



## Trabajo Original

Epidemiología y dietética

### Food neophobia, Mediterranean diet adherence and acceptance of healthy foods prepared in gastronomic workshops by Spanish students *Neofobia alimentaria, adhesión de la dieta mediterránea y aceptación de alimentos saludables preparados en talleres gastronómicos por estudiantes españoles*

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#### Abstract

**Introduction:** food neophobia can affect dietary variety and hedonic acceptance due to rejection of healthy foods.

**Objective:** to evaluate the impact of dietary neophobia on adherence to the Mediterranean diet and on the hedonic acceptance of healthy foods made in gastronomic workshops by schoolchildren.

**Methodology:** descriptive cross-sectional study of Primary (8-11) and Secondary (12-18) schoolchildren from Murcia, Spain, participating in gastronomic workshops, where two recipes were prepared and tasted (vegetables + blue fish and fruits). Food neophobia (FN) and adherence to the Mediterranean diet (KIDMED) were identified and each participant assessed the acceptance of each recipe using a hedonic scale (seven points).

**Results:** a total of 1,491 students (49.5% girls) participated in the study; 13.5% were neophobic and 61.1% presented optimal diet quality. A linear inverse relationship between the degree of neophobia and the quality of the diet ( $\rho$  [rho] = -0.31,  $p$  = 0.001) was found. High adherence to the Mediterranean diet was associated with lower neophobia and better hedonic scores, compared to intermediate or low adhesions ( $p$  < 0.0001). Neophobic schoolchildren presented significantly worse results in vegetable consumption, especially at the Secondary level, and in the acceptance of healthy preparations ( $p$  < 0.05). A good acceptance of the prepared preparations was associated with the usual adequate consumption of fruits, vegetables, fish and legumes.

**Conclusion:** food neophobia affects the adherence to the Mediterranean diet and the acceptance of healthy foods elaborated in gastronomic workshops by Spanish schoolchildren.

#### Key words:

Food neophobia.  
Hedonic acceptance.  
Mediterranean diet.  
Gastronomic workshops.

#### Resumen

**Introducción:** la neofobia alimentaria puede afectar la variedad dietética y la aceptación hedónica debido al rechazo de alimentos saludables.

**Objetivo:** evaluar el impacto de la neofobia alimentaria en la adherencia a la dieta mediterránea y en la aceptación hedónica de alimentos saludables realizados en talleres gastronómicos por escolares.

**Metodología:** estudio descriptivo transversal de escolares de Primaria (8-11) y Secundaria (12-18) de Murcia, España, que participaron en talleres gastronómicos donde se prepararon y probaron dos recetas (verduras + pescado azul y frutas). Se identificaron la neofobia alimentaria (FN) y la adhesión a la dieta mediterránea (KIDMED) y cada participante evaluó la aceptación de cada receta utilizando una escala hedónica (siete puntos).

**Resultados:** participaron 1.491 alumnos (49,5% niñas); el 13,5% eran neofóbicos y el 61,1% presentaban una calidad óptima de la dieta. Se encontró una relación lineal inversa entre el grado de neofobia y la calidad de la dieta ( $\rho$  [rho] = -0,31,  $p$  = 0,001). La alta adherencia a la dieta mediterránea se asoció con menor neofobia y mejores puntuaciones hedónicas en comparación con adherencias intermedias o bajas ( $p$  < 0,0001). Los escolares neofóbicos presentaron resultados significativamente peores en el consumo de vegetales, especialmente en el nivel secundario y en la aceptación de preparaciones saludables ( $p$  < 0,05). Una buena aceptación de las recetas elaboradas se asoció con el habitual consumo de frutas, verduras, pescado y legumbres.

**Conclusión:** la neofobia alimentaria afecta la adherencia a la dieta mediterránea y la aceptación de alimentos saludables elaborados en talleres gastronómicos por escolares españoles.

#### Palabras clave:

Neofobia alimentaria.  
Aceptación hedónica.  
Dieta mediterránea.  
Talleres gastronómicos.

