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Article

Nutrition Literacy and Food Practices of Preschool Teachers in Greece

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Abstract: Nutrition literacy, defined as “the skills to comprehend and implement nutrition information into everyday practice”, is a new area of study. Preschool teachers affect children’s perception of nutrition and health and contribute to their nutrition literacy skills. This cross-sectional study aimed to assess the level of nutrition literacy (NLS-Gr) of preschool teachers. The research included two stages of cluster sampling in a sample of kindergarten teachers in Greece (Rhodes Island). Nutrition literacy was assessed with NLS-Gr, the Greek version of NLS, and adherence to Mediterranean diet with MEDDIET score. The mean NLS-Gr score was 25.87 (SD±2.2) and is considered adequate. The correct answers range from 65.1% to 100%. Meddiet score was calculated at 33.94 (SD±3.8), and no correlation was found between Meddiet score and NLS-Gr. The NLS-Gr score of kindergarten teachers was adequate, higher than that of previous research on different populations. Yet their adherence to the Mediterranean diet requires improvement and food waste reduction. Educators should be empowered through targeted educational interventions to enhance students' health and nutritional behaviors. Further research could contribute to formulating nutrition strategies and policies in kindergarten.

Keywords: nutrition literacy (NLS-Gr); MEDDIET score; preschool teachers; food practices

1. Introduction

Modern technological advancements and large-scale industrialization have drastically altered agricultural practices, resulting in increased food production, a global trade network, and a surge in processed foods [1]. While this has led to positive outcomes such as an increase in life expectancy, it has also contributed to a decline in dietary quality, becoming a primary factor in the global disease burden. A significant portion of the world's population currently experiences various forms of malnutrition, including undernutrition, micronutrient deficiencies, overweight, obesity, and related non-communicable diseases [2]. In many developing nations, children face a “double burden” of malnutrition, experiencing simultaneously the challenges of undernutrition (such as stunting and wasting) and the increasing prevalence of overweight and obesity. This double burden significantly impacts their health and cognitive abilities [3]. Furthermore, climate change threatens ecosystems, biodiversity, agricultural production, and food security, while population growth intensifies food security challenges [4].

Under these circumstances, in the last decades, new concepts have emerged in research and policy, such as “health literacy” and related terms “nutrition literacy” and “food literacy”[5]. “Nutrition literacy” is defined as “the degree to which individuals can obtain, process, and understand basic nutrition information and nutrition services they need to make appropriate nutritional decisions [6,7]. Furthermore, there is evidence that nutrition literacy is critical for better

nutritional habits and overall diet[8,9]. Adherence to a balanced diet is positively associated with higher nutrition and food literacy skills [10]. Other researchers suggest that nutrition literacy predicts adherence to healthy/unhealthy diet patterns [9]. Tools intended for nutrition literacy assessment focus primarily on functional nutrition literacy [11], even though some researchers [12] developed a critical nutrition literacy scale and highlighted the importance of skills beyond basic knowledge, such as effectively communicating about nutrition and taking action within social contexts to overcome barriers to healthy eating. Naigaga et al. [13] emphasize that the two aspects of critical nutrition literacy – “critical evaluation of nutrition information” and “engagement in dietary behavior” are linked at a personal level.

However, there hasn't yet been a consensus among researchers about one generic method of measuring health and nutrition literacy [11,14]. Vamos et al. and Nutbeam [15,16] share a similar perspective, asserting that health literacy skills continuously evolve, enrich, and develop throughout individuals' lives within diverse and rapidly changing environments and contexts. It represents a continuous and lifelong learning process and qualitative education that is essential for achieving health literacy across different groups. Therefore, nutrition literacy is interconnected with social institutions such as schools, families, and the welfare state, aiming at the health promotion of individuals, families, and communities throughout their lifespan [17].

