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Food Neophobia and its Association with Nutritional Status and Diet Quality in Children Ages 2 to 5 in Barangay Gulang-gulang, Lucena City, Philippines

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Abstract

Food neophobia (FN) is the reluctance to eat novel foods. It peaks around the toddler and preschool years, a sensitive time for developing dietary habits. If this eating behavior persists, children are susceptible to acquiring lifelong unhealthy dietary habits, ultimately affecting their development. Hence, this cross-sectional study involved 88 parents or caregivers of children ages 2 to 5 to describe FN relative to nutritional status (NS) and diet quality (DQ) and identify factors affecting its development. Data were collected using a computer-assisted personal interviewing (CAPI) online survey. Weight-for-height and height-for-age measurements were used to assess NS. While dietary diversity score (DDS) and Menu Eval Plus for DQ. The Child Food Neophobia Scale was adopted to measure FN. No significant associations were noted regarding NS and DQ. However, food-neophobic children had fewer intakes of legumes (p-value=0.041) and non-vitamin A-rich vegetables (p-value=0.048) and excessive intakes of phosphorus (p-value=0.002), vitamin A (p-value=0.027), and riboflavin (p-value=0.037). Snacks and discretionary foods are also frequently consumed as they are readily available and accessible. This behavior may probably be due to the innate preference of children for sweet and salty over bitter and sour flavors. Results warrant further research to develop interventions to address FN in children.

Keywords— diet quality, Filipino children, food neophobia, nutritional status

1 Introduction

Food neophobia is characterized as the reluctance to eat novel and unfamiliar foods [1]. Different from picky eating or the unwillingness to eat familiar or previously introduced foods [2], food neophobia develops as a result of visual refusal before the specific food is consumed [3]. This feeding behavior specific to childhood peaks around the ages of 2 and 5 among toddlers and preschool children [4], a crucial time for the development of dietary habits [5] and where the risk of malnutrition is highest [6]. Foods most commonly rejected are fruits and vegetables, potentially because of their bitter or sour flavor. In contrast, fatty and sugary foods are inherently preferred because of their sweet and salty taste [7]. This would result in decreased food diversity and quality, ultimately resulting in nutritional deficiencies [8]. If this eating behavior persists, it will put them at risk of developing lifelong unhealthy eating habits, ultimately affecting a child's development [9].

Further, the effect of food neophobia on diet quality can potentially result in adverse outcomes in weight on both extremes. This means that food neophobia can lead to children being undernourished and overnourished. For instance, being underweight results from insufficient energy and nutrient intake due to food avoidance. Meanwhile, neophobic behavior may prompt children to limit their intake predominantly to foods with perceived palatability, which often are high in energy density, fat, and sugar, resulting in excess weight gain and increased adiposity [4, 7]. However, illustrating the association of food neophobia with dietary patterns would be unsatisfactory, as socioeconomic factors are also a strong predictor of nutritional status and diet quality. Therefore, the potential confounding influence of socioeconomic factors needs to be investigated.

The prevalence of food neophobia varies globally, primarily due to differences in age groups, methods and instruments used, and cut-off values. Still, estimates indicate that food neophobia level in children is consistent with moderate and high grades of neophobia. A study in Brazil with 1112 children revealed a prevalence of high food neophobia at 33.4% [1]. In Poland, 10.8% of 325 participating children had a high food neophobia level [9]. Another study conducted on 216 Saudi Arabian children presented a high and moderate prevalence of food neophobia at 89.8% and 98.6%, respectively [10]. However, not much information has emerged on food neophobia in a population of Filipino children, not even eating behavior, per se, among children in Quezon Province. Therefore, with a lack of data, this study aimed to describe food neophobia regarding nutritional status and diet quality of Filipino children ages 2 to 5 in Barangay Gulang-gulang—the largest and most populous barangay in Lucena City, Philippines. It also aimed to identify factors affecting the development of food neophobia among the study children.

Given that food neophobia poses adverse health effects on the growth and development of children, there is a sense of urgency and significance to carry out similar studies to understand this largely ignored feeding behavior specific to childhood. As a result, it would provide an avenue for prevention, early detection, and relevant intervention. The direct beneficiaries of this study include children and their parents or caregivers, healthcare professionals, and future studies. With enough knowledge on this issue, parents will be able to identify if their children have a predisposition to developing or are already exhibiting food-neophobic behavior, and therefore, prevent the adverse and most often life-long effects of food neophobia on the health and development of their children. This study would also support healthcare professionals in developing food-based recommendations and intervention techniques to address the nutritional deficits of this population. Finally, it can add to the limited literature on food neophobia and serve as a reference for future nutrition and health intervention initiatives, particularly in the Philippines.

