These were converted to daily equivalents for statistical analysis. The FFQ also included 10 short questions on the consumption of fruit, vegetables, sugar, eggs, and the quantity and type of milk, cheese, bread, and fat spreads. Photographs of different portion sizes of selected food items and dishes were included in the FFQ to assist in the calculation of daily energy and nutrient intake. These were estimated with the use of software developed by the Cancer Council of Victoria on the basis of Australian food composition tables as contained in the Nutrient Data Table for Use in Australia (NUTTAB95) (26), the national government food composition database of Australian foods. The 74 foods listed on the FFQ were grouped into 25 food groups on the basis of the similarity of food type and nutrient composition. Some foods, such as milk and sugar, were kept as single items within the groups.

At the 21-y follow-up, 3564 mothers and 3654 offspring returned their main questionnaire and FFQ (Supplemental Figure 1). We excluded 183 mothers and 116 offspring with incomplete FFQ information, such as a missing or blank FFQ page or whole section, or a lack of information on alcohol consumption. Another 109 mothers and 313 children were excluded because of implausible energy intake reports, defined as <500 or >3500 kcal/d for female participants, and <800 or >4000 kcal/d for male participants (27). We only included participants with <40% missing FFQ items (blanks), leaving an analytic cohort of 3022 mothers and 2760 children with 2017 matched mother-offspring dyads (Supplemental Figure 1).

Other variables

The following maternal sociodemographic and lifestyle factors were assessed at the 21-y follow-up (2001–2003): age (years), family income (no weekly income, AU$1–39/wk, AU$40–79/wk, AU$80–119/wk, AU$120–159/wk, AU$160–199/wk, AU$200–299/wk, AU$300–399/wk, AU$400–499/wk, AU$500–599/wk, AU$600–699/wk, AU$700–799/wk, AU$800–999/wk, AU$1000–1499/wk, or ≥AU$1500/wk), marital status (currently married; living together; single; or separated, divorced, or widowed), smoking status (none, 1–19 cigarettes/d, or ≥20 cigarettes/d), alcohol consumption (abstainer or light, moderate, heavy, or very heavy drinker), BMI [in kg/m^2; normal weight (<25), overweight (25–30), or obese (>30)] (28), and recreational (vigorous) physical activity (never or ≥1 time in the previous week). Mothers provided information on ethnicity (Caucasian, Asian, or Aboriginal or Torres Strait Islander), parity (1, 2, or ≥3 children), and education (did not complete secondary school, completed secondary school, or completed postsecondary school) at the first antenatal visit (1981–1983). We obtained the same information for offspring at the 21-y follow-up. The variable income was regrouped into 2 categories, low income (<AU$300/wk for mothers and <AU$159/wk for offspring) and middle income (≥AU$300/wk for mothers and ≥AU$159/wk for offspring), based on the 20th percentile of the income distribution of mothers and offspring.

Statistical analyses

Descriptive statistics (proportions and means ± SDs) were obtained. Sociodemographic and lifestyle factors of mothers, young adult offspring, and mother-child dyads were compared

between those who were excluded and those who provided usable dietary data at the 21-y follow-up. Statistically significant differences were tested with the use of *F* tests for continuous variables and chi-square tests for categorical variables.

Estimates of nutrient intake were adjusted for total energy intake with the use of the nutrient residual method described by Willett et al. (29). All dietary variables were log-transformed before calculation of residuals for each individual in the pooled sample. Results are presented as means ± SDs, and are shown separately for mothers and female and male offspring. To test for statistically significant differences, we used the paired *t* test for mother-child dyads and the unpaired *t* test for daughter-son comparisons.

We used pairwise partial correlations to estimate the correlation between mother-offspring dyad for intake of selected nutrients and food groups. Correlations were adjusted for maternal and offspring age, education, vigorous physical activity, and energy intake (food groups). Complete case analysis was used for multivariate analysis, which was adjusted for multiple comparisons with the use of the Šidák test (30) to control the familywise error rate to be 0.05, based on 18–25 tests, depending on the number of nutrients and food groups included in the analyses. Thus, individual *P* values <0.002 (24 or 25 tests) or 0.003 (18 tests) were considered to be statistically significant.