Research on nutrition literacy in Mediterranean countries is limited. Mohsen et al. [22] conducted research on food and nutrition literacy in the Middle East and North Africa, including countries of the Mediterranean (e.g., Lebanon, Morocco, Syria, etc.). In some of these countries, nutrition literacy was assessed. In this research, participants were insufficiently literate in food and nutrition, especially regarding their skills rather than their cognitive domain [18].

In Greece, even though the national dietary guidelines provide a nutritional framework for the Greek population based on age, to our knowledge, there is no official national policy for improving the health and nutrition literacy of the population [19]. Limited studies about nutrition literacy were conducted recently in the Greek population [20,21]. In a study in the Greek population, better parental feeding practices were significantly and positively associated with higher levels of parents' health and nutrition literacy[22].

Schools, as prominent social institutions, play a crucial role in shaping children's educational and nutritional experiences. Nutrition education in the school context significantly affects the health and well-being of students during their childhood and later stages of life [23]. In school-based programs, teachers have a critical role in implementing educational materials and innovative practices about health and nutrition literacy. Effective nutrition education interventions in school settings are long-lasting and comprehensive and take into account the students' social environment, such as family, other students and classmates, teachers, and the local community [24,25]. Research also suggests that such interventions are effective when they are based on best evidence-based practices and included in the school curricula and everyday activities[26].

In Greece, nutrition policy during the preschool years has many discrepancies in its overall structure. For instance, in public kindergarten, families are responsible for the meals of the preschoolers (preparation, cost, etc.), and teachers are responsible for advocating nutrition education for preschoolers and, consequently, for their parents. A comparative analysis of nutrition education in Greece against other nations like Sweden and the USA exposes notable shortcomings in educational nutritional strategies. Beneficial practices in dietary education for students should be implemented in Greece under particular economic and social circumstances [27].

Empowering preschool teachers to advocate for nutrition education and health promotion initiatives for preschoolers is crucial [28]. They play a pivotal role in implementing nutritional educational materials within the curriculum, regardless of the level of detail provided. Teachers, especially, have a distinct opportunity to design and execute inventive programs to meet students' health and educational requirements. They can offer formal and informal educational experiences focused on healthy eating and lifestyles to prevent obesity [29,30]. Educators should be empowered to promote nutrition education and health promotion programs for students. They are a key factor in

implementing educational materials for nutrition included in the curriculum, whether detailed or not [24].

The study aims to assess the level of nutrition literacy of preschool teachers and their adherence to the Mediterranean diet in the context of sustainable kindergarten in Greece. Even though the role of preschool teachers in students' nutrition education is robust, a gap exists in the literature regarding the impact of empowering teachers as change agents in delivering integrated nutrition knowledge into core subjects. Measuring the teachers' nutrition literacy could contribute to research development about nutrition policy formulation in kindergarten and prevent nutritional deficiencies and excess weight in young children. To the best of our knowledge, this is the first research conducted in this population group to date, and it could contribute to promoting nutrition education for preschoolers and improving their dietary habits in the context of health-promoting schools.

2. Materials and Methods

2.1. Ethical Aspects

University of the Aegean approved the study protocol with the approval decision 690/18.03.2021. The research complies with the ethical rules and principles of the Ethics and Deontology Committee of the University of the Aegean and according to the University's Code of Ethics and Deontology of Research. Participants were informed about the study and its purpose via email. Participation in the research was voluntary. The confidentiality of their responses was also emphasized, ensuring their information was used solely for research purposes and protected from unauthorized access.

2.2. Subjects and Criteria for Participation in the Study

The research was conducted during the school year 2021-2022. The data collection commenced in November 2021 and was completed in February 2022. The questionnaire was online and anonymous and included anthropometric measures like height and weight. Preschool teachers self-reported data of anthropometric measurements. BMI was calculated as weight/height^2 (kg/m^2). Specific criteria of inclusion and exclusion for participation in the study were applied. Kindergarten teachers who served in a public primary school on the island of Rhodes were included in the study. In contrast, kindergarten teachers were excluded if they served in private schools because the nutrition policy diverged, the institutes prepared the school meals, and both preschool teachers and parents had limited control over meal selection. Preschool teachers who weren't employed in any kindergarten were also excluded. Participants were informed about the questionnaire via email, and the completion was done online. The questionnaire was not distributed on social media to omit answers from non-kindergarten teachers. Additionally, the researcher communicated with the kindergarten principals' multiple times to ensure better response rates and inform the entire population of kindergarten teachers. The research was conducted when various COVID-19 containment measures were implemented and prohibited the physical presence of researchers in schools.