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## INTRODUCTION

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Exposure to high food diversity in the early years modulates food preferences and improves dietary variety. Children identified with dietary neophobia have a poorly varied diet because they present an important rejection to many foods (1,2). This situation is more common at younger ages and is maintained over the years (3). Some variables associated with the consumption of vegetables (most rejected foods) in young children are: early feeding practices, parental education, and family income (4), low vegetable consumption by parents (5) and home availability (6). Likewise, breastfeeding and the early introduction of fruits and vegetables are related to their consumption (7).

Food neophobia negatively correlates with fruit acceptance and, to a greater extent, with vegetables (8). Vegetables are the least accepted food group by children, and this is probably the reason for their low consumption. It has been identified that the number and type of preparations that the child consumes depend on the type of vegetable, and the best accepted dishes are those that combine them with other foods. Likewise, consumption is greater as the variety of methods of culinary preparation increases (9). Equally, the acceptance of fish by children depends to a great extent on the method of culinary preparation (10). Recently, it has been reported that food manipulation by children through tactile contact may be related to the acceptance of a greater variety of fruits and vegetables, although not with an increase in their consumption (11). In addition, it has been proposed that the participation of children in the kitchen can reduce food neophobia and promote the consumption of foods such as vegetables (12).

Due to the above, it is important to know the impact of food neophobia on the hedonic acceptance of healthy foods, the variety of diet and eating habits in school children, as well as the lack of information about its effects on different aspects associated with the consumption of food, such as participation in the elaboration itself. The objective of the present work was to evaluate the impact of dietary neophobia on adherence to the Mediterranean diet and acceptance of healthy preparations made by students in gastronomic workshops.

## METHODS

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### PARTICIPANTS

A cross-sectional descriptive study was carried out in schoolchildren from Murcia (Spain) aged 8-18 years. The study was carried out in the framework of sensorial gastronomy workshops, where two recipes were cooked and tasted; the main ingredients of these recipes were healthy components of the Mediterranean diet (recipe 1 = with vegetables and blue fish; recipe 2 = with fruits). The City Council of the city of Murcia carries out a program to promote the Mediterranean diet for schoolchildren that takes place in the "Raimundo González" gastronomic classroom located in a local market.

The study comprised eleven schools that voluntarily requested to participate in the project between 2013 and 2015. The total sample was stratified by gender and school level: 8-11 years (Primary level) and 12-18 years (Secondary level). All schoolchildren surveyed participated voluntarily with a written authorization from parents or guardians and with the consent of each school's management.

## INSTRUMENTS AND DATA COLLECTION

The recipes were designed by the manager of the community nutrition service and adapted by a professional chef. The questionnaires were sent to the school prior to the workshop in the gastronomic classroom and were self-answered by each participant.

Each workshop consisted in a visit to the gastronomic classroom located in a local market, where the students chose the ingredients. It should be mentioned that the cost of food was covered by tenants of the local market, due to their commitment to the city council. Recipe 1 was a "healthy" pizza with various vegetables and fresh blue fish (anchovies). Recipe 2 consisted of seasonal fruits presented as a dessert and in a colorful way for students. Fruit and vegetables were chosen by children according to availability and seasonality. During the workshop, while the students were preparing and cooking the food, a nutritionist described how these foods are part of the Mediterranean pyramid and how to introduce them into your usual diet. All children participated voluntarily in the tasks related to the purchase, cutting, mixing and cooking of ingredients. Finally, after the preparation, all the children performed the tasting and hedonic evaluation of the prepared foods.

## FOOD NEOPHOBIA

Participants responded to a survey assessing the presence of food neophobia (13), which is recognized and consolidated in the scientific literature as a highly reliable instrument for assessing individuals' attitudes towards novel foods (14). The survey consisted of ten questions, rated with a Likert scale of seven points (range 0-70). The presence of neophobia was defined as  $> 1$  standard deviation of the mean, as reported in the literature (13). Before carrying out the statistical analysis, some questions of the scale were inverted in order to be able to obtain valuations in the same sense. According to another reference population, this questionnaire has shown sufficient internal validity for its application in Spanish children (15).

## MEDITERRANEAN DIET

The participants answered a questionnaire on adherence to the Mediterranean diet (KIDMED) consisting of 16 items (range 0-12) and validated for the Spanish population in the ENKID

study (16). In this survey, 12 aspects of the Mediterranean diet were positively rated, as the consumption of fruit and vegetables, fish, olive oil, cereal and dairy consumption at breakfast, etc., with four negative points (remaining): the consumption of fast food, sweets and candies, pastries and the omission of breakfast. Three points or less was considered as a low adherence; 4-7 points, medium adherence; and  $\geq 8$  points, good adherence. For comparative purposes, diet quality was defined as good adherence to those with scores  $\geq 8$  and improved adherence with seven points or less (16).