We repeated the dyad analyses stratified by offspring living arrangements at age 21 y. Children were asked "Do you: Live at

TABLE 1
Background characteristics of mothers and offspring[1]

Characteristics	Mothers (*n* = 2017)	Offspring (*n* = 2017)	Daughters (*n* = 1122)	Sons (*n* = 895)
Age,[2] y	46.7 ± 5.0	20.6 ± 0.8	20.6 ± 0.7	20.6 ± 0.8
BMI,[2] kg/m^2	27.9 ± 6.0	24.1 ± 4.8	24.0 ± 5.0	24.3 ± 4.5
Education[3]				
Incomplete secondary school	13.3	16.7	14.3	19.7
Secondary school	64.4	54.6	53.1	56.4
Postsecondary school	22.3	28.8	32.7	23.9
Income[2]				
Middle income	83.2	79.7	78.6	81.2
Low income	16.8	20.3	21.4	18.8
Marital status[2]				
Married	71.0	3.7	5.7	1.2
Living together	7.1	16.8	21.5	10.9
Single	2.1	79.0	72.3	87.4
Separated, divorced, or widowed	19.8	0.6	0.6	0.5
Smoking status[2]				
None	74.5	67.0	70.2	62.8
1–9 cigarette/d	15.0	28.3	27.0	29.9
≥20 cigarettes/d	10.5	4.8	2.8	7.2
Alcohol consumption[2]				
Abstainer	11.9	5.3	5.8	4.5
Light drinker	58.9	39.8	50.5	26.4
Moderate drinker	15.8	18.7	18.7	18.7
Heavy drinker	13.5	26.6	20.7	33.9
Very heavy drinker	—	9.7	4.3	16.5
Categorical BMI,[2] kg/m^2				
Normal weight (<25.0)	40.7	66.9	68.1	65.6
Overweight (25.0–29.9)	31.0	21.1	20.5	21.8
Obese (≥30.0)	28.3	11.9	11.4	12.6
Vigorous physical activity in past week[2]				
Never	56.6	30.8	34.8	25.7
≥1 time	43.4	69.2	65.2	74.3
Maternal ethnicity[4]				
Caucasian	93.7	—	—	—
Asian	3.4	—	—	—
Indigenous	3.0	—	—	—
Maternal parity[4]			—	—
1 child	44.0	—	—	—
2 children	29.9	—	—	—
≥3 children	26.1	—	—	—
Offspring living arrangements[2]				
Living with parents	—	61.4	54.8	69.8
Not living with parents	—	38.6	45.2	30.2

[1] Values are means ± SDs or percentages.
[2] Assessment at 21-y follow-up.
[3] Assessment at 21-y follow-up (offspring), and at first antenatal visit (mothers).
[4] Assessment at first antenatal visit (mothers).

home with parents (1), Own your accommodation outright (2), Live in own accommodation with loan or mortgage (3), Rent your own accommodation (4), or Other (5)." We combined categories as follows: *1*) lived with parents if they reported living at home with parents, and *2*) did not live with parents if they reported otherwise. We used a *Z* test to identify statistically significant differences between the correlations within the 2 groups.

Statistical tests were 2-sided, and *P* values <0.05 were considered to be significant. All analyses were undertaken with the use of Stata version 13.0.

RESULTS

Mothers with usable dietary data (**Supplemental Table 1**) were more likely to have higher education and middle income and to be married, overweight, nonsmokers, and light or moderate alcohol consumers ($P < 0.05$ for all) than were excluded women. Similarly, included offspring tended to have higher education and to be nonsmokers and light-to-moderate alcohol consumers than did their excluded counterparts.

Background characteristics of mother-child dyads are shown in **Table 1**. The mean ages of mothers and offspring were 47 y (range 36–67 y) and 21 y (range 18–23 y), respectively. About two-thirds of children were still living with their mother or parents. The majority of mothers and offspring had completed secondary education, had a middle income, and were nonsmokers and light alcohol drinkers. Although there were no self-reports of very heavy drinking among mothers, ~10% of offspring indicated that they were very heavy drinkers (17% of sons and 4% of daughters). Mothers were more likely to be overweight and obese than were their offspring (59% compared with 33%), and they were less likely to engage in vigorous physical activity.

Dietary intake and food groups of mother-child dyads

Mean ± SD energy intake was between 1706 ± 528 kcal/d and 1727 ± 574 kcal/d for mothers, 1761 ± 582 kcal/d for daughters, and 2631 ± 791 kcal/d for sons (**Table 2**). For both mothers and offspring, 39–41% of daily energy intake was derived from carbohydrate, 36–38% from fat, and 19–20% from protein. Sons had a significantly higher percentage of energy intake from fat and lower percentage of energy intake from carbohydrates than did mothers, whereas there was no difference between daughters and mothers. Both sons and daughters had a significantly lower percentage of energy intake from protein, but a higher percentage of energy intake from alcohol than their mother. Most absolute daily intake values of nutrients differed significantly between mothers and offspring. Both daughters and sons had a higher intake of saturated fat, but a lower intake of cholesterol than mothers. Consumption of sugar was highest in mothers.

