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## Article

# Adherence to Mediterranean Diet and Food Neophobia Occurrence in Children: A Study Carried Out in Italy

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**Abstract:** Food Neophobia (FN), defined as the reluctance to eat new or unfamiliar foods, mainly concerns fruit, vegetables, and legumes, typical of the Mediterranean Diet (MD). Considering these premises, this study aimed to clarify the relationship between FN and AMD in a sample of Italian children and their association with some socio-demographic factors and children's nutritional status. A sample of 288 children aged 3-11 years, participated to an assessment carried out with a questionnaire evaluating FN and AMD, respectively with Child Food Neophobia Scale (CFNS) and the KIDMED Test. Most of the sample showed an intermediate (67.3%) or high level of FN (18.1%) with high rates among 6-11 years old children (63.9%) and especially in only-child (50%). The AMD was mostly low (29.5%) or medium (54.8%) and reached lower levels among higher neophobic children (51.9%;  $p$  value < 0.05). Present results confirm the study hypothesis that FN is a driver of MD abandonment and show the positive effects on children's eating habits of having siblings. Finally, this study proves the relevance of adopting effective feeding strategies against FN to avoid its maintenance in adulthood and detrimental effects on future overall health and well-being.

**Keywords:** Food Neophobia; Adherence to Mediterranean Diet; sociodemographic characteristics; children; Italy

## 1. Introduction

Food preferences in children are linked to the exposure to high food diversity in the early years which improves dietary variety at the later developmental stages [1]. The reluctance to eat new or unknown foods is defined as Food Neophobia (FN) [2]. It is a normal developmental phase, occurring without distinction of gender, that typically peaks between 2 and 6 years of age and then gradually decreases into adulthood [2,3]. However, FN could have pervasive implications for food-related behaviors impacting the sensory perception of food in the sense that people having high levels of FN reported limited enjoyment of food [4].

Typical foods of the Mediterranean Diet (MD), such as fruit, vegetables, whole grains, and legumes are related to children's FN [1]. MD is negatively associated with the risk of non-communicable chronic diseases, such as diabetes, cardiovascular diseases, and all causes of mortality [5–9] when compared with Western Diet [10]. Hence, the nonadherence to MD in developmental ages was a behavior that needed to be corrected. Eating habits and behaviors are shaped in childhood and then maintained in adulthood [11] hence it is important to act early on neophobic behavior to ensure that it does not impact diet quality [12].

Over the last years in the Mediterranean Countries, a progressive abandoning of MD was observed either in children or adults [13]. Among children in Italy, several reports showed inadequate consumption of typical foods of MD such as fruit, vegetables, and legumes [14].

Among neophobic children it is common to find high consumption of foods rich in saturated fatty acids and sugars [15,16], typical of a Western-style diet [10]. Poor dietary variety and quality

due to FN could be a predictor of childhood overweight/obesity, however to date, findings are not univocal [17–20].

FN is primarily a hereditary trait, in which the genetic determinants accounted for 78% [21]; however, several socio-environmental factors can influence its development [22,23]. Parent's eating patterns and feeding strategies adopted are strongly associated with the development of FN in children [12,24]. During family mealtimes, due to the social facilitation mechanism [25], children can observe and acquire the eating habits of their parents and peers (e.g., siblings) [26–28].

Parents' low consumption of fruit and vegetables is strongly associated with limited consumption of these foods by children [29] because of the transposition of parents' food preferences on children. Consequences of this attitude could be the children's restricted experience of learning about various types of food as well as a poor variety of dietary preferences [2,22,30]. Consistently, several studies demonstrated that the mother's high level of neophobia is correlated with the highest neophobia in children [20,31,32]. Low parents' educational level could be one of the causes of low Adherence to the Mediterranean Diet (AMD) and the high level of neophobia in children [33–36]. Moreover, parents' insufficient nutritional knowledge about what foods are healthy for their children and how to offer them [15] could exacerbate either neophobia or low adherence to MD.

To the best of our knowledge, few studies have evaluated the relationship between FN and AMD in the pediatric population, mostly conducted in Spain [1,37]. For these reasons, the present study aimed to clarify the correlation between FN and AMD in children in an Italian sample. Specific purposes of the work were the analysis of the socio-demographic factors influencing AMD and FN as well as the relationship of AMD and FN with children's nutritional status.

The hypothesis basis of this work was that a high level of FN would correspond to worse adherence to MD. Consequently, the research questions this study would like to answer are: (i) FN could be a driver of AMD?; (ii) what children's behavior, in line or non-in line with MD, could be identified as most related to FN?; iii) what aspects characterizing the family would influence children's neophobia?

