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Original Article

Diet in pregnancy and risk of small for gestational age birth: results from a retrospective case-control study in Italy

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Abstract

This study aims to analyse the association between selected dietary indicators during pregnancy and the risk of small for gestational age (SGA) births in a South European population. This is a case-control study. Cases were 555 women who delivered SGA babies at the Luigi Mangiagalli Clinic of Milan and the Obstetric and Gynecology Clinic of the University of Verona. The controls were women who gave birth at term (≥37 weeks of gestation) to healthy infants with normal weight in the same clinics. Dietary information was collected with a food frequency questionnaire. Women with SGA babies reported a more frequent consumption of meat and olive oil, and a less frequent consumption of fish and eggs. Women with high consumption of olive oil had an increased risk of delivering an SGA baby [odds ratio (OR) 1.6, 95% confidence interval (CI) 1.0–2.5]. The multivariate OR for high meat consumption was 1.4 (95% CI 1.1–1.9); for fish 0.8 (95% CI 0.6–1.0, χ^2 for trend 4.0, $P = 0.045$) and for egg 0.7 (95% CI 0.5–0.9). After allowing for factors generally known to be associated with SGA, we have shown that eating more fish and eggs, and less meat and possibly olive oil, are associated with a lower risk of delivering an SGA baby.

Keywords: diet, pregnancy, birthweight, risk factors, case-control study.

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Introduction

Infants born small for gestational age (SGA) have an increased risk of death and developmental and behavioural problems in childhood (Pallotto & Kilbride 2006). The importance of adequate maternal nutrition to reduce the risk of giving birth to SGA infants in developing countries, where under-nutrition is quite common, is widely recognized. In developed countries, where severe malnutrition is rare, the evidence is still controversial. For example, Petridou *et al.* (1998) found a positive association between birth weight and olive oil intake, widely consumed in Mediterranean countries, whereas in Lagiou *et al.*'s (2004) research, no relation emerged. Several studies, mainly conducted in Northern Europe, where there is a high fish consumption, gave inconsistent results. Higher consumption of fish and fish oil was associated with higher birthweight in some studies (Olsen & Secher 2002; Mitchell *et al.* 2004; Rogers *et al.* 2004) but not in others (Olsen *et al.* 1992, 2000). The findings of Oken *et al.* (2004) and Thorsdottir *et al.* (2004) supported the conclusion that seafood intake during pregnancy is associated with reduced fetal growth. Protein intake from meat has been found to be protective in a meta-analysis by Kramer & Kakuma

(2003) but at risk in a cohort study by Moore *et al.* (2004). The role of other foods is also still under discussion.

Most published studies refer to North American or North European populations. A specific point of interest of this study is that it analyses this association in a South European population, where dietary intakes are substantially different: for example, daily average consumption is different for fish and seafood (i.e. similar in Finland and Italy but lower than in Norway), vegetables and fruits (higher in Italy, Greece and Spain than in Norway, Finland and Sweden), pasta (three- to 10-fold higher in Italy than elsewhere), whereas the intake of meat, eggs and milk is very similar (EuroFIR 1996–2004).

The aim of this study was to assess the effect of the above-mentioned foods intake during pregnancy on the risk of delivering SGA babies, using data from a large case-control study conducted in Italy (Chiaffarino *et al.* 2006).

Subjects and methods

This case-control study on risk factors for SGA birth was conducted from 1989 to 1999.

Cases were 555 women (mean age 31 years) who had a spontaneous delivery of SGA baby, at term or preterm, without premature rupture of membranes, at the Clinica Luigi Mangiagalli (the largest obstetric hospital in Milan) and the Obstetric and Gynecology Clinic of the University of Verona. SGA was defined as having a birthweight smaller than the 10th percentile for the infant's gestational age when compared with that expected for the same gestational age and sex, according to Italian standards (Parazzini *et al.* 1995); 143 births were preterm SGA and 412 full-term SGA.