The mean intake (grams per day) of food groups for mothers and offspring by sex is presented in **Table 3**.

TABLE 2
Daily energy and energy-adjusted intake of nutrients of mother-adult offspring dyads by sex[1]

	Mother-daughter dyads			Mother-son dyads			
Total energy and nutrients	Mothers (n = 1122)	Daughters (n = 1122)	P for mothers vs. daughters	Mothers (n = 895)	Sons (n = 895)	P for mothers vs. sons	P for daughters vs. sons
Energy, kcal	1706 ± 528	1761 ± 582	0.0114	1727 ± 574	2631 ± 791	<0.0001	<0.0001
Fat, E%	35.8 ± 5.6	36.0 ± 5.9	0.3298	35.9 ± 5.6	37.7 ± 5	<0.0001	<0.0001
Carbohydrate, E%	41.1 ± 6.4	41.4 ± 6.3	0.1563	41.1 ± 6.4	39.0 ± 5.7	<0.0001	<0.0001
Protein, E%	20.0 ± 3.2	19.0 ± 2.9	<0.0001	20.1 ± 3.2	18.9 ± 2.9	<0.0001	0.4569
Alcohol, E%	3.5 ± 5.4	4.0 ± 5.2	0.0103	3.3 ± 4.8	4.9 ± 4.7	<0.0001	<0.0001
Protein, g	89.8 ± 14.3	85.2 ± 13.2	<0.0001	90.3 ± 14.3	86.1 ± 13.4	<0.0001	0.1240
Carbohydrate, g	183.9 ± 28.6	185.6 ± 27.3	0.0962	184 ± 28.4	180.5 ± 25.8	<0.0001	<0.0001
Fat, g	72.6 ± 11.3	72.8 ± 11.7	0.6636	72.7 ± 11.2	72.8 ± 9.7	0.8320	0.9344
Saturated fat, g	29.9 ± 6.8	31.0 ± 6.8	<0.0001	29.9 ± 6.8	30.8 ± 5.7	0.0011	0.3967
Monounsaturated fat, g	25.9 ± 4.4	25.7 ± 4.4	0.1896	26.0 ± 4.3	25.7 ± 3.7	0.0572	0.8575
Polyunsaturated fat, g	10.4 ± 3.5	9.8 ± 3.3	<0.0001	10.4 ± 3.7	9.8 ± 3.0	0.0001	0.7560
Cholesterol, g	291.2 ± 78.5	269.6 ± 73.1	<0.0001	293.5 ± 83.4	276.5 ± 63.9	<0.0001	0.0267
Fiber, g	19.5 ± 5.5	17.6 ± 4.9	<0.0001	19.5 ± 5.5	17.3 ± 4.4	<0.0001	0.1385
Sugar, g	80.3 ± 22.8	78.9 ± 22.4	0.0908	81.1 ± 23.2	72.7 ± 21.2	<0.0001	<0.0001
Alcohol, g	10.0 ± 15.9	11.3 ± 14.7	0.0376	9.5 ± 14.6	10.2 ± 10.4	0.2173	0.0741
Folate, μg	256.6 ± 64.3	248.4 ± 65.9	0.0010	254.3 ± 62.5	240.7 ± 55.2	<0.0001	0.0051
Vitamin C, mg	120.2 ± 58	126.5 ± 63.5	0.0066	116.7 ± 55	112.5 ± 56.9	0.0808	<0.0001
β-Carotene, μg	3857.1 ± 1986.7	3139.8 ± 1700.5	<0.0001	3763 ± 1874.2	2910.1 ± 1490.1	<0.0001	0.0015
Vitamin E, mg	5.7 ± 1.3	5.3 ± 1.2	<0.0001	5.7 ± 1.5	5.3 ± 1.1	<0.0001	0.3303
Retinol, mg	778.0 ± 211.6	718.4 ± 201.2	<0.0001	770.3 ± 209.5	716.4 ± 175.4	<0.0001	0.8203
Calcium, mg	888.5 ± 242	851.8 ± 245.4	0.0001	891 ± 247.1	830.1 ± 225.1	<0.0001	0.0410
Iron, mg	12.2 ± 2.7	11.5 ± 2.5	<0.0001	12.3 ± 2.8	11.3 ± 2.2	<0.0001	0.0355
Magnesium, mg	274.9 ± 50	254.1 ± 45.6	<0.0001	272.7 ± 50.4	250.0 ± 38.0	<0.0001	0.0303
Sodium, mg	2456.8 ± 354.1	2497.4 ± 334.2	0.0021	2481.8 ± 340.8	2513.1 ± 287.6	0.0228	0.2663
Zinc, mg	11.6 ± 2.1	10.9 ± 2	<0.0001	11.7 ± 2.1	11 ± 2.1	<0.0001	0.2149