2 Methodology

2.1 Study Locale

Barangay Gulang-gulang was selected as the study area because it is the most populous barangay in Lucena City, a first-class and the only highly urbanized city in Region IV-A CALABARZON. The most recent census determined the barangay's population at 28,405, making up 10.18% of the city's total population [11]. Interestingly, although the barangay is in this highly urbanized city, households lie within a wide range of income class brackets, potentially providing diverse information regarding their dietary data. Moreover, it is also one of the largest barangays in the city in terms of the population of children ages 2 to 5, with an estimated population of 949 children according to the most recent nutrition survey in the barangay through Operation Timbang (OPT) Plus 2022 of the National Nutrition Council.

2.2 Research Design and Participants

The study employed a descriptive cross-sectional design. Operation Timbang (OPT) Plus report of the barangay provided the population size needed to determine the sample size. The study then included 88 parents and caregivers with children ages 2 to 5 as study respondents. Simple random sampling was conducted, in which respondents in the population are sampled by a random process so that the probability of each child in the population being included in the sample is the same.

2.3 Data Collection Methods

Data were collected using a computer-assisted personal interviewing (CAPI) online survey, where responses were recorded through the Google Forms platform. Information on the children's socioeconomic status, demography, anthropometry, dietary, and eating patterns indicative of food neophobia was also collected. Data collection was conducted from August 8 to September 8, 2022. To initiate the data collection method, written informed consent was obtained from the parent or caregivers. Following the completion of the consent, the interview was administered.

Demographic and Socioeconomic Data Collection. Consenting parents or caregivers were interviewed using a socioeconomic and demographic questionnaire developed using relevant literature. The questionnaire was translated into the local language for better data collection. Determination of Nutritional Status. Height and weight were procured to assess the nutritional status of the children. The height was measured to the nearest 0.1 cm using a stadiometer, while weight was at the nearest 0.1 kg with a portable weighing scale. The nutritional status was determined using the weight-for-height (WHZ) and height-for-age (HAZ) indices, with data on age and sex. The anthropometric classifications were based on the 2006 WHO Child Growth Standards [12].

Determination of Nutritional Status. Height and weight were procured to assess the nutritional status of the children. The height was measured to the nearest 0.1 cm using a stadiometer, while weight was at the nearest 0.1 kg with a portable weighing scale. The nutritional status was determined using the weight-for-height (WHZ) and height-for-age (HAZ) indices, with data on age and sex. The anthropometric classifications were based on the 2006 WHO Child Growth Standards [12].

Diet Quality Collection. The consenting parents or caregivers completed a two-nonconsecutive-day 24-hour food recall questionnaire to collect individual dietary data of their children. This method provided information on the type and amount of food consumed over 24 hours. The data collected from this method was quantitatively assessed using Menu Eval Plus. This web-based software provides calculations for energy and selected nutrient contribution of a meal based on the Recommended Energy and Nutrient Intake (REI/RENI) based on the tables of the Philippine Dietary Reference Intakes (PDRI) [13]. Additionally, the dietary diversity score (DDS) was used to determine the qualitative diet quality of the population. This study adopted the method outlined for assessing diet diversity and micronutrient adequacy among Filipino school-age children [14],

which made use of 9 DDS food groups: (1) cereals, grains, and tubers; (2) meat, poultry, and fish; (3) dairy; (4) eggs; (5) legumes, pulses, and nuts; (6) vitamin A-rich fruits and vegetables; (7) other fruit; (8) other vegetables; and (9) oils and fats. This DDS food grouping system was created following the recommendations made at the Food and Agriculture Organization (FAO) workshop on dietary diversity validation procedures [15]. In this study, a child might obtain a maximum score of 1 for a particular DDS food group if they consumed at least 10g of at least one food item, except for oils and fats, for which the cut-off of 1g was used. The total amount of DDS food groups each child consumed during their first 24-hour recall was used to determine their individual DDS. The DDS allows for scores as low as 0 and as high as 9. The higher the DDS score, the more diverse a diet is. It is also in this section where other supplementary questionnaires were asked regarding the children's behaviors indicative of food neophobia.

Assessment of Food Neophobia Level. The Child Food Neophobia Scale (CFNS) that was used in this study adopted the Food Neophobia Scale (FNS) [16]. The original FNS contains ten questions, with five neophilic questions and five neophobic questions. However, four of these were excluded on the basis that they were inappropriate for the age range of the study. It has been demonstrated that the six remaining questions are concise and reliable [17] and have also been widely used in studies involving children as young as two [18, 19]. The included questions were modified and translated into the local language for better understanding and are shown in Table 1. Furthermore, a 4-point bipolar Likert scale was used to record the responses of the consenting parents or caregivers, ranging from "strongly agree" (4) to "strongly disagree" (1), with a higher score indicating a higher level of food neophobia. The scores of the first and last questions were reversed for consistency. Cut-off values were adapted [20] based on the mean ±1 standard deviation (SD) of the CFNS scores to determine whether a child exhibits a food-neophobic behavior. CFNS scores of < mean ±1SD were evaluated as neophilic (low food neophobia), mean ±1SD as neutral (medium food neophobia), and > mean ±1SD as neophobic (high food neophobia).

