

Comparing diet composition and growth of children living in two liminary Greek islands (Samos and Corfu)

Maria G Grammatikopoulou*, Efstratia Daskalou, Margarita Hatzopoulou, Loukia Sourtzinou and Maria Tsigga

Department of Nutrition & Dietetics, Alexander Technological Educational Institute, PO Box 141, GR-57400 Thessaloniki, Greece

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Abstract

Objective: The study aimed to assess differences in dietary intake and growth of pre-schoolers and schoolchildren living in two liminary Greek islands; Samos, situated on the eastern border, and Corfu, situated on the western border.

Design: Cross-sectional two-site study.

Methods: A total of 248 children aged 3–12 years from the two islands participated in the survey. Body weight and height were recorded and Z-scores were calculated. A 3 d food record was collected for each child, computer-analysed and compared with the Recommended Daily Allowances (RDA). Intakes $\leq 70\%$ of the RDA were considered inadequate.

Results: The prevalence of overweight in participants from Samos and Corfu was 10.7% and 6.5% respectively, according to the Centers for Disease Control and Prevention growth charts. In Corfu, the diet comprised 52% carbohydrate, 34% fat and 14% protein, all different from the composition of the Samian diet (42% carbohydrate, 39% fat, 19% protein; $P \leq 0.05$). Inadequacies in micronutrient intake were evident only in the diet of Samos and concerned folate and P of the pre-schoolers and biotin of the school-aged participants. The diet in Corfu was more similar to the overall Mediterranean pattern as well as that of Italian children. Growth and overweight trends in Corfu resembled the ones in Italy, whereas in Samos, similarities were identified with trends from Turkey.

Conclusions: Border areas at a distance from the mainland exhibit different dietary intakes compared with rest of the country; thus when designing nutrition surveys the setting should also include such liminary areas.

Keywords
Food
Traditional diet
Mediterranean diet
Z-scores
Dietary intake
Geographical influence

The 'proper' diet for children is of increasing concern as it can ensure proper growth, safeguard future health and minimize the prevalence of obesity. In recent years, Greek children have been affected by a nutrition transition in favour of a more 'Westernized' diet and this has elevated the rates of overweight and obesity^(1,2). In order to clarify the nature of children's current diets, research in Greece has focused on dietary intake and growth, with the majority of studies being based in urban areas like Athens or Thessaloniki, or in areas that host a university, like Crete. Recent research involving five different counties within the Greek mainland revealed that 16.0% of pre-school boys and 15.5% of girls were overweight⁽³⁾ according to the Centers for Disease Control and Prevention (CDC) growth charts⁽⁴⁾. Mamalakis *et al.*⁽⁵⁾ studied the insular population of children in Crete and classified 24.0% of the boys and 19.2% of the girls as overweight, and 8.2% of the boys and 5.0% of the girls as obese, according to the CDC growth charts. In urban areas of mainland Greece, children were

reported to be slimmer. In the city of Thessaloniki, the prevalence of overweight was 31% in boys and 21% in girls⁽⁶⁾, according to the International Obesity Taskforce criteria⁽⁷⁾.

Although ethnicity has been proved to affect children's food consumption in the USA⁽⁸⁾ and the European Union⁽⁹⁾, the possible influence of geographical residence within the same country has not yet been studied. It has been suggested that the diet of Greeks living a distance from the mainland⁽¹⁰⁾, or in liminary areas, might differ in three ways, by: (i) sustained insistence to traditional dietary habits⁽¹¹⁾; (ii) being affected by local abundance in production; or (iii) being influenced by neighbouring countries⁽¹⁰⁾. Thus, although Greece is a relatively small country, variations in dietary habits exist and might induce changes in the prevalence of childhood obesity.

The present double-site, cross-sectional study aimed to assess nutrient intake and growth of Greek children living in the border areas. The setting involved two liminary

*Corresponding author: Email maria@nutr.teithe.gr

islands, Samos and Corfu, situated on the eastern and western border of the country, respectively.