## 2. Materials and Methods

### 2.1. Study Design

The present assessment is a cross-sectional study carried out on a sample of children aged 3–11 years, in the period between March 9 and May 11, 2022. The only inclusion criterion was the class of age.

The sample size was calculated according to Pourhoseingholi et al. [38], using the following formula: This is example 1 of an equation:

$$n = [Z^2 * P(1-P)]/[d^2] \quad (1)$$

where n is the sample size, the Z value is 1.96 corresponding to a 95% level of confidence and P denotes the phenomenon to be measured. In this case, P is the prevalence of FN in children, which was estimated at 25% according to Predieri et al. [39], and expressed as a decimal. Finally, d is the precision level of 5%, expressed as a decimal. The resulting sample size was 288 subjects.

Most of the sample (227 subjects) resulted from direct data collection carried out by interviewing randomly selected parents of children attending schools and parks in Rome's fifth municipality and in the surrounding areas. The remaining sample (61 subjects) was obtained through an online administration of the questionnaire distributed through instant messaging apps (e.g., WhatsApp) and the social platforms Instagram and Facebook.

### 2.2. Data Collection Procedure

Following the European Commission General Data Protection Regulation (679/2016) those willing to participate signed a privacy policy and consent form concerning the collection and processing of socio-demographic data in advance. Before starting the data collection, participants were informed about the objective of the research, the consequent statistical analysis, and the intention to publish the results of the assessment in a scientific journal. Participation in the study was fully voluntary and anonymous and subjects could withdraw from the study at any time for any

reason. This study was conducted according to the guidelines of the Declaration of Helsinki [40]. The present research is not considered either as medical experimentation, or a direct intervention on human subjects with diet changes or formulated food administration and did not involve any invasive procedures. In addition to that the Council for Research Economics and Agriculture (CREA) that performed the study is part of the National Statistical System (SISTAN) and guarantees individual data protection [41]. Hence an additional ethical committee review of the study protocol was considered unnecessary once informed consent was obtained.

### 2.3. The Questionnaire

The questionnaire was developed according to the objective of the study and was completed by an adult who acted as a caregiver of the assessed child. It consisted of three sections reported in the Supplementary Material (Table S1). The first section included questions on sociodemographic characteristics (gender, age, weight, and height of the child, ethnic group of the family, household income, number of workers in the family, and number of children in the family). Weight status identification was based on Body Mass Index (BMI) comparison with growth charts of the WHO and their cut-offs [42,43].

The second section investigated FN behavior in children with the Child Food Neophobia Scale (CFNS) developed by Pliner [44] and validated in Italy by Laureati et al. [45]. The CFNS consists of 10 items (five referring to neophilic and five to neophobic attitude) evaluated with a 7-point scale ranging from 1 = "I strongly disagree" to 7 = "I strongly agree."

The individual CFNS scores were computed according to Predieri et al. [39] as the sum of the scores of the 10 items, reversing the neophilic items to have a univocal sense of all the responses. Therefore, the scores theoretically ranged from 10 to 70 with higher scores reflecting higher FN levels. Three groups of individuals were identified according to the following calculation: neutrals (score in the interval  $\text{mean} \pm 1 \text{ SD}$ ), neophobic (score  $> \text{mean} + 1 \text{ SD}$ ), and neophilic (score  $< \text{mean} - 1 \text{ SD}$ ) [16,46,47].

The third section of the questionnaire assessed the AMD in children with the "Mediterranean diet and quality index in children and adolescents KIDMED Test" [48], a questionnaire specifically developed to evaluate if children's eating habits are based on principles of MD pattern. The test consists of 16 questions with closed answers (yes or no). The 14 questions denoting attitude in line with the MD principle were assigned a value of +1 (e.g., Uses olive oil at home); the 4 questions corresponding to attitude not in line with the MD principle were scored -1 (e.g., Skip breakfast). The KIDMED score ranges from 0 to 12, and the sums of the values from the administered test are classified into three levels of AMD:  $\geq 8$  indicates "optimal" AMD; 4-7 points indicates "average" AMD (improvement needed);  $\leq 3$  points indicate "very low" AMD.