[1] The *P* value is the statistical difference of the mean between the 2 groups. A paired *t* test was used for the dyad comparisons and an unpaired *t* test was used for the comparisons between daughters and sons. Adjustment for multiple comparisons was made with the use of the Šidák test (30); $P < 0.002$ is considered to be significant based on 25 tests. E%, percentage of energy.

TABLE 3
Food group consumption of mother-adult offspring dyads by sex[1]

	Mother-daughter dyads			Mother-son dyads			
Food groups	Mothers (n = 1122)	Daughters (n = 1122)	P for mothers vs. daughters	Mothers (n = 895)	Sons (n = 895)	P for mothers vs. sons	P for daughters vs. sons
Vegetables[2]	123 ± 17.4	82.3 ± 12.4	<0.0001	122.3 ± 17.7	93.1 ± 12.8	<0.0001	<0.0001
Legumes	2.6 ± 0.5	2.7 ± 0.2	<0.0001	2.2 ± 0.3	2.6 ± 0.6	<0.0001	0.7538
Potato	36.2 ± 8.7	29.2 ± 5.4	<0.0001	34.6 ± 8.7	32.8 ± 4.2	<0.0001	<0.0001
Fruit[3]	187.3 ± 28.3	145.3 ± 16.2	<0.0001	189.2 ± 32	167.6 ± 24.2	<0.0001	<0.0001
Fruit juice	68.9 ± 30.5	110.7 ± 43.4	<0.0001	66.7 ± 30	130.1 ± 40.7	<0.0001	<0.0001
Dairy products	13.8 ± 3.6	12.5 ± 3.5	<0.0001	14.0 ± 4.0	12.7 ± 2.8	<0.0001	0.0674
Milk	300.4 ± 39.9	255.2 ± 44.5	<0.0001	303.4 ± 43.1	351.7 ± 59.7	<0.0001	<0.0001
Eggs	16.0 ± 2.5	13.4 ± 2.7	<0.0001	16.0 ± 1.9	17.6 ± 3.7	<0.0001	<0.0001
Poultry	31.4 ± 8.9	32.1 ± 9.8	<0.0771	32.8 ± 12.1	43.0 ± 13.4	<0.0001	<0.0001
Red meat	74.0 ± 27.9	67.2 ± 29.2	<0.0001	77.3 ± 33.4	119.6 ± 45.2	<0.0001	<0.0001
Processed meat	15.1 ± 5.2	14.9 ± 5.9	0.2971	16.2 ± 5.9	23.6 ± 8	<0.0001	<0.0001
Meat pies and savory pastries	36.3 ± 14.5	60.8 ± 23.8	<0.0001	38.1 ± 17.7	113.3 ± 39.2	<0.0001	<0.0001
Fish	35.5 ± 11.2	28.1 ± 11.4	<0.0001	35.3 ± 12.8	41.8 ± 17.3	<0.0001	<0.0001
Breakfast cereals	54.5 ± 21.9	35.1 ± 13.8	<0.0001	50.3 ± 20.1	42.2 ± 13.8	<0.0001	<0.0001
Cereal products	8.2 ± 3.6	6.3 ± 3.1	<0.0001	7.9 ± 3.7	6.7 ± 2.9	<0.0001	0.0047
Rice	35.8 ± 12.2	36.7 ± 13	<0.0001	37.1 ± 15.9	47.5 ± 14.6	<0.0001	<0.0001
Pasta or noodles	43.4 ± 16.6	57.9 ± 22.8	<0.0001	43 ± 17.9	75.3 ± 26.7	<0.0001	<0.0001
Bread	70.8 ± 15.6	69.4 ± 13.6	0.0141	70.1 ± 12	107.8 ± 17.8	<0.0001	<0.0001
Spreads containing fat	13 ± 3.7	12.2 ± 3.5	<0.0001	13 ± 3.4	20.0 ± 5.5	<0.0001	<0.0001
Nonfat spreads	1.6 ± 0.6	1.8 ± 0.7	<0.0001	1.5 ± 0.6	2.0 ± 0.7	<0.0001	<0.0001
Nuts	3.1 ± 1.3	1.5 ± 0.5	<0.0001	3.0 ± 1.2	2.3 ± 0.8	<0.0001	<0.0001
Snacks	3.9 ± 1.8	6.4 ± 3.7	<0.0001	4.5 ± 2.8	11.3 ± 5.1	<0.0001	<0.0001
Cakes and pastries	20.8 ± 12.4	19.9 ± 11.4	0.0490	21.3 ± 11.2	29.3 ± 12.9	<0.0001	<0.0001
Chocolate and sweets	9.3 ± 4.2	13.1 ± 6.3	<0.0001	10.4 ± 6.2	12.6 ± 5	<0.0001	0.0992