Methods

Subjects

The sample consisted of 248 children, aged 3–12 years, from the islands of Samos and Corfu. Samos is situated in the Aegean Sea, on the eastern border with Turkey, and Corfu is situated in the Ionian Sea, on the western border, opposite Italy (Fig. 1). Children were randomly selected from four different public schools in Samos, all from the areas of Karlovasi and Marathokambos. In Corfu, participants were randomly selected through friends and acquaintances from Kanali, Kassiopi and Corfu city. Due to small sample size, both sexes were grouped together. Participants were divided into two groups according to age. The first group comprised seventy-six young children aged 3–6 years (pre-schoolers), thirty-nine girls and thirty-seven boys (mean age 4.86 (SD 0.82) years). The second group consisted of 172 older children aged 7–12 years (school-children), ninety-three girls and seventy-nine boys (mean age 9.87 (SD 1.58) years). Eighty-two subjects dropped out during data collection, as the initial sample aimed to recruit 165 participants from each site.

Ethical consent

Approval for the research was provided from local authorities, the school directors and the Alexander Technological Educational Institute. The same procedures and instruments were used in both islands. Parents were informed of the nature and purpose of the study before giving their consent for participation. Research was self-funded.

Procedure

A 3 d food recall (one weekend day and two weekdays), collected via three next-day interviews, was used to assess dietary intake. Recalls were not filled in by the parents alone, as many were illiterate, especially in the island of Samos. Instead, a qualified dietitian interviewed one of the subject's parents, in the presence of the child, in order to collect data. Dietary intake was assessed using the Food Processor computer program version 7.4 (ESHA, Portland, OR, USA) and was expressed as the mean of the three recorded days. Nutrient intake was compared with the sex- and age-specific US Recommended Daily Allowances (RDA)⁽¹²⁾ in the absence of Greek RDA values. Intakes less than or equal to 70% of the RDA were considered inadequate.

Subjects' height was measured with a stadiometer and their weight with an analogue scale that was calibrated regularly (Seca 789). All anthropometric measurements were taken in morning hours (08.00–11.00 hours), in school, by the same experienced physicians. Body fat was not measured, as most participants felt embarrassed to undress in front of their classmates. Data were compared with the latest growth curves for US children⁽⁴⁾, as growth



Fig. 1 Study setting: the island of Corfu is situated on the upper western border of Greece and the island of Samos is on the eastern border

curves for Greek children are of questioned validity⁽¹³⁾. The Epi Info 3.3.2 computer program (CDC, Atlanta, GA, USA) was used for calculating the Z-scores of each participant, as Z-scores allow for a mixed sexes sample.

Statistical analysis

Independent-samples *t* tests were performed in order to assess differences between the two islands. Differences between age groups were omitted, as they would further complicate the results.

Results

Growth

Table 1 presents the anthropometric characteristics of the participants. BMI, weight-for-height Z-score (WHZ), body weight and height-for-age Z-score (HAZ) were significantly higher in Corfu pre-schoolers ($P \leq 0.001$ for the first two and $P \leq 0.05$ for the latter). Among school-children, weight-for-age Z-score (WAZ) was significantly higher in Corfu ($P \leq 0.001$).

Only eight (10.1%) of the participating girls in Samos and seven (11.3%) of the boys were overweight according to the CDC growth charts ($WAZ \geq 2$) and none was underweight. In Corfu, one girl (1.9%) and six boys (10.7%) from the sample were overweight. Thus, a total of 10.7% and 6.5% of the participating children living in Samos and Corfu, respectively, were classified as being overweight.

Eleven girls and nine boys in Samos were taller for their age ($HAZ \geq 2$) and one girl was stunted ($HAZ \leq 2$). In Corfu, all participants presented normal height for their age.