### 2.4. Statical Analysis

Descriptive statistics of the data collected were produced. Single continuous and categorical variables were summarized as mean  $\pm$  standard deviation and percentage (%). A contingency analysis was performed to check associations between variables. Specifically, double-entry tables were processed, and the Chi-square test of independence was applied, along with post-hoc tests to check pairwise comparisons, with Bonferroni corrections of the p-values. The test of independence on the mean was applied to compare continuous variables with categorical variables. Results were considered significant for p-value  $< 0.05$ . Statistical analysis was performed using Microsoft® Excel software.

## 3. Results

### 3.1. Characteristics of the Sample

Table 1 shows the sociodemographic characteristics of the sample. Females accounted for 42.7% and males 57.3%; a large part of the sample was Caucasians (79.8%) even a certain level of multi-ethnic origin was observed (12.9% Eurasians, 4.5% Africans, 1.4% Hispanics, and 1.4% Asiatic). The average age of the assessed children was 7.4 years ( $\text{SD} = 2.6$ ) with most of them (71.2%) aged 6-11 years. Consistently, 65.6% of the sample attended primary school. In most cases, both parents were

employed (87.8%). Consistently, household income for most families ranged between 25.000-40.000 euros (35.8%) and 10.000-25.000 euros (31.6%).

Comparison of BMI with growth charts of the WHO and their cut-offs [42,43] showed that almost half of the sample (44.8%) was normal weight, while 20.8% and 28.8% of respondents were respectively overweight or obese, and only 5.6% of the population resulted with underweight.

**Table 1.** Characteristics of the sample (n=288).

	<b>n</b>	<b>(%)</b>
<b>Gender</b>		
Females	123	42.7
Males	165	57.3
<b>Age</b>		
3-5 years	83	28.8
6-11 years	205	71.2
<b>Ethnic group</b>		
African	13	4.5
Asiatic	4	1.4
Caucasian	229	79.8
Eurasian	37	12.9
Hispanic	4	1.4
<b>Parents employment</b>		
Both parents employed	253	87.8
≤1 parent employed	35	12.2
<b>Household income</b>		
Up to 10.000 euros	26	9
Between 10.001 and 25.000 euros	91	31.6
Between 25.001-40.000 euros	103	35.8
Between 40.001 and more	68	23.6
<b>Children per family</b>		
1	108	37.5
2	145	50.3
≥2	35	12.2
<b>BMI</b>		
Underweight	16	5.6
Normal weight	129	44.8
Overweight	60	20.8
Obesity	83	28.8

### 3.2. The Adherence to Mediterranean Diet Assessment (KIDMED Test)

The average overall AMD score was 4.9 (SD = 2.4). According to KIDMED scores categorization, 29.5% of respondents had low AMD, 54.8% showed average AMD and only 15.6% resulted in a high AMD (Figure 1). Inadequate consumption of fruit (<2 servings/day: 61.8%), vegetables (<2 servings/day: 73.3%), legumes (<1 serving/week: 53.8%), nuts (<2/3 servings/week: 74.7%), fish (<2/3 servings/week: 34.7%) was observed, on the other hand excessive consumption of sweets (>1 serving/day: 39.9%) and fast foods (>1 time/week: 18.8%) was reported. Among the habits in line with

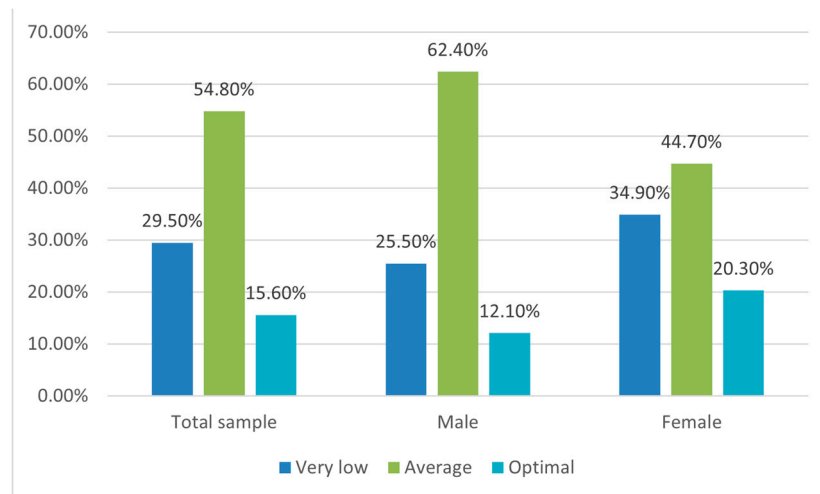
MD, it should be reported the occurrence of breakfast (88.2%), mainly with dairy products (91.7%) and commercially baked goods and pastries (81.6%). The consumption of cereals or grain (e.g., bread) for breakfast was less common (18.8%) (Supplementary Materials (Table S2)).

