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The impact of a school food aid program on household food insecurity

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Background: We had a unique opportunity to establish the extent of food insecurity and the potential impact of a large-scale school-based nutritional program, in low-socioeconomic status districts of Greece, during the current economic crisis. **Methods:** Around 162 schools with 25 349 students participated during the 2012–2013 school year. Each student received a daily healthy meal designed by nutrition specialists. Food insecurity levels, measured using the Food Security Survey Module were assessed at baseline and after a 1–8-month intervention period. Pre-post intervention responses were matched at an individual level. **Results:** Around 64.2% of children's households experienced food insecurity at baseline. This percentage decreased to 59.1% post-intervention, $P < 0.001$. On an individual level, food insecurity score diminished by 6.5%, $P < 0.001$. After adjustment for various socioeconomic factors, for each additional month of participation, the odds of reducing the food insecurity score increased by 6.3% (OR = 1.06, 95% CI: 1.02–1.11). Those experiencing food insecurity with hunger at baseline were more likely to improve food insecurity score than those who did not (OR = 3.51, 95% CI: 2.92–4.21). **Conclusion:** Children and families residing in low socioeconomic areas of Greece, experience high levels of food insecurity. Our findings suggest that participation in a school-based food aid program may reduce food insecurity for children and their families in a developed country in times of economic hardship.

Introduction

The financial crisis in Greece, which began in 2009, had adverse effects on the socioeconomic status (SES) of the Greek population and triggered humanitarian action to help those most in need. According to Eurostat, in 2012 about 3.8 million people in Greece (34.6% of the total population) were at risk of poverty or social exclusion, while unemployment reached 26% at the end of 2012. In the same year, approximately 686 000 children in Greece (35.4%) were at risk of poverty or social exclusion.¹

Children living in poverty are more prone to food insecurity, defined as little or uncertain availability or access to nutritionally adequate and safe food.^{2,3} Data from developed countries show that in 2011–2012, 8.3% of Canadian and 14.5% of US households were food insecure.^{4,5} In developing countries and among low-socioeconomic groups, food insecurity varies considerably and can reach up to 82%.^{3,6–10}

Food insecurity can lead to serious mental development and growth problems and influence school performance in children.^{1,11–13} It is also related to obesity, as the lack or inaccessibility of adequate nutrition leads to the consumption of low quality calorie-dense foods,^{3,11,14–18} with periodic access or lack of access to financial resources causing alternating episodes of fasting and binge eating.^{3,16,17} A number of factors recorded in the literature are associated with food insecurity; the most cited include limited financial resources for purchasing adequate and quality food,

unemployment, being member of single-parent families, belonging to an ethnic minority and having a low level of education.^{3,10,11} Note that although the above associations have been reported more studies are needed to prove causality.

Combating food insecurity is a high priority on the agenda of the Development Cooperation Forum of the United Nations and has been identified as the No. 1 Millennium Development Goal (MDG1).¹⁹ The prevention and treatment of child malnutrition and childhood obesity are strategic priorities both for the World Health Organization²⁰ and the Directorate General for Health and Consumers of the E.C.²¹ Policy measures adopted in both developed and developing countries often involve large-scale governmental or privately funded food aid programs that supplement children's nutritional intake at school;^{22,23} it is estimated that more than 386 million students worldwide are fed daily at school.²³

Evidence suggests that school feeding programs can successfully improve dietary energy intake and the micronutrient status of students,^{24,25} depending on the initial SES of the participants.^{26,27} Importantly, these programs have been associated with improvement of students' health status,^{24,28} mental and cognitive abilities and learning capacities,²⁸ as well as increases in school participation and reductions in school dropout rates.^{24,29}

Greek state schools do not provide meals for students in any income bracket. Instead, canteens selling snacks and beverages operate within most school premises.

A Food Aid and Promotion of Healthy Nutrition Program, under the name 'DIATROFI', was developed in response to concerns about food insecurity particularly for children as a result of the financial crisis.³⁰ The aim of the program was to provide free meals to children attending schools in underprivileged areas in Greece, while also promoting healthy nutrition. The program has been approved and run under the auspices of the Greek Ministry of Education and Religious Affairs.