Dietary intake

Energy and macronutrient intake is presented in Table 2. The Corfian children demonstrated higher energy, carbohydrate and fibre (g/kg body weight) intakes ($P \leq 0.001$)

Table 1 Anthropometric characteristics of the study sample: children (*n* 248) aged 3–12 years living on the Greek islands of Samos and Corfu

	Pre-school children				Schoolchildren			
	Samos (<i>n</i> 40)		Corfu (<i>n</i> 36)		Samos (<i>n</i> 100)		Corfu (<i>n</i> 72)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Weight (kg)	20.0	3.6	21.7*	3.3	39.2	9.1	39.5	10.3
Height (m)	1.13	0.10	1.11	0.07	1.44	0.10	1.43	0.11
BMI (kg/m ²)	15.78	1.77	17.33***	1.21	18.73	3.11	19.01	2.56
WAZ	0.77	0.99	1.06	0.62	0.63	0.97	1.44***	1.13
WHZ	0.14	1.35	0.99***	0.56	–	–	–	–
HAZ	1.59	2.12	0.67*	0.76	0.69	1.27	1.02	0.79

WAZ, weight-for-age Z-score; WHZ, weight-for-height Z-score; HAZ, height-for-age Z-score.
Mean values were significantly different from those of the children from Samos: * $P \leq 0.05$, *** $P \leq 0.001$.

Table 2 Energy and macronutrient intake: children (*n* 248) aged 3–12 years living on the Greek islands of Samos and Corfu

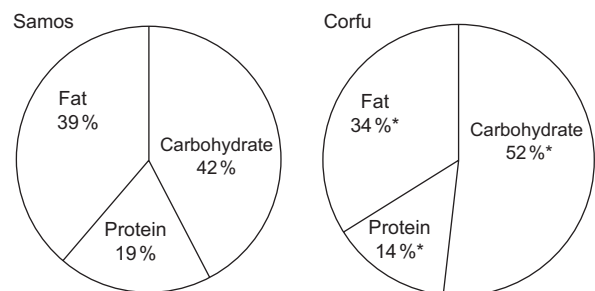
	Pre-schoolers				Schoolchildren			
	Samos (<i>n</i> 40)		Corfu (<i>n</i> 36)		Samos (<i>n</i> 100)		Corfu (<i>n</i> 72)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Energy (MJ/d)	6.54	1.51	7.71***	0.48	6.71	1.88	9.14***	0.80
Energy (kcal/kg BW)	79.8	21.5	86.8	11.9	43.6	17.2	58.6***	13.2
Protein (g/d)	73.4	21.7	73.8	13.6	76.0	29.8	74.4	15.8
Carbohydrate (g/d)	163.8	48.8	226.4***	30.9	154.1	56.4	299.2***	61.9
Fat (g/d)	70.6	22.6	74.1	13.8	78.5	25.7	81.3	15.5
Fibre (g/d)	11.3	10.7	14.6	5.8	12.5	6.9	18.0***	6.7
Fibre (g/kg BW)	0.05	0.07	0.68***	0.26	0.34	0.21	0.49***	0.23
SFA (g/d)	27.3	8.7	22.3*	8.8	28.7	9.8	21.5***	7.1
MUFA (g/d)	26.8	11.0	37.4***	9.1	31.2	13.8	42.8***	8.7
MUFA:SFA	0.99	0.32	1.88***	0.67	1.12	0.50	2.15***	0.62
<i>Trans</i> fat (g/d)	4.1	4.7	0.7***	0.6	2.6	4.0	0.6***	0.1
<i>n</i> -3 (g/d)	0.7	0.3	0.6	0.5	0.8	0.5	0.9	0.6
<i>n</i> -6 (g/d)	6.7	4.4	4.7**	1.2	7.0	4.4	5.7	1.5
Cholesterol (g/d)	0.29	0.15	0.28	0.19	0.28	0.15	0.23	0.15

BW, body weight.
Mean values were significantly different from those of the children from Samos: * $P \leq 0.05$, ** $P \leq 0.01$, *** $P \leq 0.001$.

in both age groups. Among schoolchildren, the Samians demonstrated a lower absolute fibre intake compared with their peers in Corfu ($P \leq 0.001$).