The controls were women who gave birth at term (≥37 weeks of gestation) to healthy infants with normal weight (i.e. between the 10th and 90th percentiles inclusive according to Italian standards) on randomly selected days at the hospitals where cases had been identified. The interviewers surveyed the obstetric wards on days established at random to interview controls whose age was comparable with cases. A total of 1966 controls (mean age 31 years) were interviewed. Cases and controls were interviewed in the same hospital within 3 days after delivery. Women filled out informed consent and data treatment forms to enter the study, in accordance with the ethical standards of institutions where they were identified. The proportion of cases and controls interviewed in the first, second and third day after delivery were similar. Overall participation was over 95% for cases and controls.

The classification of an infant as small or appropriate for gestational age relies on the gestational age at birth estimation accuracy. Cases and controls had an ultrasound examination before 20 weeks of gestation in order to obtain a confident estimate. Dating ultrasound was carried out routinely and not for the study as cases and controls were identified in hospital after delivery. Multiple births were not eligible for the study.

Cases and controls were administered a structured food frequency questionnaire by trained interviewers. Women were retrospectively asked about their diet in the period immediately before becoming pregnant and in the last month of pregnancy. Data on usual weekly consumption frequency of 10 indicator foods (milk, meat, liver, ham, fish, eggs, cheese, carrots, green vegetables, fruit) were collected, and simple subjective scores (low, intermediate, high) were used as measures for whole meal bread or pasta and various fats (butter, margarine, oil) consumption. Women were asked to recall their dietary habits before pregnancy. Thus, a total of 15 food items for each period (before and during pregnancy) were considered in this report. Food groups in our questionnaire were chosen to include the more frequently eaten foods in Italy and ensure the inclusion of the major sources of carotenoids and vitamins (carrots and green veg-

Key message

- Eating more fish and eggs, and less meat and possibly olive oil, are associated with a lower risk of delivering a small for gestational age baby. Small variations in maternal diet are suggested to have effect on birthweight.

etables), as well as retinoids in the Italian diet (milk, liver and meat). Meat intake included the consumption of various type of fresh meats (pork, beef and white meat), whereas ham intake included all cold cuts. This information was collected separately because the consumption of cold cuts may vary remarkably during pregnancy, mainly in Cytomegalovirus negative women. Information on pasta and bread consumption was only recorded in the last year of data collection. The questionnaire was validated for reproducibility by D'Avanzo *et al.* (1997). In order to assess information comparability and reproducibility, the authors randomly selected a total of 400 subjects from a large sample of hospital controls and contacted them at home to repeat the interview. Spectrum correlation coefficient values of consumption between the first and second interview were >0.65 for consumption of pasta, bread, fish, milk, green vegetables and eggs (the most frequently eaten food in Italian diet); between 0.50 and 0.65 for meat, ham and fruit; lower than 0.50 for a few infrequently eaten foods. This study showed a satisfactory comparability of dietary information from subjects interviewed at home with that provided during their original interview in hospital, and good information reproducibility. However, as the items for olive oil, butter and margarine were added subsequently, they are not validated.

Information was obtained on general socio-demographic habits, personal characteristics and habits, gynecological and obstetric history. The presence of hypertension in pregnancy was checked with clinical records. We defined gestational hypertension as diastolic pressure above 90 mm Hg on at least two occasions 24 h apart, without proteinuria. Body mass index (BMI) was calculated as weight in kilograms/height in m^2. Total maternal weight gain during pregnancy was recorded on admission to the delivery ward. Weight gain per completed week of gestation was calculated. All information, apart from birthweight and week of gestation at birth, were obtained from personal interview. Weight gain in pregnancy was checked with clinical record.

To account for the effects of several potential confounding factors simultaneously, we used conditional multiple logistic regression (with age as the matching variable), with maximum likelihood fitting, to obtain odds ratios (ORs) and their corresponding 95% confidence interval (CI) (Breslow & Day 1980). Terms for age and education were included in the regression equations as well as terms significantly associated with the risk of SGA birth in this data set.