We hypothesized that children and their families living in low SES districts experience food insecurity and that the food aid program would reduce its rates. This is the first program of this type and magnitude in Greece.

Methods

Study area and population

The 'DIATROFI' program, applied during the academic year 2012–2013, targeted students attending both elementary and secondary schools in areas of low SES.

Each student received a daily meal (different for each day) designed by nutrition specialists, based on the WHO food and nutrition policy guidelines for schools.³¹ Dietary guidelines from other scientific agencies and organizations (USDA, ADA, AAP) were also taken into consideration.^{32,33} The meal, wrapped in a flow pack, averaged 435 Kcal and contained a cereal product (wholemeal or arabic pita bread filled with cheese, vegetables and occasionally turkey, spinach pie, leek pie, sesame seed bagel or raisin bread) and a fresh fruit (peach, apple, tangerines (two) or banana). Three to four days a week, the meal was accompanied by a carton of white, low-fat milk or a cup of low-fat plain yogurt. Informational material (brochures, leaflets and games) promoting healthy nutrition was distributed to all students and parents, combined with presentations by health promotion specialists at the participating schools.

The Program targeted students attending both elementary and secondary state schools in areas of low SES throughout Greece. In specific, postal codes with average taxable income below pre-specified thresholds (different thresholds were set by wider geographical region, so as to cover approximately 25% of Greek state schools) were considered areas of low SES. After communicating the program to all schools in SES areas, we received a total of 394 applications.

The final selection was based on (i) relative regional taxable income, (ii) written reports by school principals providing estimates of the number of students facing food insecurity and special characteristics of schools (i.e. students from social institutions, Roma students, fainting episodes) and (iii) personal interviews with teachers, parents and other personnel, conducted by an expert in qualitative methodology, to weigh the level of food insecurity in the school. Based on this information, a total of 162 schools were ultimately selected.

All students of selected schools were offered the opportunity to participate, irrespective of their SES, so as to avoid stigmatization. Alternatively, parents could provide a signed statement that their child would not participate in the daily healthy meal; only 1.8% opted not to participate.

Instrument

Food insecurity levels were measured using the FSSM (Food Security Survey Module) questionnaire administered to parents.^{5,6} FSSM is based on the premise that food insecurity causes predictable reactions, which can be measured by a survey and then summarized through an index. It contains 18 questions covering characteristic incidents of food insecurity (stress caused by lack of food, inadequate quality and quantity of food consumed, weight loss, etc.). The sum of insecurity-affirming responses produces a

score ranging from 0 to 18, with higher numbers indicating higher food insecurity. The score is used to determine the level of food insecurity, as categorized on a four-point scale: 'food security' (score 0–2), 'food insecurity without the experience of hunger' (score 3–7), 'food insecurity with medium experience of hunger' (score 8–12) and 'food insecurity with serious experience of hunger' (score 13–18).

Parents received a questionnaire with written instructions and returned it to the school principal, both at (i) the start (pre-intervention) and (ii) the end (post-intervention) of the program. All questionnaires were completed anonymously, however, the respondents were asked to provide a personal ID number of their own choice that, along with the child's and parents' birth dates, was used to match pre- and post-intervention responses. Children would receive the daily meal irrespective of whether their parents completed the anonymous questionnaires or not.

Statistical analysis

Chi-square analysis was used to explore relations among food insecurity and participants' demographic characteristics. Wilcoxon signed-rank test was undertaken to compare food insecurity scores before and after the intervention. Receiver operating characteristic (ROC) curve was used to identify the effect of the duration of the program on the probability of reducing food insecurity scores and hunger rates. Logistic regression analysis was performed to control for the effect of possible confounding factors. SPSS 21 and STATA 12 statistical packages were used.

Role of the funding source

The funding source had no involvement in the study design; in the collection, analysis and interpretation of data; in the writing of the report; nor in the decision to submit the article for publication.