Table 1. Child Food Neophobia Scale (CFNS) English version and Filipino translation

	English Version	Filipino Translation
1	My child is always trying new and various foods (R).	Ang aking anak ay laging sumusubok ng mga bago at iba't ibang pagkain (R).
2	My child does not trust new foods.	Ang aking anak ay hindi nagtitiwala sa mga pagkaing bago sa kanya.
3	My child will not try a food if they do not know what is in it.	Hindi susubukan ng anak ko ang isang pagkain kung hindi nila alam kung ano ang laman nito
4	My child is hesitant to eat foods they have never had before.	Ang aking anak ay nag- aalangan na kumain ng mga pagkaing hindi pa nila nakakain noon.
5	My child is extremely picky about the foods they will eat.	Ang aking anak ay napakamapili sa mga pagkaing kanilang kakainin.
6	My child will eat almost everything (R).	Halos lahat ng pagkain ay kayang kainin ng anak ko (R).

2.4 Data Analysis

Data processing and analysis were performed using the Statistical Package for Social Science (SPSS) software version 20. Information on the participants' sociodemographic profile, anthropometry, diet quality, and other intrinsic and extrinsic factors was reported as frequencies and percentages, part of descriptive statistics. The association between nutritional status, diet quality, and the final CFNS scores was analyzed using the Pearson correlation coefficient with the adopted significance level of 5% ($p<0.05$). This correlation test verified the linear relationship between variables and measured their degree of association in at least an interval scale. The data was then summarized

and presented in tables and appropriate figures and graphs.

2.5 Ethical Considerations

As it involves human participation, this study took into account and provided a method for handling the ethical concerns shown in an informed consent written in the local language that the participating parents and caregivers understand well. Participation in this study is entirely voluntary. An eligible participant was presented and asked to sign an informed consent form that provided information to help make an informed choice. Additionally, participants have the right to quit or withdraw from this study at any time. No actions were taken to force a participant to join the research process. In cases when a participant decided to withdraw from the research process, a new qualified participant was selected.

Furthermore, all collected data from this study was used only for academic purposes and treated with strict confidentiality. The study had limited access to identifiable information and only required the necessary data from the participants related to the objectives and methodologies of this paper. The identity of the consenting participants also remained anonymous and confidential, and the assurances not only protected their names but also refrained from using language and materials that could be used to identify their responses.

3 Results

3.1 Food Neophobia in the Sample Population

The mean CFNS score of the population was 15.6±3. A score of 6-13 indicated a low level of food neophobia. The group with a medium food neophobia level had scores between 14-17. Moreover, a score of at least 18 was evaluated as a high level of food neophobia. Given the cut-off values established, it can be inferred that most children in the population had medium levels of food neophobia (56.8%). On the other hand, 17.0% of the population had low levels of food neophobia, while more than one-fourth of the population had high levels of food neophobia (26.1%).

3.2 Food Neophobia across Demographic and Socioeconomic Characteristics

The demographic and socioeconomic characteristics of the sample population concerning the level of food neophobia are presented in Table 2. Of the 88 children, there were more males (51.1%) than females (48.9%). The mean age of the population was 3.52 years. Children aged four (28.4%) represented the largest proportion of the population. Most children live in households with more than four members (69.3%), and three-quarters of the population (75.0%) live below the poverty threshold or whose household monthly income is below Php 12,000 [21]. Among the parents and caregivers interviewed, the highest educational attainment was secondary education (60.2%).

No significant associations were found in terms of sex, age, and household size. A probable reason for this is that the differences between frequencies and percentages of children in each demographic and socioeconomic class and food neophobia levels are minimal. On the other hand, a significant association exists in terms of parental education and monthly household income. Study results suggest an increased likelihood of developing food-neophobic behaviors among children with parents with low education levels (p-value=0.027) and living in low-income households (p-value=0.023).