Results

Table 1 shows the distribution of cases and controls according to age, gestational week at birth and selected factors. Smoking during the first trimester of pregnancy, history of SGA birth and gestational hypertension increased the risk of SGA birth. No significant association emerged between marital status and risk of SGA birth. Parous women and women with gestational weight gain over 0.25 kg per week were at lower risk. Women with BMI at conception between 20 and 25 were considered as normal weight. Compared with women with normal BMI, underweight women gave birth more frequently to SGA babies.

Older women consumed carrots, vegetables and fish more frequently than younger ones. More educated women had significantly higher consumption frequency for fruit and vegetables (18.9 vs. 20.7 portions per week in subjects with ≤6 and ≥14 years of education, respectively) and less frequent intake of fats: 73.6% of women with 6 or less years of education and 79.0% women with 14 or more years of education had lower butter consumption (7.8% vs. 4.1%, respectively, for margarine intake). Olive oil consumption was more frequent in less educated women (16.9%) than in more educated ones (9.9%). BMI was positively associated with meat and ham intake.

The crude analysis showed a significant difference in the weekly consumption frequency of meat (4.0 vs. 3.7, $P < 0.001$), liver (0.7 vs. 0.6, $P = 0.03$), fish (1.2 vs. 1.4, $P = 0.01$) and fruit (10.4 vs. 11.4, $P < 0.001$) between cases and controls.

Table 2 shows the distribution of cases and controls according to low, intermediate and high level of weekly consumption. After adjusting for maternal age, years of education, parity, smoking habits, gestational hypertension, history of SGA births, heavy alcohol consumption, BMI and weight gain in preg-

Table 1. Distribution of 555 cases of SGA births and 1966 controls according to selected factors*

	SGA no. (%)	Controls no. (%)	OR† (95% CI)
Age (years)			
≤24	60 (10.8)	180 (9.2)	
25–29	176 (31.7)	637 (32.4)	
30–34	207 (37.3)	767 (39.0)	
≥35	112 (20.2)	382 (19.4)	–
Gestational week at birth (mean, range)	37.4 (28–42)	39.6 (37–44)	–
Education (years)			
≤6	24 (4.3)	53 (2.7)	1‡
7–13	415 (74.8)	1439 (73.2)	0.6 (0.3–1.0)
≥14	116 (20.9)	473 (24.1)	0.5 (0.3–0.9)
Marital status			
Married	541 (97.5)	1934 (98.4)	1‡
Unmarried	14 (2.5)	32 (1.6)	1.0 (0.5–2.0)
Parity			
0	404 (72.8)	1103 (56.1)	1‡
1	118 (21.3)	693 (35.3)	0.5 (0.4–0.6)
≥2	33 (6.0)	170 (8.7)	0.5 (0.3–0.7)
Previous SGA birth§			
No	133 (88.1)	853 (98.8)	1‡
Yes	18 (11.9)	10 (1.2)	9.9 (4.2–23.4)
Smoking during the 3rd trimester of pregnancy			
No	414 (74.6)	1711 (87.0)	1‡
Yes	141 (25.4)	255 (13.0)	2.6 (2.0–3.3)
Hypertension in pregnancy			
No	435 (78.4)	1863 (94.8)	1‡
Yes	120 (21.6)	103 (5.2)	6.1 (4.5–8.4)
Weight gain per week (kg)			
≤0.24	185 (33.3)	367 (18.7)	1‡
0.25–0.30	147 (26.5)	550 (28.1)	0.5 (0.4–0.7)
0.31–0.36	122 (22.0)	464 (23.7)	0.5 (0.3–0.6)
≥0.37	101 (18.2)	578 (29.5)	0.3 (0.2–0.4)
Maternal BMI at conception (kg m^{-2})			
≤19.99	205 (37.1)	618 (31.5)	1.3 (1.0–1.6)
20.00–24.99	287 (51.9)	1098 (55.9)	1‡
25.00–29.99	54 (9.8)	189 (9.6)	0.8 (0.5–1.1)
≥30.00	7 (1.3)	58 (3.0)	0.2 (0.1–0.5)
Alcohol drinking in pregnancy (units day^{-1})			
0–2	532 (95.9)	1939 (98.6)	1‡
≥3	23 (4.1)	27 (1.4)	3.0 (1.6–5.6)