2.3. Study Design

The present study is cross-sectional. Before officially distributing the survey, a pilot study involving 20 individuals was conducted. The distribution, data collection, and analysis processes were thoroughly tested. A total of 149 kindergarten teachers serving in public schools on the island of Rhodes, out of a total of 228, participated in the research. The sample selection included the two-stage cluster sampling method. This probability sampling method divides the target population into groups, such as regions or schools [31]. This specific type of sampling was carried out in two stages. In the first stage, the clusters (schools) were sampled, and in the second stage, the participants (kindergarten teachers) were selected from each cluster (school). In the present research, kindergartens on the island of Rhodes represent the clusters, and kindergarten teachers participate in each cluster.

2.4. Sample Size

The sample size was initially approached according to Simple Random Sampling. This means that each member of the population of preschool teachers must have the same probability as the rest of the members to be selected in the sample. Specifically, for a Type I error of 5%, a confidence interval of 95%, a population size of 228 preschool teachers on the island of Rhodes, and a response distribution of 50%, it was found that the required sample size is 143 individuals. The above method is integrated into various available online tools, such as <https://www.calculator.net/sample-size-calculator.html> and <http://www.raosoft.com/samplesize.html>, and others [32].

The usual sample size estimates assume the independence of observations. Clustering involves designing choices made by the researcher to avoid the phenomenon called contamination. Even in cases where the risk of contamination is possible, randomizing the sample can be a suitable choice in research design aimed at estimating the effect of a factor under real-world conditions [33]. During research design, increasing the number of clusters (kindergartens) may increase the power of the study more than increasing the elements within clusters (teachers). Fixed formulas can be used for sample size, but in order to determine the effective sample size, adjustments should be made using the design effect to find the required sample size [34–36]. The intraclass correlation coefficient (ICC) is a measure of correlation within clusters. In studies involving human subjects, it is usually small, but the design effect is magnified by the number of elements within the cluster (m). The smaller the design effect, the greater the efficiency of the sample size [34]. Therefore, the initial sample of 143 kindergarten teachers should be increased by 2.8%. Considering all the above, the research sample should be adjusted using the research's impact and ultimately amount to 147 kindergarten teachers. Additionally, two more questionnaires were added (10% extra), resulting in a final sample size of 149 kindergarten teachers.

2.5. The Questionnaire

Different research tools emerged from the literature review based on the research questions for the implementation of the research. A questionnaire consisting of 65 questions was developed, weighted, and included the MedDietScore tool by Panagiotakos et al. [36] and the NLS-GR tool by Michou et al. [20].

The questionnaire intended for preschool teachers included anthropometric characteristics of the sample (gender, height, weight, age), adherence to the Mediterranean Diet using the MedDietScore tool, level of physical activity, and sedentary lifestyle, which included four questions about physical activity and sedentary behavior on weekdays and weekends and, lastly, nutrition literacy scale the NLS-GR tool. Socioeconomic characteristics of the sample, including educational level, type of employment, and net family income. An additional question for parents asked whether the children lived with one or both parents.

2.5.1. MedDietScore Tool

Regarding the MedDiet score, a tool for measuring adherence to the Mediterranean Diet was developed by Panagiotakos et al. [37] and has been applied to Greek populations [37–40]. It is considered a valid and scientifically well-recognized tool for assessing adherence to the Mediterranean Diet according to review studies and comparisons of different tools for assessing Mediterranean Diet adherence in healthy adults [41].