In terms of clusters of fat intake, boys and girls from Corfu consumed more MUFA ($P \leq 0.001$) than their peers from Samos, but the Samians demonstrated a diet denser in SFA ($P \leq 0.05$ and $P \leq 0.001$ for pre-schoolers and schoolchildren, respectively) as well as in *trans* fats ($P \leq 0.001$). The MUFA:SFA ratio was significantly higher in the Corfu participants ($P \leq 0.001$). When fat was expressed as a proportion of energy intake, the diet in Samos comprised 16.0 (SD 4.0) % SFA and 15.1 (SD 3.8) % MUFA, values significantly different compared with Corfu (18.8 (SD 3.9) % SFA and 18.3 (SD 4.5) % MUFA, $P \leq 0.001$). Concerning *n*-6 fatty acids, the only difference was observed in pre-school children ($P \leq 0.01$), with the residents of Samos consuming the most.

Carbohydrate as a percentage of energy intake was significantly higher in the Corfian participants, but protein and fat represented significantly more of the consumed energy in Samos (Fig. 2).

**Fig. 2** Macronutrient composition of the diets of children (*n* 248) aged 3–12 years living on the Greek islands of Samos and Corfu. Values were significantly different from those of the children from Samos: * $P \leq 0.05$

Inadequacies in micronutrient intake were evident only in the diet of Samos (Table 3) and concerned folate for all of the Samians, P for the pre-school sample and biotin for school-aged participants. Between the islands, the younger participants from Corfu exhibited a higher intake of biotin, folate, Mg, P ($P \leq 0.001$) and pantothenic acid

Table 3 Percentage of the Recommended Daily Allowance for selected micronutrients: children (*n* 248) aged 3–12 years living on the Greek islands of Samos and Corfu

	Pre-schoolers				Schoolchildren			
	Samos (<i>n</i> 40)		Corfu (<i>n</i> 36)		Samos (<i>n</i> 40)		Corfu (<i>n</i> 36)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Vitamin A	145	128	230	241	178	55	251	76
Vitamin B ₁	182	82	207	70	141	86	171***	28
Vitamin B ₂	315	67	344	94	201	67	259***	134
Niacin	146	76	195	57	110	60	163***	60
Vitamin B ₆	230	88	207	61	146	62	186***	56
Vitamin B ₁₂	263	86	308	113	168	126	370***	117
Biotin	121	42	170***	52	59	27	101**	157
Vitamin C	250	218	235	174	160	149	199***	154
Vitamin D	108	39	140	127	94	60	118*	93
Vitamin E	128	99	144	43	86	44	113	29
Folate	66	35	149***	109	51	40	111***	35
Pantothenic acid	120	46	152*	64	78	34	138***	65
Ca	125	31	139	50	70	25	93***	38
Fe	107	54	116	47	149	67	190**	121
Mg	138	40	188***	31	81	30	140***	44
P	44	12	252***	47	95	30	111***	27
Zn	168	59	175	32	101	39	118	43
Iodine	160	57	155	83	87	39	102*	47

Mean values were significantly different from those of the children from Samos: * $P \leq 0.05$, ** $P \leq 0.01$, *** $P \leq 0.001$.

($P \leq 0.05$). In the school-aged sample, children from Corfu consumed more vitamins B₁, B₂, niacin, B₆, B₁₂, C, folate and pantothenic acid ($P \leq 0.001$), as well as vitamins D ($P \leq 0.05$) and biotin ($P \leq 0.01$). Mg, P and Ca were more adequate in the diet of Corfian schoolchildren ($P \leq 0.001$), as were Fe ($P \leq 0.01$) and iodine ($P \leq 0.05$).

Discussion

As expected, differences were observed in the diet and growth of children living on the east and west borders of Greece. Overall, children in Corfu presented a diet adequate in energy, macro- and micronutrients and a lower prevalence of overweight. On the other hand, children from Samos demonstrated a higher prevalence of overweight, unbalanced macronutrient distribution and inadequate micronutrient intake.