BMI, body mass index; CI, confidence interval; OR, odds ratio; SGA, small for gestational age. *In some cases, the sum does not add up to the total because of some missing values. †Adjusted in turn for education, parity and smoking during the third trimester of pregnancy, gestational hypertension, history of SGA birth. ‡Reference category. §Parous women only.

nancy, we found that women with high levels of meat consumption had an increased risk of delivering an SGA baby (OR 1.4, 95% CI 1.1–1.9), as well as women that rated 'high' (self evaluation) for the use of olive oil (OR 1.6, 95% CI 1.0–2.5). High fish and egg consumption frequency represented a protective factor (OR 0.8, 95% CI 0.6–1.0 and OR 0.7, 95% CI 0.5–0.9, respectively). When we included each term in the regression equations of the other items, the associations were confirmed.

The correlation among pre-pregnancy and in-pregnancy servings a week was high for each food ($r > 0.80$), except for ham ($r = 0.65$). The pre-pregnancy consumption analysis gave the same

Table 2. Small for gestational age birth and selected food in late pregnancy

Weekly consumption (cutoff for low, intermediate and high intake)	Frequency of consumption (no. of cases/no. of controls)*			Odds ratio estimates† (95% CI)			Chi-square trend	P
	Low	Intermediate	High	Low‡	Intermediate	High		
Milk (≤5, 6–7, ≥8)	182/640	262/986	111/340	1	1.0 (0.8–1.3)	1.3 (0.9–1.7)	2.1	0.14
Meat (≤4, 5–7, ≥8)	126/548	145/533	284/881	1	1.2 (0.9–1.6)	1.4 (1.1–1.9)	8.4	0.0004
Liver (<0.5,0.5–1, ≥2)	326/1175	183/674	46/117	1	0.9 (0.7–1.2)	0.8 (0.5–1.2)	1.0	0.31
Ham (0, 1, ≥2)	127/468	141/578	287/920	1	0.9 (0.7–1.3)	1.1 (0.9–1.5)	1.4	0.23
Fish (0, 1, ≥2)	143/447	210/682	202/837	1	1.1 (0.8–1.4)	0.8 (0.6–1.0)	4.0	0.04
Eggs (0, 1, ≥2)	131/353	181/642	243/971	1	0.8 (0.6–1.0)	0.7 (0.5–0.9)	7.8	0.005
Cheese (≤2, 3–4, ≥5)	141/452	173/675	241/839	1	1.0 (0.8–1.4)	1.1 (0.8–1.4)	0.6	0.45
Carrots (<0.5, 0.5–1, ≥2)	105/309	245/1001	205/656	1	0.8 (0.6–1.1)	1.0 (0.8–1.4)	0.3	0.61
Green vegetables (≤5, 6, ≥7)	169/581	53/247	333/1138	1	0.9 (0.7–1.4)	1.1 (0.8–1.3)	0.3	0.59
Fruit (≤8, 9–13, ≥14)	212/619	62/223	281/1124	1	1.0 (0.7–1.5)	0.9 (0.7–1.1)	0.6	0.45
Olive oil	72/209	417/1611	65/146	1	1.1 (0.8–1.5)	1.6 (1.0–2.5)	4.1	0.04
Butter	400/1453	155/513	0/0	1	1.1 (0.9–1.4)	–	–	–
Margarine	520/1838	35/128	0/0	1	0.9 (0.6–1.4)	–	–	–
Bread§	11/22	31/149	12/35	1	0.5 (0.2–1.2)	1.0 (0.3–3.2)	0.0006	0.98
Pasta§	18/83	27/125	12/31	1	1.2 (0.6–2.4)	1.8 (0.6–5.6)	0.97	0.32

CI, confidence interval. *For some items, the sum of strata does not add to the total because of missing values. †Multiple logistic regression estimates including terms for age, education, parity, body mass index, smoking habits, heavy alcohol consumption, gestational hypertension, history of SGA births and weight gain in pregnancy. ‡Reference category. §Only 296 women.

results as in-pregnancy consumption analysis (data not shown).