Results

Participants' characteristics

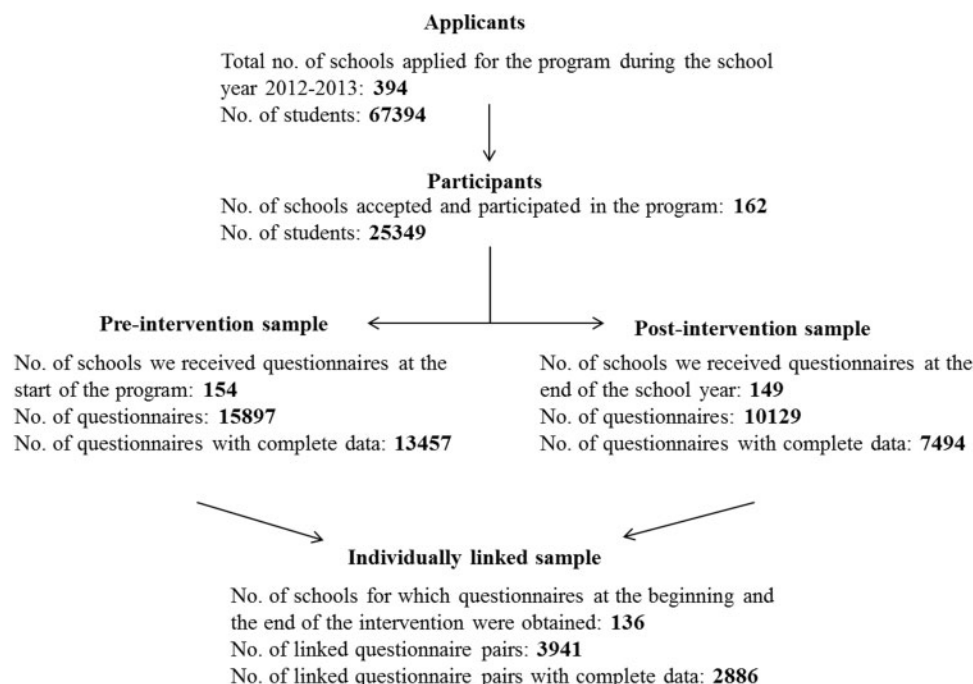
A total of 162 schools with 25 349 students participated in the program (figure 1). About 15 897 parents (response rate 62.71%) returned the questionnaires at the beginning and 10 129 (response rate 39.96%) at the end of the program. 3941 pre-post-intervention questionnaires were linked on an individual level.

Mean age of participating students was 10.4 years (std. deviation 3.18); 49.2% were girls. Most students were born in Greece (93.1%), whereas 64.6% of parents were born in Greece (table 1). 14% of parents had not completed middle school (compulsory education), while 27.4% had completed tertiary education. 26.7% of fathers and 26.1% of mothers were unemployed. Considering those active in the labour force, parents' unemployment rate was 32.5%. 46.3% of the children had at least one unemployed parent and 10.6% of children had both parents unemployed.

Most of the families had 2 children (53.4%) and 33.8% of the families had 3 or more children (the national average (National census 2001) was 9.6%). 11.4% of children lived with one parent and 1.2% lived in a household other than that of their parents.

Food insecurity at the start and the end of the intervention

In the pre-intervention period food insecurity was recorded among 64.2% of participants (figure 2a) and fell to 59.1% in the post-intervention period ($P < 0.001$). The percentage of food insecurity with hunger decreased from 26.9% to 23.1% ($P < 0.001$). The average food insecurity score (on a continuous scale) fell from 5.15 (\pm SE 0.040) to 4.59 (\pm SE 0.051), a statistically significant reduction of 10.87%, $P < 0.001$.

**Figure 1** Flow diagram of participants' enrolment**Table 1** Household and demographic characteristics and food insecurity with hunger at baseline