In males, AMD is more common than in females (65.2% vs 34.8% p-value <0.05). The occurrence of having both parents employed was associated with AMD in children (93% vs 7% p-value <0.05), while for the other sociodemographic characteristics, no significant association with AMD was found (age: dependency ratio on average 0.004; household income: p-value 0.5; ethnic group: p-value 0.2). Weight status was not significantly associated with AMD; however, higher levels of AMD were found in normal-weight children (42.2%) than in overweight (24.4%) or obese (24.4%) individuals (Table 2).

**Table 2.** Association between socio-demographic characteristics of the sample, BMI, and Adherence to Mediterranean Diet (AMD) resulting from KIDMED test \*p < 0.05.

AMD levels		Very low (≤3)		Average (4-7)		Optimal (≥8)	
		n	%	n	%	n	%
Socio-demographic characteristics and BMI							
Gender	Males	42	49.4	103*	65.2	20	44.4
	Females	43	50.6	55	34.8	25	55.5
Household income	< 10.000€	9	10.6	11	6.9	6	13.3
	10.000 - 25.000 €	28	32.9	46	29.1	17	37.8
	25.000 - 40.000 €	30	35.3	62	39.2	11	24.4
	> 40.000 €	18	21.2	39	24.7	11	24.4
Parents employment	Both parents employed	68	80	147*	93	38	84.4
	≤1 parent employed	17	20	11	7	7	15.6
Children per family	1	35	41.2	65	41.1	8	17.8
	2	40	47.1	73	46.2	32*	71.1
	> 2	10	11.8	20	10.8	5	11.1
Ethnic group	African	1	1.2	9	5.7	3	6.7
	Asiatic	2	2.3	1	0.6	1	2.2
	Caucasian	69	81.2	129	82.2	31	68.9
	Eurasian	11	13	16	10.2	10	22.2
	Hispanic	2	2.3	2	1.3	0	0
BMI	Underweight	3	3.5	9	5.7	4	8.9
	Normal weight	42	49.4	68	43	19	42.2
	Overweight	9	20	40	25.3	11	24.4
	Obesity	31	36.5	41	26	11	24.4





**Figure 1.** Adherence to the Mediterranean Diet (AMD) in the total sample, in males, and females.

### 3.3. Food Neophobia Assessment

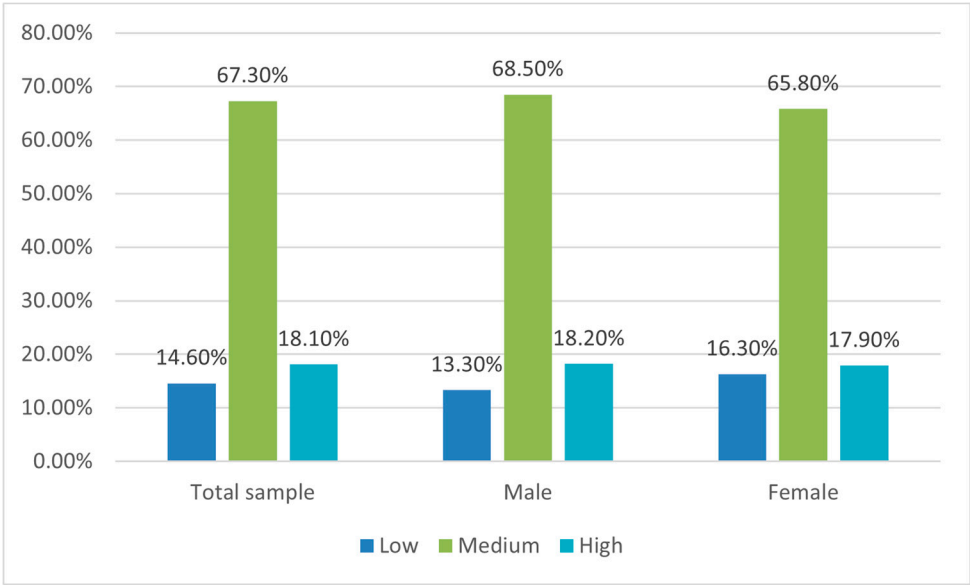
The average CFNS score was 42.2 (SD = 14.04) resulting in a large majority of the sample with an intermediate level of FN (67.3%) followed by a high (18.1%) and low (14.6%) level (Figure 2).