## HEDONIC EVALUATION

The acceptance of the preparations elaborated with healthy foods typical of the Mediterranean diet was carried out with the support of a hedonic scale of seven points that consisted of images of different facial expressions that represented the following: 1 = super bad, 2 = very bad, 3 = bad, 4 = not good, not bad, 5 = good, 6 = very good, and 7 = super good (15), which was previously used by our working group in school cafeteria users (17). For comparative purposes, scores of 5 to 7 were scored as good acceptance and bad ratings of 1 to 4.

## STATISTICAL ANALYSIS

The normal distribution of quantitative variables was verified by the Kolmogorov-Smirnov test and internal consistency analysis of the neophobia scale (Cronbach's alpha) was performed. The associations between food neophobia, adherence to the Mediterranean diet and hedonic food assessment were determined using the non-parametric Pearson  $\chi^2$  test. Since the data from the hedonic appreciation were not normal, Mann-Whitney U-analysis was used to establish differences between the groups. A stepwise multivariate logistic regression analysis was also performed to establish the independent predictors of acceptance of each preparation, previously selecting the variables with a value of  $p \leq 0.2$  in the univariate analysis. All analyses were performed with the statistical package SPSS version 23.0, considering the probability of 95% confidence.

## RESULTS

There were 1,491 students: 478 (32%) in 2013, 592 (40%) in 2014 and 421 (28%) in 2015. The participation of public schools was 84% and of private centers, 16%. The participants were divided into two groups: 1,057 primary schoolchildren between eight and eleven years old (71.6%) and 424 secondary schoolchildren between 12 and 18 years old (28.4%). Of the total number of participants, 49.5% were girls and 50.5% were boys; 4.7% were immigrants and, of all of them, only 22% used the school cafeteria on a regular basis.

## FOOD NEOPHOBIA

The mean score of the food neophobia scale was  $33.5 \pm 11.8$  ( $33.1 \pm 11.8$  for primary and  $32.93 \pm 11.8$  for secondary), with no significant difference between the groups. No difference was found as well between genders ( $34.0 \pm 12.3$  in females and  $32.1 \pm 11.3$  in males). The results indicated that 13.5% of the participants presented food neophobia. The scale had an internal consistency (Cronbach's alpha) of 0.76, indicating that neophobia was reliably quantified (15). An analysis was made of age and the presence of neophobia, noting that at the primary level, the presence of neophobia did not seem to influence dietary habits, although there was a trend towards lower consumption of fruits, vegetables, fish and greater omission of breakfast. However, the secondary level, with food neophobia, did present statistical differences with a lower consumption of vegetables and breakfast cereals or derivatives, as well as greater consumption of candy and sweets ( $p < 0.05$ ). There was also a trend towards lower fish consumption, although this difference was not significant (Table I). In addition, an inverse linear relationship was found between the degree of neophobia and the quality of the diet ( $\rho$  [rho] =  $-0.31$ ;  $p = 0.001$ ).

## MEDITERRANEAN DIET

The mean score on the KIDMED scale was significantly lower in Secondary school students than in Primary school ( $6.9 \pm 2.4$  vs  $8.4 \pm 2.3$ ;  $p < 0.01$ ). It was also identified that the good adherence to the Mediterranean diet was lower in the Secondary group than in the Primary group (44.2% vs 68%, respectively,  $p < 0.01$ ). The poor adherence category was 7.3% in the Secondary group and 4% in the Primary group, with no statistical differences.

An analysis by age and gender was carried out (Table II), showing that in the Primary level, boys consumed more dairy (milk, yogurt) and industrial bakery than girls ( $p < 0.05$ ). On the other hand, in Secondary school, boys were observed to consume less vegetables once a day ( $p < 0.05$ ) and for the second occasion in the day ( $p < 0.01$ ). On the other hand, girls consumed fewer pastas or rice and nuts ( $p < 0.5$ ), and consumed less cereals and derivatives ( $p < 0.01$ ) than boys. In addition, girls skipped more breakfast and consumed more candy and sweets than boys ( $p < 0.05$ ). Although no significant difference was observed, a lower consumption of fish at the Secondary level was found.