Ta	Total	Food insecurity with hunger			Total	Food insecurity with hunger	
	N (%)	N (% by category)	P values*		N (%)	N (% by category)	P values*
Region				Child's country of birth			
Attica	9941 (73.9)	2693 (27.1)	<0.001	Greece	12169 (93.1)	3160 (26.0)	<0.001
Thessaloniki	1887 (14.0)	415 (22.0)		Other	896 (6.9)	310 (34.6)	
Rest of Greece	1629 (12.1)	511 (31.4)		Child's gender			0.075
School type			<0.001	Male	6723 (50.8)	1839 (27.4)	
High	491 (3.6)	140 (28.5)		Female	6519 (49.2)	1694 (26.0)	
Middle	3722 (27.7)	1091 (29.3)		Type of household			<0.001
Elementary	8699 (64.6)	2253 (25.9)		Living with married parents	11066 (85.3)	2559 (23.1)	
Kindergarten	545 (4.0)	135 (24.8)		Living with unmarried parents	268 (2.1)	132 (49.3)	
No. of children in the household			<0.001	Living only with mother	1345 (10.4)	582 (43.3)	
1	1661 (12.6)	371 (22.3)		Living only with father	135 (1.0)	51 (37.8)	
2	7034 (53.4)	1539 (21.9)		Living with another family	158 (1.2)	69 (43.7)	
3	2872 (21.8)	873 (30.4)		Maternal country of birth			<0.001
4	1080 (8.2)	439 (40.6)		Greece	7572 (63.0)	1813 (23.9)	
≥5	533 (4.0)	267 (50.1)		Other	4456 (37.0)	1314 (29.5)	
Paternal country of birth			<0.001	Maternal education			<0.001
Greece	7923 (66.3)	1858 (23.5)		Not completed elementary	286 (2.3)	180 (62.9)	
Other	4033 (33.7)	1177 (29.2)		Elementary	1258 (10.0)	666 (52.9)	
Paternal education			<0.001	Middle school	2397 (19.0)	784 (32.7)	
Not completed elementary	201 (1.6)	147 (73.1)		High school	4913 (39.0)	1080 (22.0)	
Elementary	1740 (14.2)	796 (45.7)		Tertiary education	3745 (29.7)	602 (16.1)	
Middle school	2641 (21.5)	748 (28.3)		Maternal employment			<0.001
High school	4635 (37.7)	975 (21.0)		Full-time employment	2977 (24.4)	490 (16.5)	
Tertiary education	3067 (25.0)	492 (16.0)		Part-time employment	1215 (9.9)	340 (28.0)	
Paternal employment			<0.001	Self-employed	784 (6.4)	99 (12.6)	
Full-time employment	4562 (40.0)	818 (17.9)		Unemployed	3191 (26.1)	1221 (38.3)	
Part-time employment	1161 (10.2)	347 (29.9)		Retired	124 (1.0)	32 (25.8)	
Self-employed	2254 (19.8)	327 (14.5)		Housewife	3922 (32.1)	1001 (25.5)	
Unemployed	3039 (26.7)	1324 (43.6)					
Retired	347 (3.0)	95 (27.4)					
Housework	30 (0.3)	10 (33.3)					

*: Chi-square tests examining the relationship between food insecurity (with hunger vs. those reporting food security or food insecurity without hunger) and each characteristic.

In the individual level data (figure 2b) the percentage of families experiencing food insecurity decreased from 59.6 to 56.3% ($P = 0.011$), whereas the percentage of families experiencing food insecurity with hunger decreased from 22.3 to 19.9% ($P = 0.024$). The average food insecurity score fell from 4.50 (\pm SE 0.079) to

4.20 (\pm SE 0.078), a statistically significant reduction of 6.54%, $P < 0.001$.

About 52.5% of students experiencing food insecurity with serious hunger at baseline improved food insecurity category after the intervention (Supplementary table 1); 16.4% of them did not