Having siblings influences the occurrence of FN in the sense that among neophilic children a lower proportion of only-child was found with respect to the neophobic counterparts (16.7% vs 50%;  $p$  value <0.05). FN did not show significant associations with socio-demographic variables (gender:  $p$  value 0.7; age: dependency average of ratio 0.01; household income:  $p$  value 0.3; parental employment: 0.1; ethnic group:  $p$  value 0.6). The relationship between FN and weight status was also studied, resulting in a significant association. Higher rates of normal weight than overweight/obesity were found among respondents with lower levels of neophobia (61.9% vs 38.1%;  $p$  value < 0.05). However, even in higher neophobic individuals about half were normal weight (42.3%) (Table 3).

**Table 3.** Association between socio-demographic characteristics of the sample, BMI, and level of Food Neophobia (FN) resulting from Child Food Neophobia Scale (CFNS) \* $p$  < 0.05.

FN levels		Low		Medium		High	
		n	%	n	%	n	%
<b>Socio-demographic characteristics and BMI</b>							
<b>Gender</b>	Males	22	52.4	113	58.2	30	57.7
	Females	20	47.6	81	41.8	22	42.3
<b>Household income</b>	< 10.000€	2	4.8	19	9.8	5	9.6
	10.000 - 25.000 €	8	19	67	34.5	16	30.8
	25.000 - 40.000 €	18	42.8	68	35.1	17	32.7
	> 40.000 €	14	33.3	40	20.6	14	26.9
<b>Parents employment</b>	Both parents employed	40	95.2	170	87.6	43	82.7
	≤1 parent employed	2	4.8	24	12.4	9	17.3
<b>Children per family</b>	1	7*	16.7	75	38.7	26	50
	2	25	59.5	98	50.5	22	42.3
	> 2	10	23.8	21	10.8	4	7.7
<b>Ethnic group</b>	African	2	4.8	10	5.2	1	1.9

BMI	Asiatic	0	0	4	2.1	0	0
	Caucasian	34	80.9	153	79.3	42	80.8
	Eurasian	6	14.3	22	11.4	9	17.3
	Hispanic	0	0	4	2.1	0	0
	Underweight	0	0	12	6.2	4	7.7
	Normal weight	26	61.9	81	41.8	22	42.3
	Overweight	16	38.1	36	18.5	8	15.4
	Obesity	0*	0	65	33.5	18	34.6



**Figure 2.** Level of Food Neophobia (FN) in the total sample, in males, and females.

3.4. The Relationship between Adherence to the Mediterranean Diet and Food Neophobia

To test the study hypothesis that a high level of FN could be a driver of poor AMD, the association between these variables was assessed and significant results were observed (p-value <0.05). Specifically, almost half of children with a high level of FN (51.9%) showed poor AMD (Table 4).

To assess the intake of different food groups in both neophobic and neophilic children, the association between FN and the items of the KIDMED Test was carried out. In lower neophobic children, adequate consumption of fruit (2 servings/day;76.2%), vegetables (2 servings/day;66.7%), and legumes (>1 serving/week; 92.9%) was found (p-value < 0.05). Otherwise, in higher neophobic respondents an insufficient consumption of fish (<2-3 servings/week; 48.1%; p-value <0.05) was observed. On the other hand, neophilic children were less frequent consumers (< once a week) of fast foods than neophobic respondents (97.6% vs 75%; p value <0.05). Having breakfast did not show a significant association with FN (p-value 0.09), with almost all both neophilic (95.2%) and neophobic (80.8%) children that did not skip breakfast. Concerning food choices, the consumption of milk (p-value 0.1) and commercially baked goods and pastries (p-value 0.7) was not related to FN, instead of cereals/grains for breakfast was higher in participants with a low level of FN than in those with a high level (31% vs 11.5%; p value 0.05) (Table 4).

Among higher neophobic children, the lowest daily Fruit and Vegetables (F&V) consumption frequencies were observed. In particular, 80.4% of the children with an intermediate level of FN and 65.4% with a high level of FN consumed only one fruit or fruit juice every day. Consumption of two servings per day was reported by 35% of children with intermediate FN and 21.5% of children with high FN. Similarly, 68% of the children with an intermediate level of FN and 46.1% with a high level of FN consumed fresh or cooked vegetables only once a day. These percentages reduced to 22.7% and