Table 2. Child and household profile of children ages 2 to 5 in Barangay Gulang-gulang, Lucena City, Philippines, according to the level of food neophobia (n=88)

Demographic and Socioeconomic Characteristics	Total (*n* 88)		Level of Food Neophobia						*p*-value
			Low (*n* 15)		Medium (*n* 50)		High (*n* 23)		
	f	%	f	%	f	%	f	%	
Sex									0.724
Boy	45	51.1%	8	9.1%	26	29.5%	11	12.5%	
Girl	43	48.9%	7	8.0%	24	27.3%	12	13.6%	
Age (years)									0.989
2	20	22.7%	2	2.3%	13	14.8%	5	5.7%	
3	23	26.1%	5	5.7%	11	12.5%	7	8.0%	
4	25	28.4%	6	6.8%	14	15.9%	5	5.7%	
5	20	22.7%	2	2.3%	12	13.6%	6	6.8%	
Household Size									0.588
≤ 4	27	30.7%	3	3.4%	17	19.3%	7	8.0%	
> 4	61	69.3%	12	13.6%	33	37.5%	16	18.2%	
Parental Education									**0.027***
Primary	11	12.5%	3	3.4%	6	6.8%	2	2.3%	
Secondary	53	60.2%	11	12.5%	30	34.1%	12	13.6%	
Vocational	8	9.1%	0	0.0%	6	6.8%	2	2.3%	
Tertiary	16	18.2%	1	1.1%	8	9.1%	7	8.0%	
Household Monthly Income									**0.023***
≤ Php 12,000	66	75.0%	13	14.8%	40	45.5%	13	0.0%	
> Php 12,000	22	25.0%	2	2.3%	10	11.4%	10	11.4%	

* denotes that association is significant at the 0.05 level (2-tailed)
** denotes that association is significant at 0.01 level (2-tailed)

3.3 Comparison of Anthropometric Profile and Food Neophobia

The data for weight-for-height (Table 3) showed that most of the children were normal (73.9%), with very few deviating from the normal range. Overweight and obese had the same percentage at 9.1%. The remaining percentages were severely wasted and moderately wasted, representing 2.3% and 5.7% of the population, respectively. Almost the same can be said in terms of the height-for-age of the children. Most of the children had normal heights for their age (68.2%), while 6.8% were tall for their age. Severely stunted and moderately stunted children represented 5.7% and 19.3% of the population, respectively.

In this population, weight-for-height and height-for-age anthropometric indices were not significantly associated with food neophobia. This can be attributed to the result that most children with high levels of food neophobia had normal weights for their height and heights for their age. Even so, several neophobic children were classified as wasted, overweight, or obese for their weight-for-height and stunted or tall for height-for-age.

Table 3. Anthropometric assessment and nutritional status of children ages 2 to 5 in Barangay Gulang-gulang, Lucena City, Philippines, according to the level of food neophobia (n=88)

Anthropometric Indices	Total (*n* 88)		Level of Food Neophobia						*p*-value
			Low (*n* 15)		Medium (*n* 50)		High (*n* 23)		
	f	%	f	%	f	%	f	%	
Weight-for-height (WHZ) Classification									0.351
Severely wasted	2	2.3%	0	0.0%	1	1.1%	1	1.1%	
Moderately wasted	5	5.7%	0	0.0%	2	2.3%	3	3.4%	
Normal	65	73.9%	11	12.5%	39	44.3%	15	17.0%	
Overweight	8	9.1%	3	3.4%	4	4.5%	1	1.1%	
Obese	8	9.1%	1	1.1%	4	4.5%	3	3.4%	
Height-for-age (HAZ) Classification									0.982
Severely stunted	5	5.7%	1	1.1%	3	3.4%	1	1.1%	
Moderately stunted	17	19.3%	3	3.4%	8	9.1%	6	6.8%	
Normal	60	68.2%	11	12.5%	34	38.6%	15	17.0%	
Tall	6	6.8%	0	0.0%	5	5.7%	1	1.1%	

* denotes that association is significant at the 0.05 level (2-tailed)
** denotes that association is significant at 0.01 level (2-tailed)

3.4 Associations between Food Neophobia and Diet Quality

Data on the dietary intake evaluated using the dietary diversity score (DDS) showed that the children's diet quality in this population was not significantly associated with food neophobia (Table 4). This may be because most neophobic children had scores close to the mean DDS. However, their diets consisted of a small variety of foods, primarily refined rice and other low-nutrient-dense foods, with minimal contributions from fruits and vegetables, consistent with a report on Filipino children's intake and food sources [22]. Furthermore, looking into the intake per DDS food group, it can be noted that there is a significant negative association between food neophobia and the consumption of legumes (p-value=0.041) and non-vitamin A-rich vegetables (p-value=0.048) (Table 5). Neophobic children had limited or no intake of foods from these two DDS food groups. A probable reason for this is the children's innate tendency to dislike bitter- and sour-tasting foods, which are common vegetable characteristics [7].