2.5.2. NLS-GR Tool

Nutrition Literacy Scale for the Greek population (NLS-Gr) is a tool designed to assess the degree to which adults, parents, and educators are sufficiently informed and able to apply their knowledge to make conscientious decisions regarding their nutrition and health. This tool is the Greek version of the NLS tool [42] and includes 29 questions to assess the nutrition literacy of adults [43]. The reliability of the Greek version of the NLS-Gr is tested and is considered a valid tool for measuring

nutrition literacy among healthy adult populations with satisfactory psychometric characteristics [43].

2.5.3. Statistical Analysis

Data analysis was performed using the Statistical Package for the Social Sciences 27.0 (SPSS Inc., Chicago, IL, USA). First, the demographic characteristics of participants were described. Independent Samples t-test and One-way ANOVA, as well as the corresponding non-parametric Mann-Whitney U test and Kruskal-Wallis H test, were used to investigate the relationships between qualitative and quantitative variables. In the case of a statistically significant result in the One-way ANOVA and Kruskal-Wallis tests, repeated tests (post-hoc tests) were applied using the Bonferroni correction. In addition, to investigate the relationship between quantitative and ordinal variables, Spearman's correlation coefficient (r_s) was calculated along with 95% confidence intervals (95% CI). Finally, the χ^2 test (chi-squared test) and Fisher's exact test (Fisher's exact test) in case of expected counts (expected counts) lower than 5 were applied to investigate correlations between qualitative variables. For all tests, $p < 0.05$ was considered statistically significant. All tests performed were two-sided. For the presentation of the qualitative variables, frequencies were used along with percentages, n (%), and bar graphs. In the quantitative variables, either the mean value with the standard deviation (mean SD) or the median value with the interquartile range (median Q1-Q3) were analyzed depending on whether the condition of normality was met, as well as boxplots. Normality testing was performed with the Shapiro-Wilk test and appropriate graphs (Histograms and Q-Q plots).

3. Results

3.1. Sample Characteristics

The sample consisted of 96% females (143) and 4% males (6). Most preschool teachers, at a percentage of 43.6%, were aged 44-55 years old, 38.3% were aged 33-43 years old, 17.4% were aged 22-32 years old, and 0.7% were older than 56 years old.

Table 1. Sample descriptive characteristics for total ($n=149$).

Sample characteristics	Participants ($n=149$)
Gender, n (%)	
Male	6 (4.0)
Female	143 (96.0)
Age in years, n (%)	
22-32	26 (17.4)
33-43	57 (38.3)
44-55	65 (43.6)
>56	1 (0.7)
Weight in Kg, Median value	62 (55.0-71.5)
Height in m, Mean value (SD)	1.64 (0.08)
BMI Kg/m², Median	23.34 (20.82-25.74)
Body weight, n (%)	
Underweight	8 (5.4)
Normal weight	96 (64.4)
Overweight	32 (21.5)
Obese	13 (8.7)
Education, n (%)	
B.Sc. Degree	69 (46.3)
M.Sc. Student	17 (11.4)
M.Sc. Degree	57 (38.3)
PhDc	4 (2.7)

PhD	2 (1.3)
Years of teaching experience, n (%)	
≤1	12 (8.1)
1-10	44 (29.5)
11-15	32 (21.5)
16-20	29 (19.5)
>20	32 (21.5)
Marital status, n (%)	
Single	31 (20.8)
Married	112 (75.2)
Divorced	6 (4.0)
Net Annual family income, n (%)	
<10.000 €	29 (20.0)
10.001-20.000 €	76 (52.4)
20.001-30.000 €	27 (18.6)
>30.000 €	13 (9.0)

Q1-Q3: SD: Standard deviation.