## SENSORY EVALUATION

In all ages, fruit preparations (recipe 2) were better valued than those containing vegetables and fish (recipe 1) ( $6.1 \pm$  vs  $5.4 \pm$ ,  $p < 0.01$ ) (Table III). In the Primary group, the students evaluated positively both preparations, with no statistically significant differences between them. The presence of neophobic in Primary school did not affect acceptance since both recipes had high

**Table I. Differences in adherence to the Mediterranean diet by educational level and presence of food neophobia**

KIDMED - Mediterranean Diet Quality Index	Primary level (8-11 y) n = 1,057			Secondary level (12-18 y) n = 424		
	Without neophobia (%)	With neophobia (%)	Total (%)	Without neophobia (%)	With neophobia (%)	Total (%)
Takes a fruit or fruit juice every day	85.6	78.8	84.7	82.6	76	81.8
Has a second fruit every day	65	60.6	64.4	34.7	24	33.3
Has fresh or cooked vegetables regularly once a day	77.9	66.7	76.3	72	48	68.9*
Has fresh or cooked vegetables more than once a day	44.2	46.9	44.5	36.5	12	33.3*
Consumes fish regularly (at least 2-3 times per week)	77.1	71.9	76.4	60.7	48	59.1
Goes more than once a week to a fast-food (hamburger) restaurant	21.5	18.8	21.1	22.8	24	22.9
Likes pulses and eats them more than once a week	77.4	83.3	78.2	71.9	60	70.3
Consumes pasta or rice almost every day (5 or more times per week)	76.1	78.8	76.5	69.6	68	69.4
Has cereals or grains (bread, etc.) for breakfast	87.1	84.8	86.8	70.1	48	67.2*
Consumes nuts regularly (at least 2-3 times per week)	67.8	63.6	67.2	51.8	56	52.4
Uses olive oil at home	95	100	95.7	98.2	95.8	97.9
Skips breakfast	15.6	24.2	16.8	20.4	33.3	22
Has a dairy product for breakfast (yogurt, milk, etc.)	93	87.5	92.2	83.9	80	83.4
Has commercially baked goods or pastries for breakfast	16.2	9.1	15.2	14.5	20	15.2
Takes two yogurts and/or some cheese (40 g) daily	66.8	51.6	64.8	48.8	48	48.7
Takes sweets and candy several times every day	22.3	9.1	20.4	20.6	52	24.7†

$\chi^2$ , \* $p < 0.05$ ; † $p < 0.01$ .

values. However, although this difference was not statistically significant, the preparation with vegetables and fish had an average hedonic acceptance of  $5.2 \pm 1.9$  in neophobic compared to  $5.5 \pm 1.7$  in non-neophobic ( $p > 0.05$ ). In the case of the Secondary group, the neophobics evaluated the recipe with vegetables and fish significantly ( $3.80 \pm 1.6$  vs  $5.1 \pm 1.2$ ;  $p < 0.01$ ), although they positively evaluated the recipe with fruits.

Additionally, the relationship between the adherence to the Mediterranean diet and the hedonic valuations given to the elaborations prepared in the gastronomic classroom was explored. It was found that those with a good adherence gave better hedonic scores, in contrast to intermediate or lower adhesions in both

age groups, especially of the preparation with vegetables and fish (Table IV).

According to multivariate stepwise logistic regression analysis (Table V), it was found that in the Primary group, independent predictors of acceptance of the recipe with vegetables and fish were consumption of fresh or cooked vegetables more than once a day (OR = 1.5, 95% CI 1.1-2.1), fish consumption at least two or three times per week (OR = 1.5, 95% CI 1.1-2.1) and vegetable consumption once a week (OR = 1.7, CI 95% 1.2-2.5). In the fruit recipe, they consumed a second fruit or fruit juice every day (OR = 2.0, 95% CI 1.2-3.4), fresh vegetables or cooked once a day (OR = 2.1, 95% CI 1.2-3.6), fish at least two or three times per