In the present study none of the participants was underweight or obese, whereas only a small percentage of the participants was overweight (10.7% and 6.5% in Samos and Corfu, respectively). In mainland Greece the prevalence of overweight has been reported to be approximately double in a study situated in the north⁽⁶⁾ as well as in a nationwide study⁽¹⁴⁾ and triple in the wider Athens county⁽¹⁵⁾. Children of mainland semi-rural Greece⁽¹⁶⁾ have also demonstrated higher BMI values compared with the present sample. However, rural children are generally more active⁽¹⁷⁾, as they have more space to play, and thus the prevalence of overweight is lower. Traffic and criminality limit children's activities in urban areas, as parents are afraid to leave them unattended outside the home⁽¹⁸⁾. In contrast, the setting of the

present study – in both Samos and Corfu – included plentiful seaside, small alleys and houses with courtyards, where children can play safely.

Compared with children from neighbouring countries, the Samian participants presented similar overweight rates to children from west Turkey^(19,20) with the school-aged girls demonstrating similar BMI (18.3 kg/m²) to their Turkish peers⁽²¹⁾. However, the high rates of stunting and underweight reported in Turkey were not demonstrated in Samos, as Turkey is still a developing country⁽²⁰⁾. On the western Greek border, the older children of Corfu exhibited similar prevalence of overweight to residents of urban Tuscany in Italy (7%) and the present boys also demonstrated similar BMI (18.8 kg/m²) to Tuscan boys⁽²²⁾. The lower rate of overweight in the participating girls compared with the boys in Corfu has also been reported in northern Italian children⁽²³⁾.

The diet of Samian participants was lower in terms of energy and inadequate in several micronutrients like folate, biotin and P. Similar diets that lead to folic acid deficiency have been reported in girls from Edirne, a city on the west Turkish border⁽²⁴⁾, within an hour's distance from Samos. The Samian diet included foods high in fat (39%) and protein (19%) but low in some micronutrients. Diets with similar fat and cholesterol density, but lower levels of MUFA, have been demonstrated by children living in the semi-rural Volos area in central mainland Greece⁽¹⁶⁾. Such dietary patterns were associated with poorer diet quality, less fibre and vitamins⁽²⁵⁾. The Samian participants presented significantly lower fibre but higher SFA intake compared with the children from Corfu, indicative of an increased consumption of full-fat dairy products and fatty meats

but decreased consumption of fruit and vegetables. Moschandreas and Kafatos⁽²⁶⁾ suggested in Crete that low fibre eaters have higher intakes of saturated fat and this was justified by the present results. In addition, the MUFA:SFA ratio of the Corfian children was closer to the ratio deriving from a traditional Mediterranean diet (1.7)⁽²⁷⁾. The high proportions of MUFA in the examined diets could be explained by the use of olive oil, as olive tree cultivation is common in Greece and favoured by the climate. α -Linolenic acid (*n*-3), as a marker of fish intake, was similar in both islands. Compared with Turkey, the sample from Samos consumed less carbohydrate but more protein and fat^(19,21). It is possible that dietary habits in the island of Samos have been affected by Turkish cuisine, as the island was under Turkish siege for approximately 400 years and hosted many Greek immigrants from the west Turkish coast during the persecution in 1922.

At the other end of Greece, in Corfu, the diet appears to be closer to the Mediterranean recommendations in terms of macronutrient intake. Similar macronutrient content to Corfu's diet has been demonstrated in Italian children⁽²⁸⁾ since many of the traditional Corfian dishes are affected by Italian cuisine, given the cultural dominance of Venice on the island⁽¹⁰⁾ and the fact that the island was for a long time a Venetian province.

The findings of the present study suggest differences in the diets of children living in the east and west borders of Greece, with the diet in Corfu being more abundant in micronutrients. There is mounting evidence that in liminary areas in distance from the mainland, dietary habits are affected by neighbouring countries. Especially in Samos, where Turkey is closer than any Greek city and transportation is frequent throughout the day, the trade of local goods and herbs is an everyday occurrence. Thus, although mainland Greece might consist of an easy setting for research, border areas ought to be considered when examination of dietary intake and growth is the primary aim of the study.

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