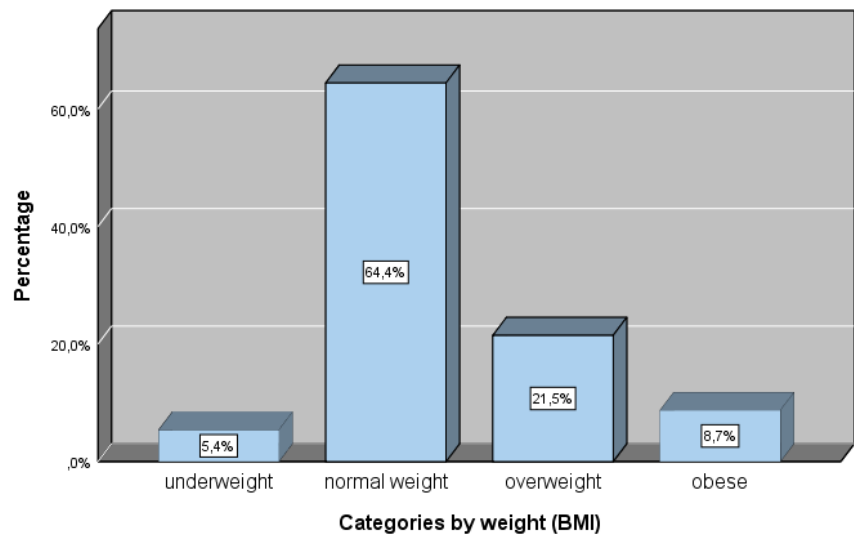


Figure 1. Distribution of BMI categories (underweight, normal weight, overweight and obese) (%).

3.1. NLS-Gr

The correct answers of kindergarten teachers in the questionnaire about nutrition literacy are shown in Table 2. The percentage of correct answers was high, ranging from 65.1% to 100%. The mean score (mean) of the NLS-GR rating for the sample of kindergarten teachers was 25.87 (SD±2.203) for the total of 29 questions in the tool. The nutrition literacy level in this research is considered adequate. Scores from 0-7 are categorized as inadequate, 8-14 are marginal, and 15-29 are adequate [42].

Table 2. Items of the Greek NLS by percentage answered correctly.

Correct answers of the Greek NLS by percentage	N (%)
Healthy eating is really supposed to help our hearts.	146 (98.0)
However, no single food can supply all the nutrients we need.	114 (76.5)
Eating a variety of foods ensures you get all the nutrients needed for good health.	145 (97.3)
Grains, fruits, and vegetables are food groups that form the basis of a healthy diet.	98 (65.8)
For a healthy diet, we are advised to eat five servings of fruits	137 (91.9)

and vegetables each day.	143 (96.0)
Foods like butter have a lot of saturated fat, which can increase cholesterol.	145 (97.3)
We also know that cholesterol can be affected by foods high in trans fatty acids.	125 (83.9)
Experts often say to avoid foods high in trans fatty acids	147 (98.7)
because they are fattening.	147 (98.7)
Obesity increases the risk of diseases such as diabetes.	146 (98.0)
Fiber is the part of plant-based foods that your body does not digest and absorb.	142 (95.3)
Whole grains provide more fiber than processed grains.	133 (89.3)
A good diet should contain approximately 25–30 grams of fiber a day.	131 (87.9)
Calcium is essential for bone health	149 (100.0)
As you age, your bones may get thinner as minerals are lost.	106 (71.1)
Even in older people, vitamin D is needed to keep bones healthy.	148 (99.3)
Foods with added sugars are sometimes called foods with empty calories.	97 (65.1)
To prevent illness from bacteria	124 (83.2)
keep eggs in the refrigerator.	147 (98.7)
Farmers who grow organic foods don’t use conventional methods.	137 (91.9)
They control weeds by techniques such as crop rotation rather than pesticides.	135 (90.6)
For this and other reasons, organic food costs more than conventional food.	118 (79.2)
A 180-calorie serving with 10 grams of fat has 50% of its calories from fat.	148 (99.3)
A 140-pound (64 kg) woman needs about 51 grams of protein daily.	143 (96.0)
Using fat-free mayonnaise on a sandwich can reduce the grams of fat.	107 (71.8)
My doctor told me that “fat-free” is not the same as calorie-free.	138 (92.6)
She also told me to make the size of my portions smaller	132 (88.6)
to help control my weight.	127 (85.2)