**Table II.** Differences in adherence to the Mediterranean diet by educational level and sex

KIDMED - Mediterranean Diet Quality Index	Primary level (8-11 y) n = 1,057			Secondary level (12-18 y) n = 424		
	Girls (%)	Boys (%)	Total (%)	Girls (%)	Boys (%)	Total (%)
Takes a fruit or fruit juice every day	87.7	89.2	88.5	85.2	76.6	81
Has a second fruit every day	65.7	67.9	66.8	38.5	31.9	35.3
Has fresh or cooked vegetables regularly once a day	75.4	70.6	72.9	76	62.8	69.5*
Has fresh or cooked vegetables more than once a day	51.7	51	51.3	38	23.4	30.8 <sup>†</sup>
Consumes fish regularly (at least 2-3 times per week)	74.1	74.3	74.2	62	62.8	62.4
Goes more than once a week to a fast-food (hamburger) restaurant	19.6	20.9	20.3	27.5	20.7	24.1
Likes pulses and eats them more than once a week	78.7	73.6	76.1	77.2	68.8	73
Consumes pasta or rice almost every day (5 or more times per week)	73.9	77.5	75.7	63.3	75.9	69.5*
Has cereals or grains (bread, etc.) for breakfast	86.9	88.9	87.9	57.7	77.2	67.3 <sup>†</sup>
Consumes nuts regularly (at least 2-3 times per week)	66.9	69.4	68.2	45.6	60.4	52.9*
Uses olive oil at home	95.9	92.6	94.3*	98	98.6	98.3
Skips breakfast	14.9	11.6	13.2	27.9	16	22.0*
Has a dairy product for breakfast (yogurt, milk, etc.)	88.4	92.8	90.6*	82.7	89.7	86.1
Has commercially baked goods or pastries for breakfast	11.9	18.5	15.2*	10.5	17.2	13.9
Takes two yogurts and/or some cheese (40 g) daily	69.6	67.3	68.4	45.3	53.5	49.3
Takes sweets and candy several times every day	19.1	22.1	20.6	31.1	19.6	25.4*

$\chi^2$ , \* $p < 0.05$ ; <sup>†</sup> $p < 0.01$ .

**Table III.** Impact of food neophobia (FN) on the hedonic assessment of prepared foods by educational level

	Primary level n = 1,057			Secondary level n = 424		
	Without FN (Mean ± DE)	With FN (Mean ± DE)	p	Without FN (Mean ± DE)	With FN (Mean ± DE)	p
Recipe 1	5.6 ± 1.7	5.3 ± 1.9	0.377	5.2 ± 1.3	3.8 ± 1.7	0.000
Recipe 2	6.4 ± 1	6.3 ± 1.3	0.555	5.8 ± 1.2	5.2 ± 1.9	0.096

Mann-Whitney U-analysis was used to establish differences between the groups (with or without FN).

**Table IV.** Impact of adherence to the Mediterranean diet (MD) on the hedonic assessment of prepared foods by educational level

	Primary level n = 1,057			Secondary level n = 424		
	Low or medium adherence (Mean ± DE)	High adherence (Mean ± DE)	p	Low or medium adherence (Mean ± DE)	High adherence (Mean ± DE)	p
Recipe 1	5.4 ± 1.9	5.7 ± 1.6	0.002	4.9 ± 1.5	5.3 ± 1.3	0.035
Recipe 2	6.2 ± 1.2	6.4 ± 1.0	0.006	5.5 ± 1.4	5.9 ± 1.3	0.026

Mann-Whitney U-analysis was used to establish differences between the groups (low/medium and high adherence to Mediterranean diet).

**Table V.** Independent predictors associated with the hedonic valuation of foods prepared by educational level

Predictors	Recipe 1 OR (CI 95%)	Recipe 2 OR (CI 95%)
<i>Primary level</i>		
Has a second fruit every day		2.0 (1.2-3.4)
Has fresh or cooked vegetables regularly once a day		2.1 (1.2-3.6)
Has fresh or cooked vegetables more than once a day	1.5 (1.1-2.1)	
Consumes fish regularly (at least 2-3 times per week)	1.5 (1.1-2.1)	1.8 (1.0-3.0)
Likes pulses and eats them more than once a week	1.7 (1.2-2.5)	2.0 (1.2-3.4)
<i>Secondary level</i>		
Food neophobia	0.2 (0.1-0.5)	
Takes a fruit or fruit juice every day		7.0 (2.2-22.1)

*Multivariate logistic regression analysis by steps.*

week (OR = 1.8, 95% CI 1.0-3.0) and legumes once a week (OR = 2.0, 95% CI 1.6-3.4). On the other hand, in the Secondary group, the only independent predictor for the recipe with vegetables and fish was to be classified as neophobic (OR = 0.2, 95% CI 0.1-0.5) and for the recipe with fruits, consumption of a fruit or fruit juice every day (OR = 7.0, 95% CI 2.2-22.1).