We investigated the possible different effect of maternal diet in SGA newborn delivered preterm and at term (Table 3). The findings of the main analysis were generally confirmed (protective effect of eggs and increased risk of eating meat and olive oil, the latter significant in preterm but not in at term SGA babies), but the suggestion that fish consumption was also protective was no longer significant when seen in a strata of gestational age, probably because of the overall scarcity of fish in the diet of enrolled women.

Discussion

Potential limitations of this study should be considered. The choice of women who delivered healthy infants only at term as controls may have introduced some bias. However, when we only considered cases who delivered after 37 weeks' gestation, no differences emerged in the ORs. Other sources of bias, including selection or confounding factors, are unlikely to have produced marked effects, especially considering that cases and controls were interviewed in the same institutions and that participation was close to complete. Findings were largely consistent when the analysis was ran separately for cases and controls collected in the two hospitals or by different interviewers or when the models included terms for centre and interviewers (data not shown).

The food frequency questionnaire was tested for reproducibility. However, any potential problem of validation is unlikely to have produced any major misclassification between cases and controls. Only a

Table 3. Small for gestational age birth and selected food in late pregnancy, in strata of gestational age

	Delivered preterm (no = 143) Odds ratio estimates* (95% CI)			*P*	Delivered at term (no = 412) Odds ratio estimates* (95% CI)			*P*
	Intermediate	High	Chi-square trend		Intermediate	High	Chi-square trend	
Milk	1.3 (0.8–2.0)	1.8 (1.0–3.1)	3.8	0.05	0.9 (0.7–1.2)	1.2 (0.8–1.6)	0.4	0.52
Meat	0.8 (0.5–1.5)	1.7 (1.1–2.8)	6.9	0.008	1.3 (1.0–1.8)	1.4 (1.1–1.8)	4.7	0.03
Liver	1.0 (0.6–1.5)	0.4 (0.2–1.1)	1.8	0.18	1.0 (0.7–1.2)	1.0 (0.6–1.5)	0.1	0.74
Ham	1.3 (0.7–2.2)	1.0 (0.6–1.7)	0.02	0.87	0.9 (0.6–1.2)	1.2 (0.9–1.6)	2.1	0.15
Fish	1.0 (0.6–1.6)	0.7 (0.4–1.1)	2.8	0.09	1.1 (0.8–1.4)	0.8 (0.6–1.1)	2.4	0.11
Eggs	0.4 (0.3–0.7)	0.5 (0.3–0.8)	6.7	0.01	0.9 (0.6–1.2)	0.7 (0.5–0.9)	4.3	0.04
Cheese	1.2 (0.7–2.2)	1.5 (0.9–2.6)	2.6	0.10	1.0 (0.7–1.3)	1.0 (0.8–1.3)	0.02	0.87
Carrots	1.0 (0.6–1.8)	1.1 (0.6–1.9)	0.1	0.78	0.8 (0.6–1.1)	1.0 (0.7–1.4)	0.2	0.64
Green vegetables	0.8 (0.3–1.7)	1.5 (1.0–2.4)	4.1	0.04	1.0 (0.7–1.5)	1.0 (0.7–1.2)	0.2	0.69
Fruit	0.8 (0.4–1.7)	1.2 (0.8–1.8)	0.5	0.46	1.1 (0.7–1.6)	0.9 (0.7–1.1)	1.3	0.26
Olive oil	1.7 (0.9–3.3)	3.3 (1.4–7.8)	7.9	0.005	1.0 (0.7–1.4)	1.3 (0.8–2.2)	1.1	0.29
Butter	1.1 (0.8–1.7)	–	–	–	1.1 (0.9–1.4)	–	–	–
Margarine	0.6 (0.3–1.6)	–	–	–	1.0 (0.6–1.6)	–	–	–