3.2. NLS-Gr and Association with Education, Professional Experience, Weight Classification and Family Income

Table 3 shows the relationship between nutrition literacy and educational level, years of teaching experience, postgraduate studies, and net annual family income. As presented in this table, only one statistically significant relationship emerged between nutrition literacy and the variable pertaining to annual family income (p-value=0.048). According to the Bonferroni correction, the group earning <10,000 euros is statistically different from the group earning 10,001-20,000 euros (adj. p-value=0.043). Furthermore, the median value of nutrition literacy is lower for individuals with a net annual family income of <10,000 euros, as the median value of NLS-Gr for this income bracket is 25 (p-value=0.048, p<0.05). In contrast, for incomes of 10,001-20,000 euros, it is 27.

Table 3. Correlation between NLS-Gr score with income, professional experience, level of education.

	Nutrition literacy /NLS-Gr	
	Median (Q1-Q3)	p-value
Educational level		0.925
University Degree (BSc)	26 (24-28)	
Postgraduate Student	26 (24-27)	
Postgraduate Degree Holder	26 (24-27)	
PhD Candidate & Doctorate Holder	26.5 (24.5-28)	
Years of Teaching Experience		
≤1	25.5 (24-27)	0.192
1-10	26 (24-27)	
11-15	27 (26-27)	
16-20	27 (24.5-28)	
>20	26 (25.3-28)	
Classification Based on BMI, N (%)		

Underweight	24.5 (24-27)	0.227
Normal Weight	26.0 (24.3-27)	
Overweight	27 (25.3-28)	
Obese	26 (24-27)	
Net Annual Family Income		
<10.000 €	25 (23.5-27)	0.048*
10.001-20.000 €	27 (25-28)	
20.001-30.000 €	26 (24-28)	
>30.000 €	26 (26-27.5)	

*Statistical significance $p<0.05$.

3.3. NLS-Gr and Association with Food Practices and Food Waste

The relationship between nutrition literacy and preschool teachers' perspectives on food rejection, meal planning, organic product consumption, and waste composting is shown in Table 4. A statistically significant correlation was found between nutrition literacy and meal planning. As shown in the table, participants who organize and plan their meals have a higher median NLS score (md=27) compared to those who do not plan meals (md=25.5), and this difference is statistically significant ($p=0.017$, $p<0.05$).

Table 4. Correlation between NLS-Gr score with food choices and food waste.

	Nutrition literacy/NLS-Gr	
	Median (Q1-Q3)	p-value
Meal Planning		0.017*
No	25.5 (24-27)	
Yes	27 (25-28)	
Shopping List		0.976
No	26.5 (24.0-27.8)	
Yes	26 (24-28)	
Storage of fruits and vegetables in the refrigerator		0.438
No	25.5 (24.0-27.3)	
Yes	26 (24-28)	
Food disposal		0.167
never or almost never	27 (25-28)	
rarely (a few times a year)	26 (24-27)	
sometimes (a few times a month)	27 (24-28)	
often (a few times a week)	26 (23.3-27.0)	
always (daily) -	-	
Organic food consumption		0.525
No	26 (24.0-27.5)	
Yes	26.5 (24-28)	
Composting food waste		0.359
No	26 (24-28)	
Yes	26 (23.5-27.0)	

* $p\text{-value}<0.05$.

3.4. NLS-Gr and Association with Meddiet Score

There was no statistically significant correlation between nutrition literacy, calculated using the NLS-GR tool, and adherence to the Mediterranean Diet, assessed with the MedDiet score tool. As illustrated in the corresponding scatter plot (Figure 2), a cloud of points is observed around the straight line, indicating no correlation between them. Furthermore, examining the relationship

between MedDiet score and NLS-GR using the Spearman coefficient (Table 5) did not reveal a statistically significant correlation ($p\text{-value}=0.202$, $p>0.05$).