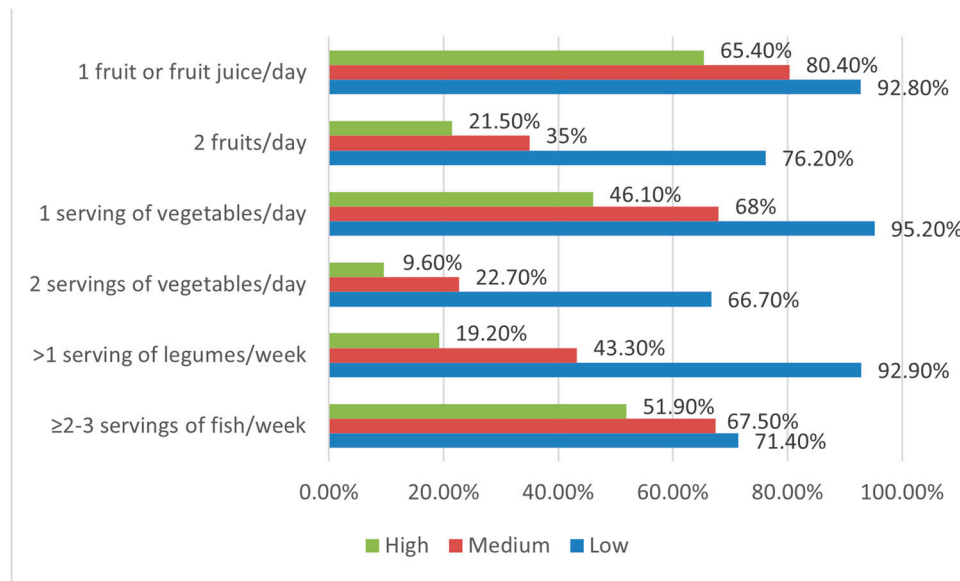


9.6% for two servings per day, respectively. A decreasing trend of weekly fish and legumes consumption between the different FN levels was also observed: among higher neophobic children only the 19.2% and 51.9% consumed, respectively, legumes more than once a week and fish at least 2-3 times per week, contrary to 92.9% and 71.4%, respectively for legumes and fish consumption, of neophiliac counterparts that showed an adequate intake (Figure 3).

Cronbach's Alpha was calculated for the combined 26 items of CFNS and KIDMED resulting in a good ( $\alpha = 0.80$ ) internal consistency and a good reliability of the scale measured [49].

**Table 4.** Association between Adherence to Mediterranean Diet (KIDMED total score and component scores) and Food Neophobia \* $p < 0.05$ .

FN levels			Low		Medium		High	
			n	%	n	%	n	%
KIDMED total score	Very low		1	2.4	57	29.4	27*	51.9
	Average		26	61.9	109	56.2	23	44.2
	Optimal		15	35.7	28	14.4	2	3.8
KIDMED Test components								
Fruit or fruit juice	every day	Yes	39	92.9	156	80.4	34	65.4
		No	3	7.1	38	19.6	18*	34.6
Second fruit every day		Yes	32*	76.2	67	34.5	11	21.2
		No	10	23.8	127	65.5	41	78.8
Fresh or cooked vegetables regularly once a day		Yes	40*	95.2	132	68	24	46.2
		No	2	4.8	62	32	28	53.8
Fresh or cooked vegetables more than once a day		Yes	28*	66.7	44	22.7	5	9.6
		No	14	33.3	150	77.3	47	90.4
Fish at least 2-3 times per week		Yes	30	71.4	131	67.5	27	51.9
		No	12	28.6	63	32.5	25*	48.1
Fast-food more than	once a week	Yes	1	2.4	40	20.6	13	25
		No	41*	97.6	154	79.4	39	75
Legumes more than	once a week	Yes	39*	92.9	84	43.3	10	19.2
		No	3	7.1	110	56.7	42	80.8
Cereals or grains (bread, etc.) for breakfast		Yes	13*	31	35	18	6	11.5
		No	29	69	159	82	46	88.5
Nuts at least 2–3 times	per week	Yes	7	16.7	56	28.9	10	19.2
		No	35	83.3	138	71.1	42	80.8
Skips breakfast		Yes	2	4.8	22	11.3	10	19.2
		No	40	95.2	172	88.7	42	80.8
Dairy product for breakfast (yoghurt, milk, etc.)		Yes	40	95.2	180	92.8	44	84.6
		No	2	4.8	14	7.2	8	15.4
Commercially baked goods or pastries for breakfast		Yes	36	85.7	156	80.4	43	82.7
		No	6	14.3	38	19.6	9	17.3
Sweets and candy several times every day		Yes	11	26.2	79	40.7	25	48.1
		No	31	73.8	115	59.3	27	51.9



**Figure 3.** Fruit, vegetables, legumes and fish consumption at different FN levels.

#### 4. Discussion

The present work clarifies the relationship between FN and AMD in a sample of Italian children and describes the association with some socio-demographic factors and children's nutritional status.