Table 4. Dietary diversity scores (DDS) of children ages 2 to 5 in Barangay Gulang-gulang, Lucena City, Philippines, according to the level of food neophobia (n=88)

Dietary Diversity Score (DDS)	Total (*n* 88)		Level of Food Neophobia						*p*-value
			Low (*n* 15)		Medium (*n* 50)		High (*n* 23)		
	f	%	f	%	f	%	f	%	
Overall DDS									0.446
1	0	0.0%	0	0.0%	0	0.0%	0	0.0%	
2	1	1.1%	0	0.0%	1	1.1%	0	0.0%	
3	13	14.8%	1	1.1%	9	10.2%	3	3.4%	
4	33	37.5%	3	3.4%	21	23.9%	9	10.2%	
5	29	33.0%	9	10.2%	12	13.6%	8	9.1%	
6	11	12.5%	2	2.3%	6	6.8%	3	3.4%	
7	1	1.1%	0	0.0%	1	1.1%	0	0.0%	
8	0	0.0%	0	0.0%	0	0.0%	0	0.0%	
9	0	0.0%	0	0.0%	0	0.0%	0	0.0%	

* denotes that association is significant at the 0.05 level (2-tailed)
** denotes that association is significant at 0.01 level (2-tailed)

Table 5. Consumption of the nine dietary diversity scores (DDS) food groups by children ages 2 to 5 in Barangay Gulang-gulang, Lucena City, Philippines, according to the level of food neophobia (n=88)

Dietary Diversity Score (DDS) Food Group	Total (*n* 88)		Level of Food Neophobia						*p*-value
			Low (*n* 15)		Medium (*n* 50)		High (*n* 23)		
	f	%	f	%	f	%	f	%	
Cereals, grains, and tubers	88	100.0%	15	17.0%	50	56.8%	23	26.1%	[a]
Meat, poultry, and fish	81	92.0%	15	17.0%	45	51.1%	21	23.9%	0.415
Dairy	59	67.0%	8	9.1%	33	37.5%	18	20.5%	0.109
Egg	36	40.9%	7	8.0%	17	19.3%	12	13.6%	0.570
Pulses, legumes, and nuts	3	3.4%	2	2.3%	1	1.1%	0	0.0%	**0.041***
Vitamin A-rich fruits and vegetables	6	6.8%	2	2.3%	2	2.3%	2	2.3%	0.727
Other fruits	11	12.5%	1	1.1%	7	8.0%	3	3.4%	0.625
Other vegetables	30	34.1%	8	9.1%	17	19.3%	5	5.7%	**0.048***
Oils and fats	77	87.5%	14	15.9%	44	50.0%	19	21.6%	0.328

* denotes that association is significant at the 0.05 level (2-tailed)
** denotes that association is significant at 0.01 level (2-tailed)
[a] cannot be computed because at least one of the variables is constant

In contrast, these children frequently consumed sugar-sweetened beverages, sweet bread, biscuits, and native and savory snacks. These discretionary foods are readily available and accessible because of several neighborhood sundry stores nearby. In addition, of all the selected nutrients evaluated to determine the diet quality of the sample population, there is a significant positive association with food neophobia and the intake of phosphorus (p-value=0.002), vitamin A (p-value=0.027), and riboflavin (p-value=0.037). Interestingly, however, more neophobic children had excessive intakes of energy, protein, and selected nutrients (Fig 1). This may be partly due to the increased intake of discretionary foods, as these also contain significant amounts of macro and micronutrients. Another hypothesis for this excessive intake was the limitation of the 24-hour food recall, as it is susceptible to overestimation.