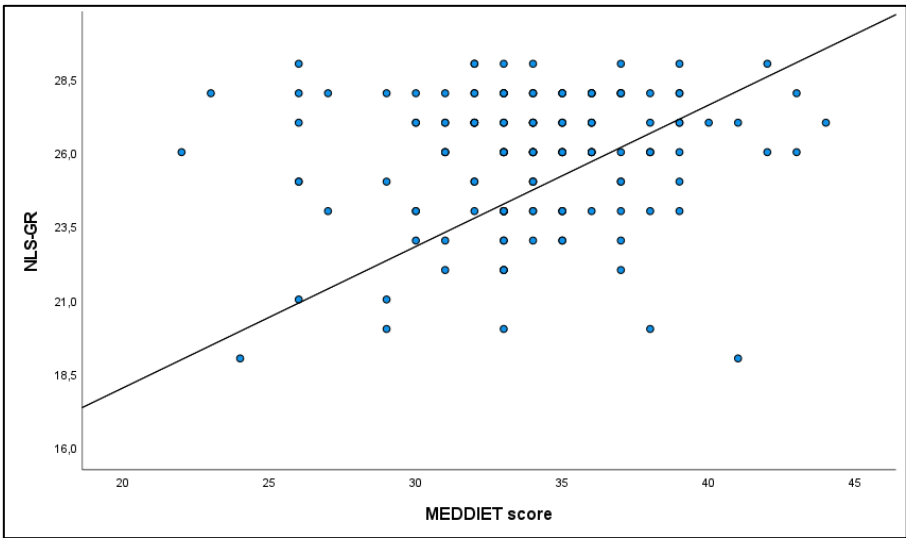


Figure 2. Scatter plot associating NLS-Gr and MedDiet score.

Table 5. Correlation between NLS-Gr score and Meddiet score.

	rs	p-value*
Spearman’s correlation coefficient	0.1 (-0.1, 0.3)	0.202

* p-value<0.05.

3.5. NLS-Gr and Correlation with BMI

Using the Spearman correlation coefficient (rs), no correlation was found between the total score of NLS-Gr and the educational level of kindergarten teachers ($rs = 0.03$, $95\% \text{ CI} = -0.14, 0.19$, $p = 0.764$) (Table 6)

Table 6. Nutrition Literacy (NLS-Gr) of Kindergarten Teachers by Educational Level.

Spearman	rs (95% CI)	p-value
BMI – NLS-Gr	0.03 (-0.1, 0.2)	0.764

Additionally, a non-parametric Kruskal-Wallis test was conducted, showing no statistically significant difference in NLS-Gr scores associated with the educational level of kindergarten teachers ($p = 0.227$, $p>0.05$).

3.6. Adherence to Meddiet and Weight Categories

According to the analysis of variance (ANOVA) test, no statistically significant difference was found between the consumption of specific food groups of the Mediterranean Diet (MedDiet score) and the categorization of body weight based on the BMI, as presented in Table 7.

Table 7. Nutrition Literacy (NLS-Gr) of Kindergarten Teachers and Body Weight Categories.

NLS-Gr, median (Q1-Q3)	Underweight	Normal	Overweight	Obese	p-value*
	24.5 (24-27)	26 (24.3-27.0)	27 (25.3-28)	26 (24-27)	0.227

* p-value<0.05.

3.7. Correlation of Adherence to Meddiet and Physical Activity

Non-parametric Spearman's correlation coefficient was used to examine associations between MedDiet components (food groups) and physical activity/sedentary behavior. As shown in Table 8, cereal, fruit, and vegetable consumption were significantly correlated with physical activity levels.

Specifically, the question "How often do you consume unprocessed cereals (whole meal bread, whole meal pasta, unprocessed rice, etc.)" was found to be associated with the questions "How many hours/ day do you lead a sedentary lifestyle" and "How many hours do you exercise per day on average" at a statistically significant level. Specifically, as the hours/ of a sedentary lifestyle increase, the consumption of unprocessed cereals in one week also increases ($r_s=0.9$, 95% CI 0.8, 0.9). Additionally, as the hours of daily exercise increase on average, the consumption of unprocessed cereals in one week also increases ($r_s=0.2$, 95% CI 0.1, 0.4).