## DISCUSSION

The present study shows that dietary neophobia affects dietary variety by adversely affecting adherence to the Mediterranean diet, and both conditions impact on the hedonic perception of healthy foods.

In our study, the prevalence of food neophobia in children and young people aged 8-11 years reached 13.5% of the participants, with an average score of  $33.5 \pm 11.8$ , in line with research in Spanish children from the same geographical area showing measurements of  $37.9 \pm 13.1$  and 16.1% prevalence (15), and in German teenagers with a median of  $31 \pm 21$  (18). However, in a study in northern Spain (12) smaller averages are reported, of approximately 21 points in nine year-old children, probably because participation in our program does not present a participation bias, since the intervention is performed in complete classrooms, regardless of the parents' concern or motivation for a healthy diet of their children.

No differences were found in the degree of neophobia according to gender and age, although large studies in Finland and the United States between 2001 and 2010 describe greater neophobia in the upper strata of age and hold controversy over gender effects (19). Our study does not show a decrease in neophobia with age, probably due to the fact that the youngest participants were eight years old and would have exceeded the age at which the peak of neophobia occurs, maintaining stability between 8-18 years, consistent with that described in Spanish children (20). The discrepancies described in the literature on the relationship

between gender and food neophobia suggest that more research is needed.

Currently, one of the biggest problems in child nutrition is the low consumption of food considered as an important part of the Mediterranean diet such as fruits, vegetables and fish. It is well known that Spanish children and young adults have a very variable adherence to the pattern of Mediterranean diet, depending on the age and area of the country (1). The KIDMED test is widely used to assess adherence to the Mediterranean diet pattern in children and young adults, and is effective in evaluating the quality and variety of the diet at these ages. In a recent systematic review, there is a clear tendency to abandon this pattern, with only a mean adequate adherence of 10% (1). The average prevalence of adequate adherence to this model in our participants reaches 68% and 44.2% in younger students and 12 years or more respectively, placing us in the upper stratum of prevalence of the reviewed studies. Specifically, a study in adolescents in a geographical area near Murcia found a 30.9% adequate adherence to the Mediterranean diet (21). In the present work, it is described that the adherence to the Mediterranean diet has an inverse relation with age, since the students of the Secondary group have lower scores than those of the Primary level, as reported in a group of ten to 16 (22) and in similar populations (15,21). The diet of the older students presents worse profile than that of the younger ones in 14 of the 16 items that compose the test. Boys consume less vegetables, skip breakfast, and consume more pasta and rice and nuts than girls.

According to our results, the presence of neophobia is negatively correlated with adherence to the Mediterranean diet, so that neophobia decreases the quality of the diet, in line with the results of another study in Spanish children and youngsters (20). In the Secondary group, its effect on the consumption of fruits, vegetables, fish, sweets and candies was identified, as in our study. In addition, our results also showed an effect of cereal consumption at breakfast, which indicates that the diet of older students may be inadequate from the beginning of the day, in congruence with

findings in the Spanish population, where only 18% of young people make an adequate breakfast (22). At the Primary level, our results show a tendency to decrease the consumption of fruits, vegetables, fish and greater omission of breakfast, but without significant differences, unlike the study by Maiz E et al. (20).

The hedonic evaluation of the foods prepared by the students in the gastronomic workshops indicated an effect of the age, since those of the Primary level group positively evaluated both preparations; however, those of the Secondary level group negatively evaluated the preparation, which included vegetables and blue fish, although the valuation of the fruits was positive. Negative assessment of vegetables may be associated with poor participation of adolescents in the preparation of family meals and low self-efficacy for the preparation of these healthy foods, a relationship that has been previously reported (23). In addition, regression analysis indicated that food neophobia was a negative predictor of the hedonic assessment of the recipe with vegetables and fish in the older group.