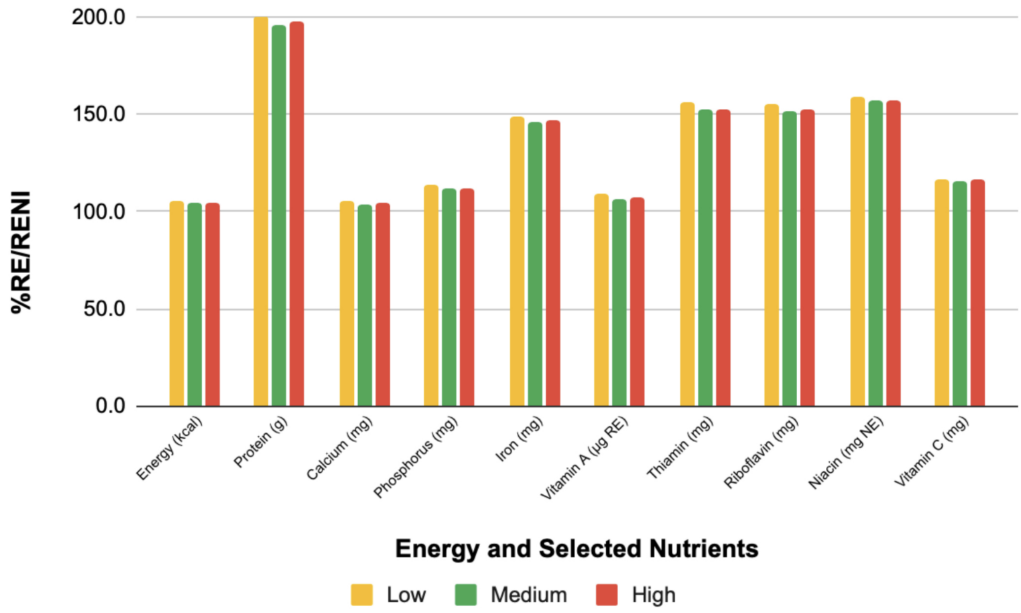

Figure 1.
Average percentage achievement of the recommended intake for energy and selected nutrients of children aged 2 to 5 in Barangay Gulang-gulang, Lucena City, Philippines, according to the level of food neophobia (n=88)

3.5 Factors Affecting Food Neophobia in the Sample Population

In addition to several socioeconomic factors, only temperament, home food environment, and rewards were found to be significantly associated with food neophobia (Table 6). There is a negative correlation between temperament and food neophobia (p-value=0.000), suggesting children who exhibit shyness or inhibited behaviors are more likely to have higher levels of food neophobia. In terms of the home food environment, children are more likely to have higher levels of food neophobia if they have limited healthy foods at home (p-value=0.001). Regarding the use of rewards, children who are rewarded frequently with food items for eating healthy or novel food are more likely to develop neophobic behaviors (p-value=0.048).

Table 6. Intrinsic and extrinsic factors affecting food neophobia among children ages 2 to 5 in Barangay Gulang-gulang, Lucena City, Philippines, according to the level of food neophobia (n=88)

Intrinsic and Extrinsic Factors	Total (*n* 88)		Level of Food Neophobia						*p*-value
			Low (*n* 15)		Medium (*n* 50)		High (*n* 23)		
	f	%	f	%	f	%	f	%	
Sensory Sensitivity									0.130
Yes	65	73.9%	8	9.1%	39	44.3%	18	20.5%	
No	23	26.1%	7	8.0%	11	12.5%	5	5.7%	
Temperament									**0.000****
Yes	49	55.7%	4	4.5%	26	29.5%	19	21.6%	
No	39	44.3%	11	12.5%	24	27.3%	4	4.5%	
Early Food Experiences (Age of Weaning)									0.173
< 6 months	1	1.1%	1	1.1%	0	0.0%	0	0.0%	
at 6 months	6	6.8%	1	1.1%	4	4.5%	1	1.1%	
> 6 months	81	92.0%	13	14.8%	46	52.3%	22	25.0%	
Parental Feeding Practices (Parental Modeling)									0.853
Yes	71	80.7%	11	12.5%	43	48.9%	17	19.3%	
No	17	19.3%	4	4.5%	7	8.0%	6	6.8%	
Parental Feeding Practices (Home Food Environment) (									**0.001****
Yes	83	94.3%	15	17.0%	50	56.8%	18	20.5%	
No	5	5.7%	0	0.0%	0	0.0%	5	5.7%	
Parental Feeding Practices (Food Restriction)									0.145
Yes	75	85.2%	10	11.4%	45	51.1%	20	22.7%	
No	13	14.8%	5	5.7%	5	5.7%	3	3.4%	
Parental Feeding Practices (Encouragement at Mealtimes)									0.331
Yes	80	90.9%	13	14.8%	45	51.1%	22	25.0%	
No	8	9.1%	2	2.3%	5	5.7%	1	1.1%	
Parental Feeding Practices (Rewarding)									**0.048***
Yes	58	65.9%	7	8.0%	33	37.5%	18	20.5%	
No	30	34.1%	8	9.1%	17	19.3%	5	5.7%	

* denotes that association is significant at the 0.05 level (2-tailed)

** denotes that association is significant at 0.01 level (2-tailed)

3.6 Perceived Interventions to Address Food Neophobia in Children

Included in the survey questionnaire were the participant's perceived intervention measures to address food neophobia (Fig 2). Most parents responded that increasing children's exposure to a larger variety of food, with repeated sampling, can potentially decrease their tendency to exhibit neophobic behaviors (50.0%). This is then followed by promoting healthy eating and encouraging eating, representing 15.9% and 10.2% of the responding parents, respectively.