The key finding in the current study highlights that a high level of FN significantly influences the lack of AMD in the assessed sample of Italian children. Notably, more than half of children with elevated FN demonstrated low AMD. The negative correlation between FN and AMD was reported in other studies carried out in the pediatric population [1,37] as well as in the adults [39]. FN in the present study was a significant barrier to a balanced and healthy diet and neophobic children resulted in a diet with lower nutritional quality than non-neophobic children.

FN was largely diffused in the present sample, since more than half of respondents showed an intermediate level of FN (67.3%), followed by a high level (18.1%), confirming rates observed in other Italian studies [19,47,50]. Children exhibiting a high level of FN are hesitant to experiment with a variety of foods, especially those they are unfamiliar with [51]. In the present sample, this results in children with limited eating variety with a dietary behavior far from the principles of MD that could have detrimental effects on future overall health and well-being. Conversely, children who were assessed as less neophobic resulted in general behaviors more in line with MD principles.

Foods commonly refused by neophobic children are fruit, vegetables, legumes, and fish, typical of MD [1]; on the other hand Western Diet characterizing foods such as highly palatable, ultra-processed foods, rich in salt and sugar and refined grains [10], are preferred by neophobic children [15,16]. Consequently, FN could be one of the many factors contributing to the shift toward a Western dietary pattern. Suboptimal children AMD was measured in this study (54.8% average and 29.5% very low), confirming trends of reducing AMD in the evolutive ages in Mediterranean areas as resulting in the meta-analysis conducted by Garcia-Cabrera et al. [13] (27% of low AMD among youths ≤12 years old).

The observed levels of AMD were related to two socio-demographic variables, namely gender and level of parental employment. Contrary to other studies [13,36], in this sample males followed more MD than females. Instead, a higher parental level of employment resulted in a negative factor for AMD as it was associated with higher rates of neophobia in children (93% vs 80%).

A more detailed examination of the data showed that a large proportion of the respondents did not achieve the recommendations for the consumption of fruit (61.8%), vegetables (73.3%), cereals or grain for breakfast (81.2%), legumes (53.8%) and fish (34.7%) and these included mainly children with an intermediate or high level of FN. Furthermore, F&V, legumes and fish consumption frequencies tended to decrease as the level of FN worsened. Overall, FN would seem to influence vegetable consumption more negatively than fruits. The sweet taste of fruit compared to the bitter taste of some vegetables could justify the difference found in this finding. However, the difference between fruit

and vegetable consumption could be minor considering that the KIDMED item on fruit consumption also refers to fruit juices, normally preferred by children [52].

Regarding more palatable foods, the consumption of commercially baked goods and pastries for breakfast (81.6%), sweets (39.9%), and fast foods (18.8%), was frequent, especially among children with an intermediate or high level of FN. These findings are consistent with those obtained in studies conducted in other Mediterranean Countries that recognize FN as a driver in the abandonment of the MD [1,37]. On the other hand, also unhealthy home food environment and low parent AMD could be a predictor of maintenance of FN in children.

An interesting result that deserves attention is related to the fact that having siblings influences the occurrence of FN with a lower percentage of only children among neophilic children compared to their neophobic counterparts (16.7% vs 50%) probably due to the influence of peers on children's eating habits [37,53].

The literature describes a peak of FN between 2 and 6 years of age with a decrease over [2,3]; in the present study, however, a high prevalence of FN was found in 6-11 years old children (63.9% of them with an intermediate level of FN). These results indicate the persistence of neophobic behavior during the child's growth and the possibility of its maintenance in adulthood. Adoption of coercive feeding strategies (e.g., pressure to eat, using food as a reward) could be one of the causes of FN persistence [23,24,54–56] considering that forcing attitude could have an immediate positive impact but a long-term negative effect on the development of preferences for healthy foods [57,58]. The prevalence of FN in adulthood in Italy has been confirmed by another study [39] that showed a strong negative association between FN and AMD and suggested that it could be a predictor of unhealthy dietary pattern adoption and greater metabolic risk. It is widely documented that FN limits the dietary variety and quality as it results in the rejection of healthy foods, both plant (e.g., fruit, vegetables, pulses) and animal (e.g., fish), and the preference for more palatable and high-calorie foods [15]. Considering these premises, it has been hypothesized that FN may contribute to childhood obesity [17].