[1] Food groups (grams per day) were adjusted for total energy intake (kilocalories per day). The P value indicates the statistical difference of the mean between the 2 groups. A paired t test was used for dyad comparison and an unpaired t test was used for the comparisons between daughters and sons. Adjustment for multiple comparisons was made with the use of the Šidák test (30); $P < 0.002$ is considered to be significant based on 24 tests.

[2] Leafy green vegetables, red and yellow vegetables, cruciferous vegetables, and other (fresh, frozen, or canned).

[3] Including citrus fruit.

For most food groups, there were significant differences between mother-daughter and mother-son dyads. The mean intake of vegetables and fruit was significantly higher in mothers than in children, whereas consumption of fruit juice was greater in children than in mothers. Sons had a significantly higher intake of red meat and processed meat than their mothers, whereas daughters had a lower intake of red meat and did not differ from their mothers with regard to consumption of processed meat. Aside from meat intake, sons had the highest intake of meat pies and savory pastries, pasta and noodles, cakes and pastries, and snacks. Sex differences between daughters and sons were significant for all food groups except for legumes, dairy products, and chocolate and sweets.

Correlations of dietary intake and food-groups: mother-child dyads

Mother-offspring adjusted dietary correlations are presented in **Table 4**. Most correlations were weak (r = 0.12–0.29) and tended to be slightly stronger for nutrients than for food groups. Mother-daughter dyads had relatively stronger correlations than mother-son dyads. The correlation for energy intake was $r = 0.15$ in mother-daughter dyads and not significant ($r = 0.01$) in mother-son dyads. The strongest correlations in mother-daughter pairs were observed for cholesterol intake ($r = 0.25$) and consumption of rice ($r = 0.28$) and vegetables ($r = 0.26$), and in mother-son pairs for fiber intake ($r = 0.29$) and, consumption of rice ($r = 0.37$) and vegetables ($r = 0.28$). Overall, multivariate adjustments did not markedly change the associations from the crude estimates (data not shown). In the sensitivity analysis, in addition, we included income in the multivariate model. The correlation coefficients and significance levels were not materially changed; therefore, we retained our initial model.

In additional analysis, we repeated the correlation analysis while stratifying by offspring living arrangements (**Table 5**). Overall, correlation coefficients appeared to be stronger in female and male offspring still living with their parents than with their counterparts not living at home. However, only a few correlations were significantly different for sons and daughters. The correlation for consumption of rice differed significantly by living arrangements in both mother-son dyads (r = 0.45 compared with r = 0.22) and mother-daughter dyads (r = 0.44 compared with r = 0.10). Other dietary correlations that differed significantly by living arrangements were vitamin E intake and consumption of meat pies in sons, and vegetable consumption in daughters.

DISCUSSION

To our knowledge, this is the first study to examine the resemblance of mothers and adult offspring in dietary intake and food group consumption with the use of data from a 21-y

TABLE 4
Partial correlation coefficients of total energy and energy-adjusted intake of nutrients and food groups in mother-offspring dyads[1]