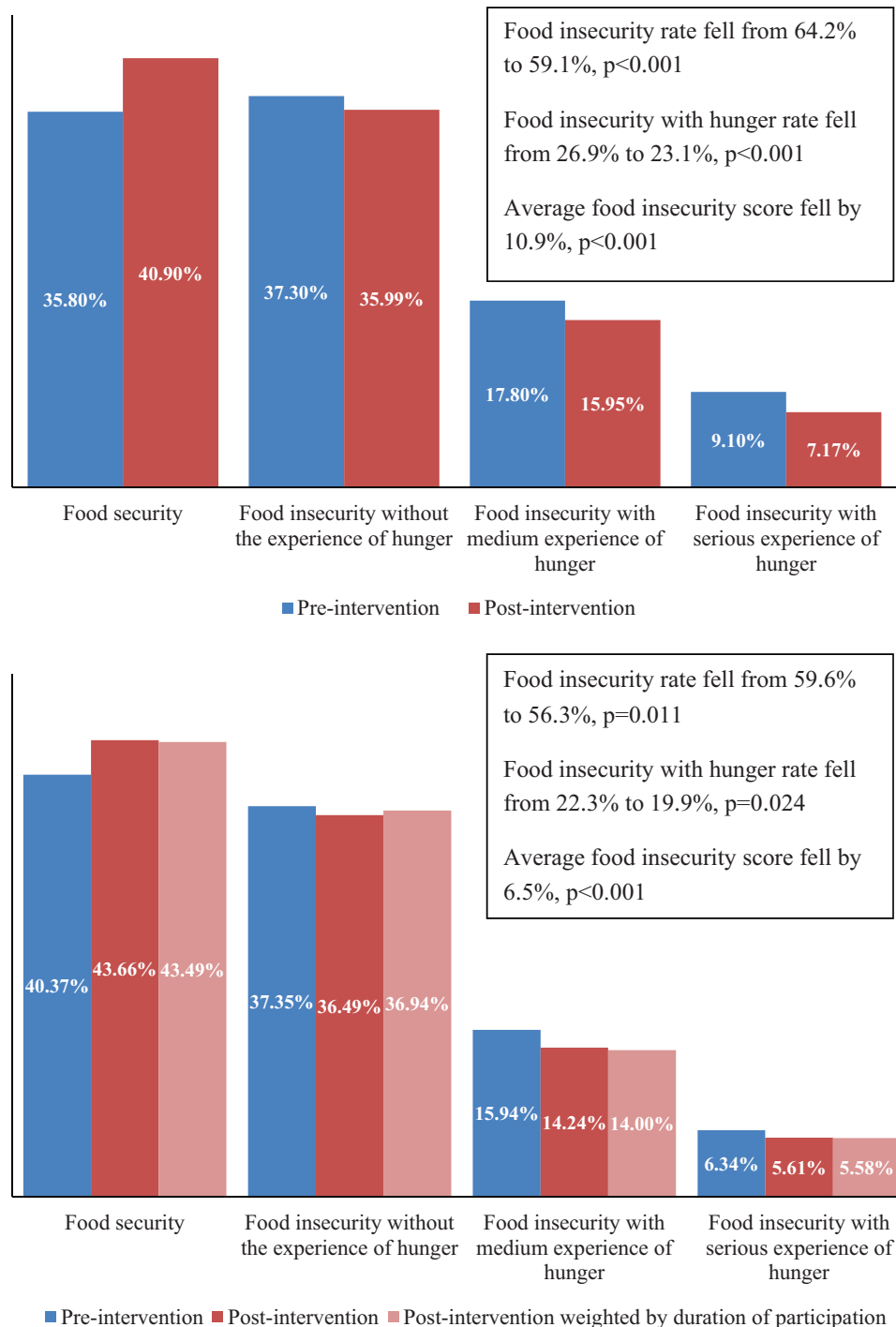


Figure 2 (a) Food insecurity level in the pre ($N = 13\,457$) and post-intervention ($N = 7494$) sample. (b) Food insecurity level in the individually linked sample ($N = 2886$)

experience hunger at the end of the school year and 8.7% were experiencing food security. About 39.8% of the students experiencing food insecurity with hunger (medium or serious), did not experience hunger or were food secure at the end of the school year.

The probability of decreasing the food insecurity score was higher for those who originally experienced more severe food insecurity. Students who faced food insecurity with hunger were 3.5 times as likely to have a reduced food insecurity score as those experiencing food security or food insecurity without hunger ($OR = 3.51$, 95% CI: 2.92–4.21). The average food insecurity score among those experiencing food insecurity with hunger at baseline (individually linked sample), was reduced by

21.4% ($P < 0.001$), from 11.06 ($\pm SE\ 0.113$) to 8.70 ($\pm SE\ 0.177$).