Present results did not confirm the association between FN and childhood obesity. In fact, among the less neophobic children, a significantly higher percentage of normal weight was observed compared to overweight/obesity (61.9% vs 38.1%). However, even in higher neophobic respondents about half were normal weight (42.3%). The relationship between FN and weight status is an open question as it has been examined in a few studies that have produced conflicting results. Most of these found no association between the variables [18,19,59–61], while a smaller number found a positive relationship in the sense that neophobic children tend to be more overweight/obese [20,32]. Further research is needed to clarify this association, but we can speculate that it depends on the home food environment and the feeding practices adopted by parents: the abundance of caloric-dense foods, rich in sugars or saturated fatty acids, and offering them to compensate for the rejection of healthy ones, could favor the development of overweight/obesity in neophobic children.

The strengths and limitations of the study can be mentioned. An important strength of this study is the fact that it addresses a research gap in Italy in which limited comprehensive assessments simultaneously investigate both FN and children's AMD. Understanding the interplay between FN and AMD is essential for promoting healthy eating habits among Italian children. Research in this area could reveal strategies to encourage a more balanced and nutritious diet in children, potentially reducing the impact of FN on their food choices. Another strength is the use of validated and largely employed questionnaires, the KIDMED test [48] and Neophobia scale [44], that have been designed to yield consistent and reproducible results. This allowed to place the findings in a broader context and make meaningful comparisons to existing research, enhancing the study's significance. Another strength of this work was that the sample size calculation fixed the level of precision of estimations ensuring the detection of meaningful effects and differences optimizing efforts and resources considering the difficulties of data collection in studies having children as the target group. This led to more robust statistical tests and analyses, increasing the study's ability to detect significant effects and relationships minimizing the risk of unnecessarily involving participants and collecting data that may not contribute significantly to the study's objectives.

This study has limitations. A significant weakness of this research lies in its cross-sectional examination of FN's association with AMD, as well as the consumption of specific foods like fruits, vegetables, and weight outcomes. Consequently, the study design did not permit to establish a causal

relationship. Nonetheless, the findings offer valuable groundwork for future investigations, which should explore causal connections between neophobia and diet quality during later stages of childhood. Another important limitation of the study is related to the fact that the assessment relied on respondent's answers to the questionnaire. This methodology has the intrinsic limitation of the response bias consisting of the fact that respondents may provide inaccurate or socially desirable responses. Dietary intake evaluation is particularly influenced by social desirability bias with a tendency to provide consistent responses, which can potentially lead to less precise representations of actual food consumption [18]. In addition, the study relied on adults' assessments of neophobic behaviors that could be interpreted differently. All these aspects were partially overcome with the use of largely validated questionnaires. Another limitation of the study is related to the fact that the sample includes medium and high socioeconomic groups limiting the generalizability of results to the broader population that however was not an objective of the present study.

## 5. Conclusions

This study confirms the widespread prevalence of FN in pediatric age in Italy, especially in only child. Contrary to several studies describing a peak of FN between 2 and 6 years of age, present results showed the maintenance of neophobic behavior also in older children. Confirming the study hypothesis, FN is a driver of low AMD, negatively influencing the consumption of typical foods of MD such as fruit, vegetables, legumes, and nuts and contributing to the high intake of sweets and fast foods, characteristic of Western dietary patterns. An inadequate home food environment, unhealthy parents' eating habits, and the adoption of ineffective feeding strategies could cause the maintenance of FN observed, predisposing to the occurrence of NCDs in adulthood. FN is a significant barrier to achieving a balanced and healthy diet, particularly among children. Neophobic children are at risk of consuming a diet with lower nutritional quality, which can impact their health and development. Encouraging neophobic individuals, especially children, to gradually expand their food choices can be a crucial step in promoting better dietary habits and overall well-being [62].

**Supplementary Materials:** The following supporting information can be downloaded at the website of this paper posted on Preprints.org, Table S1: The Questionnaire; Table S2: Results of the KIDMED Test.

**Author Contributions:** S.P., U.S. and L.R. carried out the research questions, conceptualization, and design of the study. L.R. revised the methodology. A.D.N. and S.P. carried out the database compilation and data analysis. A.D.N. carried out the manuscript writing and original draft preparation. L.R. and US did the writing, review, and editing. All authors have read and agreed to the published version of the manuscript.

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**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** The archived data and all the elaboration and analysis generated and used for the presentation of results in this study are fully available on request from the corresponding author.

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