Little has been explored the influence of the presence of neophobia in the acceptance of foods prepared by the students themselves in an environment outside the home, but according to a recent experimental research, when children participate in the elaboration of healthy foods with fruits and vegetables, they show a higher preference for these processed foods themselves, increase their willingness to try new foods and choose foods that contain vegetables (12). It has also been pointed out that children's participation in household food preparation may favor increased vegetable intake (24) and a better quality of diet for young adults identified as a valuable educational tool in these age groups (25). Likewise, it has been recommended that simple food preparation activities can lead to improved eating habits (26).

Another important finding was that those who had a better adherence to the Mediterranean diet gave higher hedonic assessments, especially to the preparation with vegetables and blue fish in both age groups, so it is clear that familiarity (intake in his habitual diet) with these foods, increased their acceptance (7).

Most recent studies analyze hedonic acceptance by subjecting different recipes to visual or tasting tests primarily in school canteens. There are few studies that have analyzed complex interactions between neophobia, diet quality and hedonic acceptance of key foods in the Mediterranean diet in a participatory context of gastronomic and sensorial workshops developed in the framework of seasonal sales and closeness.

In spite of this, one of the major strengths of the study is the participation mediated by the educational centers, which causes all the students of the courses selected by the center carry out the gastronomic workshop and all the questionnaires of the program, thus saving possible participation biases.

Given the efficacy of the dietary pattern of the Mediterranean diet in its well-known health benefits, it is necessary to promote its consumption not only in non-Mediterranean countries, but also in Mediterranean countries, where adherence has been declining in recent decades. Special attention to children and young people with a clear tendency to rapid abandonment should be paid.

The results of this study demonstrate implications for public health policies that should foster familiarity with a wide variety of foods from the earliest ages in both, families and school canteens. In addition, the introduction of practical workshops on gastronomy and sensory education as part of school programs can contribute to the creation of positive experiences with new flavors to encourage children to try new foods and therefore, increase the variety in their diets. In addition to the implications for health, the influence of these factors on the current trend of control and reduction of food waste in the domestic and community domains should be taken into account.

Among the limitations of the study are the lack of collection of demographic variables related to increased exposure to a variety of foods, such as the level of income and family income and the urban environment, and showing positive effects on neophobia. In addition, as a cross-sectional study, causal relationships cannot be established.

The results of this study indicated that food neophobia affects the adherence to the Mediterranean diet and the acceptance of healthy foods elaborated in gastronomic workshops by Spanish schoolchildren.

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## REFERENCES

1. Cabrera SG, Fernández NH, Hernández CR, Nissensohn M, Román-Viñas B, Serra-Majem L. KIDMED test; prevalence of low adherence to the Mediterranean diet in children and young. A systematic review. *Nutr Hosp* 2015;32(6):2390-9.
2. Carruth BR, Skinner JD. Revisiting the picky eater phenomenon: neophobic behaviors of young children. *J Am Coll Nutr* 2000;19(6):771-80.
3. Cano SC, Tiemeier H, Van Hoeken D, Tharner A, Jaddoe VWV, Hofman A, et al. Trajectories of picky eating during childhood: a general population study. *Int J Eat Disord* 2015;48(6):570-9.
4. Valmorbida JL, Vitolo MR. Factors associated with low consumption of fruits and vegetables by preschoolers of low socio-economic level. *J Pediatr (Rio J)* 2014;90(5):464-71.
5. Sweetman C, McGowan L, Croker H, Cooke L. Characteristics of family meal-times affecting children's vegetable consumption and liking. *J Am Diet Assoc* 2011;111(2):269-73.
6. Kouli E, Jago R. Associations between self-reported fruit and vegetable consumption and home availability of fruit and vegetables among Greek primary-school children. *Public Health Nutr* 2008;11(11):1142-8.
7. Cooke LJ, Wardle J, Gibson EL, Sapochnik M, Sheiham A, Lawson M. Demographic, familial and trait predictors of fruit and vegetable consumption by pre-school children. *Public Health Nutr* 2004;7(2):295-302.
8. Oliveira A, Jones L, De lauzon-Guillain B, Emmett P, Moreira P, Charles MA, et al. Early problematic eating behaviours are associated with lower fruit and vegetable intake and less dietary variety at 4-5 years of age. A prospective analysis of three European birth cohorts. *Br J Nutr* 2015;114(5):763-71.
9. Poelman AAM, Delahunty CM, De Graaf C. Vegetable preparation practices for 5-6 years old Australian children as reported by their parents; relationships with liking and consumption. *Food Qual Prefer* 2015;42:20-6.
10. Laureati M, Cattaneo C, Bergamaschi V, Proserpio C, Pagliarini E. School children preferences for fish formulations: the impact of child and parental food neophobia. *J Sens Stud* 2016;31(5):408-15.