CI, confidence interval. Multiple logistic regression estimates including terms for age, education, parity, body mass index, smoking habits, heavy alcohol consumption, gestational hypertension, history of SGA births and weight gain in pregnancy. *Data about bread and pasta were not analysable in strata because of low number.

small portion of the questionnaire was related to dietary factors, so the interviewers' and patients' attention was probably not concentrated on those aspects. The role of diet in SGA birth risk had not gained widespread attention in Italy and was only one of the issues of the study, hence reducing the scope for differential interviewers' attention and subjects' recall by cases and controls.

Another limitation of this study was that the fats consumption is subjectively evaluated as low, normal or high. There is the common perception, in Italy, that olive oil is part of healthy dietary habits, so it is unlikely that women with SGA babies considered this fat as responsible for the problem. Further, it seems likely that a woman thinks that her dietary habits are 'normal', so that 'intermediate' is a more frequent answer than 'high'. For these reasons, any misclassification should probably tend to underestimate the difference of olive oil consumption, rather than overestimate.

A major strength of this study is that the sample was ethnically homogeneous, participation was almost complete and we were able to check our results for all important confounders. Moreover, gestational age was confirmed both in cases and controls by ultrasound examination, so we can be confident that infants were defined SGA when they really were.

As previously reported (Chiaffarino *et al.* 2006), education, parity, history of SGA births, gestational hypertension, heavy alcohol consumption and smoking during the third trimester of pregnancy are associated with increased risk of delivering an SGA infant. After adjusting for all these factors, we found that mothers of SGA infants ate more meat and olive oil, and less fish and eggs.

Dietary patterns have been considered a valid alternative to single food approaches to describe associations between diet and disease, contributing to risk factors definition (Edefonti *et al.* 2009). It is probable that more frequent consumption of foods such as meat and olive oil is indicative of a dietary pattern related to SGA. Unfortunately, the number of food groups in our questionnaire is inadequate to calculate dietary patterns.

High protein intakes in pregnancy have been associated with both positive and negative effects on birthweight. Godfrey *et al.* (1996) found that increase of meat and dairy protein intake in late pregnancy, with high carbohydrate intake in early pregnancy, was associated with the increase of placental and birthweight. Conversely, no association emerged in a very similar sample of women enrolled in the cohort of Mathews *et al.* (1999), whereas Sloan *et al.* (2001) reported that mean protein intake ≥85 g/day was associated with a significant decrease in birth weight.

We found that, after allowing for weekly gestational weight gain, women who consumed five or more servings/week had a significantly higher risk of delivering an SGA baby than women with lower meat consumption. However, considering all the protein sources, this result was not confirmed: high consumption of fish and eggs was associated with a lower risk of SGA.

Olive oil consumption is a characteristic of Mediterranean countries. Petridou *et al.* (1998) suggested that monounsaturated lipids from olive oil could be positively associated with birth weight, but Lagiou *et al.* (2004) concluded in their study that vegetable lipids were not directly related to birth size: energy and selected nutritional intakes were associated with weight gain in pregnancy, and weight gain in pregnancy was associated with birthweight, but this relation was not reflected in a direct association between nutritional parameters and birth weight or size. Conversely, we found that use of olive oil, if high, seemed to be a risk factor for SGA birth. However, the sub-analysis for gestational age showed that the effect was stronger in delivered preterm infants, whereas in babies born at term the association with maternal olive oil consumption was not significant. In a randomized trial of fish oil supplementation by Olsen *et al.* (1992), controls were women who took olive oil supplementation or no supplementation: among the three treatment groups, babies born to mothers assuming olive oil were the lightest. Yet, pregnancies in the fish oil group were on average 4 days longer than in olive oil group, so comparison was made between babies of different gestational age. In our study, birthweight of infants was evaluated according to gestational age, removing a source of potential confounding.