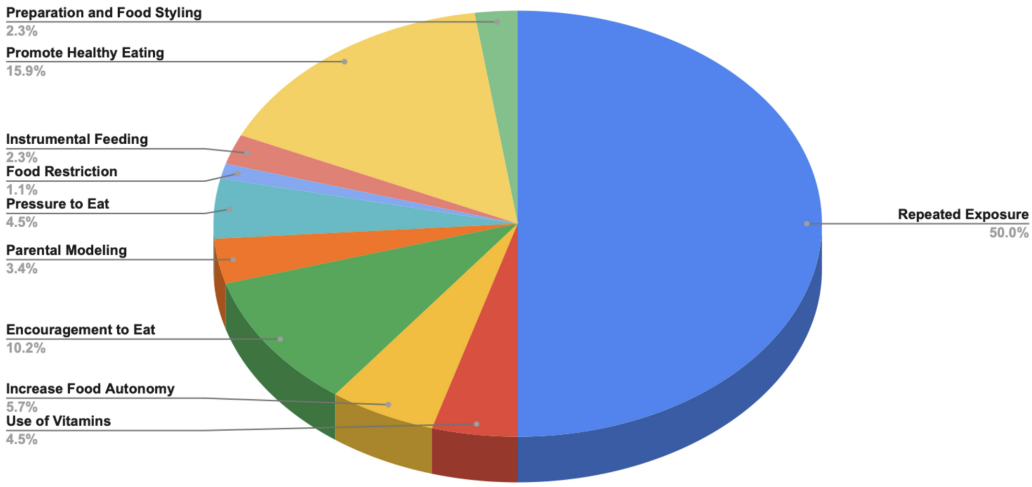

Figure 2.
Respondent's perceived intervention measures to address food neophobia in children

4 Discussion

Food neophobia—the aversion to unfamiliar foods at mere sight [23]—was initially thought to be a defense mechanism against eating foods harmful to health. However, emerging studies suggest that it is more frequently linked to adverse effects, such as decreased food diversity and quality and poor nutritional status [8, 24, 25]. Therefore, this study aimed to determine the association of food neophobia with nutritional status and diet quality and identify factors affecting its development.

Study results indicated no association in terms of the demographic variables of sex and age. This is consistent with several studies done in China [2, 26], Italy [27], Hungary [28], Brazil [1], and Saudi Arabia [10]. However, some studies suggest that boys tend to exhibit more food-neophobic, which is most likely because, practically at every age, they tend to have relatively less healthy food preferences than girls [1]. Regarding age, several studies indicate that older children are less neophobic than younger children, implying that food neophobia tends to decline with age. This can be attributed to increased environmental interaction and exposure to new foods. As a result, fewer foods are novel to older children than to their younger peers [29].

In this population, nutritional status was not significantly associated with food neophobia. Study results were the same as those in a Polish population of kindergarten children aged 3-7 years old [9] and in an Irish population of preschool children of 1-4 years old [8]. These studies noted that the percentage of neophobic children was highest among children with normal weights. Contrarily, in an Italian cohort of 2-6 years old children, weight status was significantly associated with food neophobia, with children that were overweight or obese being much more neophobic and picky [30]. This is probably because food-neophobic children consume fewer fruits and vegetables than they should and a lot more indulgent, calorie-dense, high-fat, high-sugar foods, putting them at risk for weight gain and adiposity [3, 4]. There is conflicting evidence that weight and height status have a link with food neophobia. However, it is crucial to note that in the vast majority of cross-sectional studies examining food neophobia alone, weight, even height, in children did not show a significant correlation with this eating behavior [9, 31, 32]. Because of the inadequate evidence to support a strong relationship between child weight, height status, and food neophobia, there is a need for additional research, particularly to look at the relationship between food neophobia and children's weight and height development prospectively over a range of child ages.

Notwithstanding the study results that food neophobia was not significantly associated with

diet quality, food neophobic children had limited or no intake of legumes and non-vitamin A-rich vegetables and increased intake of snack foods, such as sweet bread, biscuits, and native and savory snacks, among others which conforms with several studies [9, 32, 33]. This behavior may be attributed to many vegetables' naturally bitter taste since young children innately reject bitter-tasting foods [25, 34], particularly if they have no previous experience with the food in question [28]. Additionally, they naturally prefer salty and sweet flavors to bitter and sour ones, with fatty, sugary foods being the most preferred [7]. Another potential explanation for this rejection is that food neophobia is an evolutionary survival trait that enables young children to avoid potentially harmful foods as they experience increased mobility and autonomy [24, 33]. And, since these novel foods may be perceived as different, they might cause a strong neophobic reaction because plant foods in the hunter-gatherer years posed a considerable risk of poisoning [32]. Likewise, a study in China that used the dietary diversity score also reported the same results [32]. This study found that vegetables (apart from legumes), fruit, beans and bean products, meat and poultry, fish and shrimp, and internal organs of animals were consumed less frequently each week by toddlers with a high degree of food neophobia, with increased consumption of snacks and sugar-sweetened beverages, ultimately leading to poor dietary diversity. This may be explained by the odor, taste, texture, and difficulty these children experience chewing such foods.