11. Coulthard H, Thakker D. Enjoyment of tactile play is associated with lower food neophobia in preschool children. *J Acad Nutr Diet* 2015;115(7):1134-40.
12. Alliot X, Da Quinta N, Chokupermal K, Urdaneta E. Involving children in cooking activities: a potential strategy for directing food choices toward novel foods containing vegetables. *Appetite* 2016;105:275-85.
13. Pliner P, Hobden K. Development of a scale to measure the trait of food neophobia in humans. *Appetite* 1992;19(2):105-20.
14. Ritchey PN, Frank RA, Hursti UK, Tuorila H. Validation and cross-national comparison of the food neophobia scale (FNS) using confirmatory factor analysis. *Appetite* 2003;40(2):163-73.
15. Rodríguez-Tadeo A, Villena B, Urquidez-Romero R, Vidana-Gaytan ME, Periago Caston MJ, Ros Berruezo G, et al. Food neophobia: impact on food habits and acceptance of healthy foods in schoolchildren. *Nutr Hosp* 2015;31(1):260-8.
16. Serra-Majem L, Ribas L, Ngo J, Ortega RM, García A, Pérez-Rodrigo C, et al. Food, youth and the Mediterranean diet in Spain. Development of KIDMED, Mediterranean Diet Quality Index in children and adolescents. *Public Health Nutr* 2004;7(7):931-5.
17. Rousset S, Schlich P, Chatonnier A, Barthomeuf L, Droit-Volet S. Is the desire to eat familiar and unfamiliar meat products influenced by the emotions expressed on eaters' faces? *Appetite* 2008;50(1):110-9.
18. Rossbach S, Foterek K, Schmidt I, Hilbig A, Alexy U. Food neophobia in German adolescents: determinants and association with dietary habits. *Appetite* 2016;101:184-91.
19. Meiselman HL, King SC, Gillette M. The demographics of neophobia in a large commercial US sample. *Food Qual Prefer* 2010;21(7):893-7.
20. Maiz E, Balluerka N. Nutritional status and Mediterranean diet quality among Spanish children and adolescents with food neophobia. *Food Qual Prefer* 2016;52:133-42.
21. Grao-Cruces A, Nuviala A, Fernández-Martínez A, Porcel-Gálvez AM, Moral-García JE, Martínez-López EJ. Adherence to Mediterranean diet in rural urban adolescents of southern Spain, life satisfaction, anthropometry, and physical and sedentary activities. *Nutr Hosp* 2013;28(4):1129-35.
22. Díaz T, Ficapal-Cusi P, Aguilar-Martínez A. Hábitos de desayuno en estudiantes de Primaria y Secundaria: posibilidades para la educación nutricional en la escuela. *Nutr Hosp* 2016;33(4):6.
23. Woodruff SJ, Kirby AR. The associations among family meal frequency, food preparation frequency, self-efficacy for cooking, and food preparation techniques in children and adolescents. *J Nutr Educ Behav* 2013;45(4):296-303.
24. Van der Horst K, Ferrage A, Rytz A. Involving children in meal preparation. Effects on food intake. *Appetite* 2014;79:18-24.
25. Larson NI, Perry CL, Story M, Neumark-Sztainer D. Food preparation by young adults is associated with better diet quality. *J Am Diet Assoc* 2006;106(12):2001-7.
26. Chu YL, Farmer A, Fung C, Kuhle S, Storey KE, Veugelers PJ. Involvement in home meal preparation is associated with food preference and self-efficacy among Canadian children. *Public Health Nutr* 2013;16(1):108-12.