	Mother-daughter dyads (n = 1122)		Mother-son dyads (n = 895)	
	r	P	r	P
Total energy and nutrients				
Energy, kcal	0.15	<0.0001	0.01	0.9828
Protein, g	0.19	<0.0001	0.17	<0.0001
Carbohydrate, g	0.21	<0.0001	0.21	<0.0001
Fat, g	0.24	<0.0001	0.15	<0.0001
Cholesterol, g	0.25	<0.0001	0.20	<0.0001
Fiber, g	0.17	<0.0001	0.29	<0.0001
Sugar, g	0.16	<0.0001	0.14	<0.0001
Alcohol, g	0.14	<0.0001	0.14	<0.0001
Folate, μg	0.18	<0.0001	0.16	<0.0001
Vitamin C, mg	0.18	<0.0001	0.14	<0.0001
β-Carotene, μg	0.21	<0.0001	0.24	<0.0001
Vitamin E, mg	0.16	<0.0001	0.14	<0.0001
Retinol, mg	0.21	<0.0001	0.20	<0.0001
Calcium, mg	0.18	<0.0001	0.10	0.0025
Iron, mg	0.11	0.0003	0.17	<0.0001
Magnesium, mg	0.21	<0.0001	0.22	<0.0001
Sodium, mg	0.18	<0.0001	0.15	<0.0001
Zinc, mg	0.17	<0.0001	0.19	<0.0001
Food groups,[2] g				
Vegetables[3]	0.26	<0.0001	0.28	<0.0001
Legumes	0.15	<0.0001	0.19	<0.0001
Potato	0.17	<0.0001	0.13	<0.0001
Fruit[4]	0.16	<0.0001	0.17	<0.0001
Fruit juice	0.18	<0.0001	0.06	0.0708
Dairy products	0.12	0.0001	0.04	0.2070
Milk	0.13	<0.0001	0.08	0.0167
Eggs	0.21	<0.0001	0.08	0.0213
Poultry	0.15	<0.0001	0.05	0.1653
Red meat	0.14	<0.0001	0.19	<0.0001
Processed meat	0.11	0.0008	0.14	<0.0001
Meat pies and savory pastries	0.14	<0.0001	0.08	0.0213
Fish	0.17	<0.0001	0.12	<0.0001
Breakfast cereals	0.11	0.0002	0.07	0.0327
Cereal products	0.07	0.0321	0.10	0.0022
Rice	0.28	<0.0001	0.37	<0.0001
Pasta or noodles	0.13	<0.0001	0.13	0.0002
Bread	0.17	<0.0001	0.13	0.0001
Spreads containing fat	0.17	<0.0001	0.11	0.009
Nonfat spreads	0.11	0.0004	0.12	0.0004
Nuts	0.21	<0.0001	0.10	0.0022
Snacks	0.16	<0.0001	0.09	0.0043
Cakes and pastries	0.07	0.0176	0.09	0.0104
Chocolate and sweets	0.10	0.0007	0.14	<0.0001

[1] For P values, adjustment for multiple comparisons was made with the use of the Šidák test (30); $P < 0.003$ is considered to be significant based on 18 tests (nutrients), and $P < 0.002$ is considered to be significant based on 24 tests (food groups). The Spearman correlation coefficient (r) was adjusted for age, education, and vigorous physical activity of mother and offspring.

[2] Food groups (grams per day) were adjusted in addition for total energy intake (kilocalories per day).

[3] Leafy green vegetables, red and yellow vegetables, cruciferous vegetables, and other (fresh, frozen, or canned).

[4] Including citrus fruit.

follow-up of a large community-based cohort. This report extends findings from previous studies comparing pairs of parents and offspring <18 y of age (2, 10–12, 14–17). Associations between intake of nutrients and food groups for mothers (36–67 y of age) and their offspring (18–23 y of age) were weak. Correlations were slightly stronger for nutrients than for energy intake or food groups, and mother-daughter dyads had relatively higher correlations than did mother-son dyads. Furthermore, resemblance in diet tended to be stronger in mother-child dyads in which the offspring still lived with the parents than in their counterparts not living at their parental home.

In the present study, we observed weak dietary correlations (r = 0.12–0.29) that were similar to previous studies on family resemblance of diet, as summarized in one meta-analysis (1) and shown by others (14, 31). This may suggest that the diet of young adults is not influenced by parental or family factors alone, but more so by other socioeconomic and environmental factors (1, 10). The change from childhood to adolescence signifies a degree of autonomy over food choices (10, 32), and this is likely to increase into young adulthood, when young people separate from their family home and become financially more independent. This will lead, for example, to increasing frequency of eating out and eating food prepared away from the parental home.

The majority of previous studies were conducted in young children and adolescents aged 3–18 y. It has been suggested that parental influence may diminish over time and dietary correlations become rather weak between parents and their children as they grow older (10). However, the evidence is unclear. A large representative US study indicated that older children (>10 y of age) had a stronger association in dietary intake with their parents than did younger children (<10 y of age), and this was specifically apparent for total and saturated fat intake (10). In contrast, findings from a study in Netherlands that used a representative sample of families indicated that the associations between parents and children in fat and fatty acid intake were very similar for children 1–3 y of age up to adult children 21–30 y of age (19), although correlation coefficients were not presented for different age groups.