We did not find an association between different levels of consumption of milk and dairy products and SGA birth, though Olsen *et al.* (2007) showed that milk intake in pregnancy was associated with lower risk of SGA. Mannion *et al.* (2006) found that milk restriction was related to a decrease of protein intake and subsequent reduction of birthweight; the authors specify that the effect was related to vitamin D deficiency, and restricted to women living at latitudes associated with low sunlight exposure, that is not the case of Italy. Moreover, in our sample, only a small proportion of women never drank milk or ate cheese. It seems likely that in our sample, even a low consumption of milk and derivates was sufficient to provide the intake of vitamin D needed to appropriate fetal growth.

The associations between fish and fish oil intake and birthweight and gestational length have been widely investigated, in particular in countries where fish consumption is common (Iceland, Denmark, Sweden, Greece), with controversial findings.

No detectable effect on fetal growth was seen in randomized trials of fish oil (Olsen *et al.* 1992, 2000), but observational studies have found a direct association between measures of seafood intake in pregnancy and fetal growth rate (Olsen & Secher 2002; Rogers *et al.* 2004). Yet, the results from a recent observational study (Mitchell *et al.* 2004) did not support the conclusion that seafood intake during pregnancy is associated with fetal growth and another study, conducted in a fishing community (Thorsdottir *et al.* 2004), found that women in both lowest and highest quartile of fish consumption gave birth to smaller babies than those born to women in the central quartiles. Another cohort study by Halldorsson *et al.* (2007) found that women who consumed fatty fish, a known route of exposure to persistent organic pollutants, more than three times per month, had a high risk of giving birth to children SGA. In a population where fish is not frequently eaten (23% of women never eat it, 36% once a week), our result shows that increased eating of fish may reduce the risk of delivering an SGA baby. Likewise, the same result was found in another case-control study, when fish was consumed in early pregnancy, but not later (Mitchell *et al.* 2004). In our sample, the changes of dietary composition seem minimal (the correlation between frequency of pre-pregnancy consumption and during pregnancy consumption was high), so we found the same association in early and late pregnancy consumption of some foods and the risk of SGA birth.

In our sample, egg consumption had a highly significantly trend: women who ate more eggs were less likely to have an SGA birth. Eggs contain 12.6% proteins, all the essential amino-acids, all essential vitamins (1.7%) except vitamin C, 9.9% lipid, mainly mono- and polyunsaturated fatty acids. A recent review (Greenberg *et al.* 2008) suggested that omega-3-fatty acids may be important for the timing of gestation and for birthweight; an adequate intake from a variety of sources was recommended. Although omega-3-fatty acids in eggs are well below the levels found in fish, for women who do not eat or eat little fish, eggs may represent an important source of these nutrients, maybe contributing to explain our result.

The data regarding carbohydrate rich foods (bread and pasta) were limited to a lower number of women. It seems that a high consumption of these foods is related to smaller-sized babies, but in our small sample this result was not statistically significant, though elsewhere (Godfrey *et al.* 1996; Olsen & Secher 2002) the same was found.

As expected, because of the low fish consumption frequency in our sample, when we performed the analysis separately for preterm and at term, this result was no longer statistically significant. Conversely, this subgroup analysis confirmed the role of meat, eggs and, less consistently, olive oil consumption as they emerged from the overall analysis.

In conclusion, after allowing for factors generally known to be associated with SGA, and specifically related to birth size in our sample, we have shown that eating more fish and eggs, and less meat and possibly olive oil, are associated with a lower risk of delivering an SGA baby. Small variations in maternal diet, both in early and late pregnancy, are also suggested to have effect on birthweight, though further studies focusing on the Italian diet, using more detailed and validated questionnaires, are needed.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

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