Although no significant associations were drawn in terms of diet quality and nutritional status, study results suggest that several socioeconomic, intrinsic, and extrinsic factors influenced food neophobia among the study children. These factors are parental education, family income, temperament, home food environment, and rewards. First, food neophobia is more likely to develop among children with parents with low education levels, the same in the Irish [31] and Finnish populations [35]. This implies that parents who attain higher education are more financially likely able to expose their children to a wider variety of food and food-related events and, via their actions, encourage them to be more receptive to new food experiences, reducing their propensity for food neophobia [36]. On the other hand, food neophobia is more likely to develop in low-income households, the same in the Brazilian [37] and Saudi Arabian populations [10]. There is an implicit relationship between family income and food neophobia, which may be explained by increased access and exposure to a larger variety of food as income increases, thereby decreasing food-neophobic tendencies [38]. This is, in fact, highly studied, suggesting that diet quality and diversity vary between families apropos of household income [39, 40]. For instance, higher-income households will typically consume diets that are more in line with recommendations, with a higher intake of fruits and vegetables.

Furthermore, children who exhibit shyness or inhibited behaviors are more likely to have higher levels of food neophobia. The same was observed among school-aged children in northern Spain [41], indicating that trait anxiety of children and adolescents with food neophobia was higher than that of their neophilic peers. This was also coupled with a lower score on the social and family dimensions of self-concept. Children are also more likely to have higher levels of food neophobia if they have limited healthy foods at home. One study in China had similar results [36]. Limited studies have been done associating food availability and accessibility with food neophobia per se. However, taking into account that availability and accessibility have a direct association with diet diversity [42] and food exposure, the relationship between home food environment and food neophobia can, therefore, be drawn. That is, lack of exposure to a range of foods at home, both visually and through increased availability, prompts a child to be less likely to try new foods, increasing the likelihood of developing food neophobia. If homes have available and accessible healthy foods for children, they would have greater exposure to a variety of foods, decreasing their risk of exhibiting food neophobic behaviors [43]. Lastly, children who are rewarded frequently with food items for eating healthy or novel food are more likely to develop neophobic behaviors. Study results were similar to the Chinese population [32]. This may be explained by the tendency of the children to

increase cravings and consumption of food-based rewards while having the propensity to refuse the new food. This is in view of the fact that food-based rewards frequently contain significant amounts of calories and sugar, such as sweets or desserts, which can also prompt unhealthy eating habits [44]. Several reviews further supported this, citing that if rewarded, for example, with candy for eating a novel food, such as broccoli, children will more likely develop an increased liking for the food reward and a decreased preference for the novel food. In contrast, when given small non-food rewards, such as stickers, children are more likely to show a more significant likelihood of consuming the novel food [36, 45].

It should be noted that interventions are necessary if intakes become deficient due to refusal to eat novel foods such as fruits and vegetables, which contain essential nutrients required for healthy growth and development, especially in childhood. Studies suggest that repeated exposure is a simple yet effective method for improving the consumption of novel vegetables among preschool children, even though it may result in a boredom effect and monotony [23, 46]. However, repeated exposure to novel food only encourages acceptance if the food is tasted. This is particularly true for children ages 2 to 5, with insufficient visual exposure [36]. This, therefore, suggests that exposure interventions should include both senses of sight and taste. However, further research is needed to support the observed dietary changes in children who have participated in exposure interventions.

5 Conclusion

This present study aimed to describe food neophobia in relation to nutritional status and diet quality in selected Filipino children ages 2 to 5, as well as to identify factors affecting the development of food neophobia among the study children. No significant associations were noted between food neophobia and nutritional status. This can be attributed to the result that most children with high levels of food neophobia had normal weights for their height and heights for their age. There was also no significant association regarding diet quality. However, food-neophobic children had limited or no intake of legumes and non-vitamin A-rich vegetables and increased intake of snacks and discretionary foods. The fact that children naturally reject bitter-tasting foods due to an evolutionary feature developed to prevent poisoning and naturally prefer salty and sweet flavors may account for these findings. Although no significant associations were drawn in terms of diet quality and nutritional status, study results suggest that several socioeconomic, intrinsic, and extrinsic factors influenced food neophobia among the study children. Food neophobia in this cohort was attributed to parental education, household income, children's temperament, home food environment, and rewards. Increasing food exposure represents half the perceived interventions to address food neophobia. However, results warrant further research to support the observed dietary changes due to repeated exposure and develop novel interventions to address food neophobia in children.

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