In our study of young adults, correlations in parent-child dyads for total fat intake (r = 0.23 and 0.15 for daughters and sons, respectively) were stronger than for energy intake (r = 0.15 and 0.01 for daughters and sons, respectively), with a nonsignificant correlation for energy intake in mother-son pairs in contrast with mother-daughter pairs. This is in line with summary results from the meta-analysis by Wang et al. (1) and the study by Feunekes et al. (19), in which a relatively small number of adult children aged 19–30 y were included. In the latter study, correlations for absolute or relative fat intake were higher overall, specifically for mother-daughter pairs, compared with our data. However, correlations were based on the total cohort of sons or daughters aged 1–30 y. We could only identify 1 other small study conducted in 3 generations of women in Netherlands that included adult offspring (20–30 y of age) (20). The correlations for energy intake (r = 0.22), intake of total fat (r = 0.19), and cholesterol (r = 0.21) in 97 mother-daughter pairs were very similar to the ones we observed in our study.

Many of the correlations for nutrient intake variables were higher to some extent than for energy intake. This may indicate a greater similarity in dietary composition and that mothers from a Western society, as in our study, may want to control their food intake because of concerns about body weight, as postulated previously (1).

TABLE 5
Partial correlation coefficients of total energy and energy-adjusted intake of nutrients and food groups in mother-offspring dyads by offspring's living arrangements[1]

	Mother-daughter dyads			Mother-son dyads		
	Living with parents, r (n = 610)	Not living with parents, r (n = 503)	P	Living with parents, r (n = 617)	Not living with parents, r (n = 267)	P
Total energy and nutrients						
Energy, kcal	0.16	0.14	0.7339	0.03	−0.06	0.2225
Protein, g	0.24	0.14	0.0854	0.21	0.10	0.1260
Carbohydrate, g	0.24	0.19	0.3843	0.25	0.14	0.1188
Fat, g	0.30	0.16	0.0143	0.18	0.04	0.0536
Cholesterol, g	0.26	0.23	0.5961	0.20	0.20	1.0000
Fiber, g	0.20	0.15	0.3953	0.33	0.17	0.0198
Sugar, g	0.23	0.09	0.0173	0.17	0.10	0.3320
Alcohol, g	0.17	0.14	0.6101	0.12	0.19	0.3320
Folate, μg	0.24	0.10	0.0168	0.19	0.09	0.1645
Vitamin C, mg	0.21	0.14	0.2301	0.19	−0.001	0.0085
β-Carotene, μg	0.20	0.21	0.8650	0.28	0.16	0.0085
Vitamin E, mg	0.12	0.19	0.2340	0.23	−0.09	<0.0001
Retinol, mg	0.27	0.15	0.0375	0.24	0.11	0.0673
Calcium, mg	0.23	0.11	0.0404	0.15	0.02	0.0751
Iron, mg	0.14	0.07	0.2420	0.19	0.12	0.3320
Magnesium, mg	0.27	0.15	0.0375	0.29	0.08	0.0030
Sodium, mg	0.26	0.09	0.0036	0.16	0.12	0.5823
Zinc, mg	0.24	0.09	0.0110	0.19	0.18	0.8887
Food groups,[2] g						
Vegetables[3]	0.35	0.15	0.0004	0.32	0.20	0.0801
Legumes	0.12	0.19	0.2340	0.27	0.05	0.0021
Potato	0.20	0.13	0.2340	0.14	0.10	0.582
Fruit[4]	0.17	0.14	0.6101	0.24	0.02	0.0023
Fruit juice	0.20	0.16	0.4965	0.09	0.002	0.2301
Dairy products	0.13	0.12	0.8650	0.03	0.08	0.4965
Milk	0.15	0.10	0.4009	0.12	−0.001	0.0989
Eggs	0.23	0.19	0.5902	0.05	0.13	0.2713
Poultry	0.20	0.10	0.0891	0.07	0.01	0.4122
Red meat	0.22	0.04	0.0071	0.21	0.16	0.4839
Processed meat	0.14	0.08	0.3125	0.14	0.13	0.8887
Meat pies and savory pastries	0.18	0.08	0.0910	0.15	−0.09	0.0010
Fish	0.15	0.20	0.3953	0.12	0.13	0.8887
Breakfast cereals	0.14	0.09	0.4009	0.07	0.07	1.000
Cereal products	0.08	0.05	0.6171	0.14	−0.03	0.0032
Rice	0.44	0.10	<0.0001	0.45	0.22	0.0004
Pasta or noodles	0.15	0.10	0.4009	0.16	0.03	0.0735
Bread	0.22	0.10	0.0414	0.14	0.13	0.8887
Spreads containing fat	0.20	0.13	0.0873	0.12	0.09	0.6818
Nonfat spreads	0.17	0.05	0.0444	0.14	0.05	0.2287
Nuts	0.23	0.16	0.2263	0.10	0.14	0. 5823
Snacks	0.18	0.13	0.3953	0.11	0.03	0.2757
Cakes and pastries	0.08	0.04	0.6171	0.10	0.09	0.8887
Chocolate and sweets	0.15	0.08	0.2380	0.18	0.03	0.0394