Food insecurity, household characteristics and duration of participation

Higher percentages of food insecurity with hunger (table 1) were observed in middle and high schools (29.3 and 28.5% respectively) compared with kindergarten (24.8%) and elementary schools (25.9%), $P < 0.001$. Food insecurity was found to increase with the number of siblings ($P < 0.001$) and was higher for children living in households without their parents/guardians (43.7%), when parents were not married (49.3%), or when children lived

Table 2 Odds ratios (95% CI) and *P* values of reducing the food insecurity score by duration of participation in the program, paternal employment status, maternal country of birth, region, type of household, number of children in the family and paternal educational level

Variable	Category	OR (95% CI)	<i>P</i> values
Duration of participation in the program (months)		1.063 (1.016–1.112)	0.008
Paternal employment Reference level: Never unemployed	Unemployed at the pre- and post-intervention period	0.890 (0.686–1.154)	0.379
	Unemployed at the pre- but not in the post-intervention period	1.759 (1.179–2.623)	0.006
	Unemployed at the post- but not in the pre-intervention period	1.017 (0.663–1.560)	0.938
Maternal country of birth Ref. level: Greece	Other than Greece	1.234 (1.009–1.509)	0.040
Region Ref. level: Attica	Thessaloniki	0.693 (0.538–0.892)	0.004
	Rest of Greece	0.760 (0.572–1.010)	0.058
Type of household Ref. level: Living with either or both of its parents	Living with another family without its parents	2.584 (1.083–6.168)	0.032
Number of children in the family ^a Ref. level: <4	≥4	1.520 (1.108–2.084)	0.009
Paternal education ^b		0.889 (0.808–0.979)	0.016

No. of observations (excluding missing values for all explanatory variables) 2080; percentage correctly classified 61.3%. Statistically significant variables were identified using forward-stepwise (Wald) model selection. Explanatory variables considered: duration of participation in the program (months); region; child's gender, age and country of birth; no. of children in the household and type of household; paternal and maternal education, employment and country of birth. Bold: statistical significant at 5% level.

a: Number of children in the family taken as continuous variable was not statistically significant, so different thresholds were tested.

b: Paternal education is taken as a continuous variable, higher values signalling higher educational level (taken as a categorical variable specific subcategories were not statistically significant).

Table 3 Odds ratios (95% CI) and *P* values of not experiencing food insecurity with hunger post-intervention by duration of participation in the program, paternal employment status and paternal country of birth, among those experiencing food insecurity with hunger at baseline

Variable	Category	OR (95% CI)	<i>P</i> values
Duration of participation in the program (months)		1.130 (1.020–1.253)	0.019
Paternal employment Reference level: Never unemployed	Unemployed at the pre- and post-intervention period	0.518 (0.327–0.822)	0.005
	Unemployed at the pre- but not in the post-intervention period	1.649 (0.644–4.225)	0.297
	Unemployed at the post- but not in the pre-intervention period	0.825 (0.351–1.938)	0.659
Paternal country of birth Ref. level: Greece	Other than Greece	1.811 (1.155–2.839)	0.010

No. of observations (excluding missing values for all explanatory variables) 436; percentage correctly classified 64.4%. Statistically significant variables in logistic regression models were identified using forward-stepwise (Wald) model selection. Explanatory variables considered: Duration of participation in the program (months); region; child's gender, age and country of birth; no. of children in the household and type of household; paternal and maternal education, employment and country of birth. Bold: statistical significant at 5% level.

only with their mother (43.3%). Food insecurity was higher in households where either the father or mother had not completed compulsory education ($P < 0.001$), or where either parent was unemployed ($P < 0.001$).

Mean duration of participation was 5.6 months (std. deviation 2.1; median 7; range 1–8 months). The ROC curve for the probability of decreasing food insecurity score according to the duration of participation in the program had two local maxima, at 3 months and one at 7 months of participation, implying that at these points the relative probability of decreasing food insecurity score is maximized (area under the curve 0.53; $P = 0.010$). Similarly, the critical points, where the probability of stopping facing hunger problems is maximized, were at 3 and 7 months of participation (area under the curve 0.57; $P = 0.004$).

When household and demographic characteristics were taken into account in the logistic regression analysis, for each additional month of participation in the program, the likelihood of reducing the score increased by 6.3% (OR = 1.06, 95%CI: 1.02–1.11) (table 2). Greater odds of reducing the food insecurity score had families with four

children or more (OR = 1.52, 95%CI: 1.11–2.08) and children who were living without their parents (OR = 2.58, 95%CI: 1.08–6.17). Parental employment, education and country of birth were also significant confounders. In our analyses in the group of food insecurity with hunger at baseline (table 3), for each additional month of participation in the program, the odds of not reporting hunger problems increased by 13% (OR = 1.13, 95%CI: 1.02–1.25).