[1] Numbers for living arrangements were reduced because of missing values. P values were for the statistically significant difference between the groups living and not living with a parent. Adjustment for multiple comparisons was made with the use of the Šidák test (30); $P < 0.003$ is considered to be significant based on 18 tests (nutrients) and $P < 0.002$ is considered to be significant based on 24 tests (food groups). Spearman correlation coefficient (r) adjusted for age, education, and vigorous physical activity of mother and offspring.

[2] Food groups (grams per day) adjusted in addition for total energy intake (kilocalories per day).

[3] Leafy green vegetables, red and yellow vegetables, cruciferous vegetables, and other (fresh, frozen, or canned).

[4] Including citrus fruit.

In addition to resemblance in macro- and micronutrient intake, we examined the associations for food groups in mother-offspring dyads. Overall, food group correlations were slightly lower than those for nutrients, with the exception of consumption of vegetables (r = 0.26–0.28) and rice (r = 0.28–0.37). To our knowledge, familial resemblance in food groups has been rarely investigated (20, 33), and direct comparison with our results is limited because of the younger age of offspring or the use of different food groups and their measures in these studies.

We hypothesized that the living arrangements of the young adult offspring would influence the dietary associations between mother and child. The overall weaker dietary associations observed in offspring not living with their parents corroborate a previous report indicating that family resemblance in nutrient intake is not very apparent in adult women living apart from their mothers and weakens with time (20). When young adults (children) leave home, peer influence and greater autonomy regarding food choices possibly modify food intake to a larger extent than when they lived at home.

Some limitations have to be considered in this study. As for other long-term birth cohort studies, there was loss to follow-up in the MUSP ($\sim$51%). Those disproportionately lost to follow-up are likely to be young and economically disadvantaged, be of separated or divorced marital status, and have higher rates of alcohol, tobacco, and illicit substance use (22). To assess the impact of attrition and to correct for bias associated with differential loss to follow-up, the MUSP project used a variety of strategies, including inverse probability weighing and multiple imputations, with the conclusion that the results remained largely unaffected (22, 23, 34–36).

We excluded 715 participants from the study who had left >29 (40%) food items blank in the FFQ to allow for acceptable data quality, assuming that such a high number of blanks rather was due to inattention and not because the participant did not eat these foods (27). This and the inability of the FFQ method to provide a precise assessment of number of servings (37) could have affected estimates of food intake. As is common to all self-report dietary methods, the potential for random and systematic bias to affect estimates derived from FFQ data is acknowledged. By adjusting the dietary data for energy intake (29), we aimed to reduce the influence of errors. We compared mean energy intake from our study with estimates from the 1995 National Nutrition Survey of similar age groups (38). The mean energy intake of daughters and sons was lower than national estimates, whereas the energy intake of mothers was similar to respective estimates.

The MUSP cohort is not representative of the Australian population. However, the cohort comprises effectively all consecutive births of public patients in the Mater Hospital over 3 y from 1981 to 1983, ensuring a broad cross-section of women of middle to low socioeconomic status. There is no biological reason to suspect that the associations we found in this study should differ substantially from other populations.

Strengths of our study include the large size of the study sample, the use of 21-y follow-up data on female and male adult offspring, and the examination of their living arrangements. Earlier studies investigated young children and adolescents only and used small sample sizes, with the exception of 2 studies (10, 19).

In summary, we observed only weak associations between mother-adult offspring dyads for selected dietary factors, with slightly higher correlations in mother-daughter dyads than with mother-son dyads. This may imply that environmental and societal factors other than parental dietary habits and home environment have a stronger influence on the diet of young adults. Furthermore, our data show that resemblance in diet is weaker when adult children aged 18–23 y are not living with their parents. It would be of great interest to investigate whether the weak resemblance persists into older adult age or a convergence of food habits occurs between parents and offspring.

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