Discussion

This is to our knowledge the first study examining the effects of a school food aid program on food insecurity among socioeconomically disadvantaged populations in a developed country. Food insecurity was found in up to 64.2% of households at the start of the program. This figure indicates that families in socioeconomically disadvantaged areas of Greece, participating in the program, experienced levels of food insecurity that are closer to developing countries' averages.^{5,6}

The DIATROFI program is the first school feeding program of this magnitude in Greece, incorporating food aid, health promotion and research. The program has been welcomed by the school community across the country and currently more than 2050 schools (16% of the total number of Greek schools) with 258 000 students have applied for the 2015–2016 school year, although the available financial resources allow less than 10% of them to participate.

The program had a positive impact on students' food security, with a greater effect observed among students who were in poor baseline status and participated for a longer period. Our findings confirm previous studies that indicated unemployment, parental educational level and family type as significant predictors of food insecurity.^{3,10,11} Both the baseline level of food insecurity and the associated reduction rate was higher among children living without their parents, families with unemployed parents, large families and families with low parental educational level. This suggests that there is room for targeted interventions for these subpopulations.

Higher percentages of food insecurity with hunger were observed in middle and high schools compared with kindergarten and elementary schools. This finding is in accordance with data in the US population, where lower food insecurity among younger children was identified; food insecurity was almost twice as prevalent in households with teenage children as in households in which the oldest child was no older than age 4.³⁴ Given the limited financial resources of families under food insecurity, one must also take into account that the energy requirements of adolescents are significantly higher than that of children.³⁵

Our findings should be interpreted within the context of certain limitations. First, the food insecurity levels in our study do not reflect the situation in the whole country, since schools were selected on the basis of low regional economic indicators. Even so, findings are indicative of the serious financial problems families in these areas face. Another limitation is that many migrants and Roma families have low literacy skills and language difficulties, making it difficult to fill in the questionnaires correctly. However, this bias would be present in both the pre-intervention and post-intervention responses and is therefore unlikely to affect our estimates of changes in food insecurity levels. It could, nonetheless, lead to an underestimation of the food insecurity level in both periods, since the participation rate of this migrant subpopulation and potentially other less well educated groups was likely lower.

Although the parents of all 25 349 students in the 162 schools received questionnaires both in the pre- and post- intervention periods, the response rate in the end of the school year was lower. The questionnaires were linked on an individual level to avoid any related bias.

An additional limitation was that no comparison group was followed in order to examine whether the drop in the food insecurity levels was related to other factors besides the food aid program and the socioeconomic and demographic characteristics of each family. However, according to the official income and unemployment data, the economic recession worsened during that period, thus one would expect a rise in the food insecurity levels rather than a drop.

The present analysis focused on food insecurity reduction which is a major issue in austerity settings. Our results have produced quantifiable data on the presence of food insecurity among Greek schoolchildren and have given evidence on the successful impact of a structured intervention. Moreover, there are various positive effects of school nutrition programs recorded in the literature, including weight reduction for obese children and strengthening of healthy eating habits;^{36–38} improved physical, psychosocial and mental health;^{24,28} reduction in school dropout, absence rates and improved academic performance.^{24,29,39,40} These multiple benefits are currently under evaluation in the framework of the DIATROFI Program and are to be presented in future studies.

Conclusions

Food insecurity was prevalent among children and families residing in low socioeconomic areas of Greece. Our findings suggest the feasibility of a nationwide school-based program on food aid and promotion of healthy nutrition and that participation may reduce food insecurity for children and their families in a developed country in times of economic hardship.

Supplementary data

Supplementary data are available at *EURPUB* online.

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Key points

- We implemented a large scale school-based nutritional program in low SES districts of Greece during the current economic crisis.
- The 64.2% of children's households experienced food insecurity and 26.9% experienced hunger at baseline.
- Food insecurity dropped statistically significantly, by 6.5% as measured in the individually linked data, during the intervention.
- For each additional month of participation in the program, the odds of reducing food insecurity increased by 6.3%; significant reduction in food insecurity levels was observed after at least 3 months of participation.

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