A similar trend was observed in the kindergarten teachers' sample regarding weekly fruit consumption. Specifically, it was found that as the consumption of fruits per week increases, the hours/day of a sedentary lifestyle and the hours of daily exercise on average also increase ($r_s=0.3$; 95% CI (0.1, 0.4) and $r_s=0.2$; 95% CI (0.1, 0.4), respectively). Additionally, it was found that the hours/day of sedentary lifestyle on weekdays are positively associated with their weekly consumption of fresh or boiled vegetables ($r_s=0.3$; 95% CI (0.2, 0.5)). The hours/day of a sedentary lifestyle on weekdays are negatively associated with the consumption of dairy products ($r_s=-0.2$; 95% CI (-0.3, 0.0)). Lastly, the average hours of sedentary lifestyle led by kindergarten teachers on weekdays are negatively associated with frequent olive oil consumption ($r_s=-0.2$; 95% CI (-0.3, -0.02)).

Table 8. Meddiet score association with physical activity/sedentary lifestyle.

MedDiet score, Frequency of consumption/week rs (95% CI) p-value	Physical activity & Sedentary lifestyle		
	Sedentary lifestyle (hours, weekdays)	Sedentary lifestyle (hours weekends)	Average exercise /per day
whole grains	0.9 (0.8,0.9) <0.001	0.0 (-0.1,0.2) 0.639	0.2 (0.1,0.4) 0.009
potatoes	0.0 (-0.1,0.2) 0.780	0.0 (-0.2,0.2) 0.798	0 (-0.2,0.2) 0.933
fruits	0.3 (0.1,0.4) 0.002	-0.1 (-0.3,0.1) 0.171	0.2 (0.1,0.4) 0.009
vegetables	0.3 (0.2,0.5) <0.001	-0.1 (-0.3,0.1) 0.313	0.1 (0.0,0.3) 0.087
legumes	0.1 (0.0,0.3) 0.093	0.0 (-0.2,0.2) 0.861	0.1 (0.0,0.3) 0.105
fish and seafood	0.1 (-0.1,0.3) 0.181	-0.1 (-0.3,0.0) 0.083	0.2 (0.0,0.3) 0.067
red meat and meat products	0.2 (0.0,0.3) 0.064	-0.1 (-0.2,0.1) 0.502	0.2 (0.0,0.3) 0.055
poultry	0.0 (-0.1,0.2) 0.655	0.0 (-0.1,0.2) 0.597	-0.1 (-0.3,0.1) 0.210
diary full fat	-0.2 (-0.3,0.0) 0.026	-0.2 (-0.3,0.0) 0.068	-0.2 (-0.3,0.0) 0.078
olive oil	-0.2 (-0.3, -0.02) 0.025	0.1 (-0.1,0.2) 0.307	0.0 (-0.2,0.2) 0.868
alcohol	-0.1(-0.3,0.1) 0.291	0.0 (-0.2,0.1) 0.679	-0.2 (-0.3,0.0) 0.057

3.8. Food Disposal Practices

According to the teachers’ responses, the leading causes of food rejection are either spoilage before consumption or considering them as leftovers. The table above shows that the highest percentages are observed in these categories. Teachers could choose more than one type of food, as categorized in the questionnaire. Teachers reported that foods they mostly discard because of spoilage include vegetables (55 teachers), milk (48 teachers), and fruits (43 teachers), while less frequently mentioned are chicken (6 teachers) and fish (2 teachers). Foods that teachers stated they mostly reject because they spoil were milk and yogurts (62.5%), cheeses (75%), fruits (67.4%), vegetables (69.1%), soft drinks (76.9%), desserts (52.9%), meat (35.7%), fish (100%), and eggs (60%). In contrast, most teachers claimed that they discarded bread (61.0%), fats and oils (76.5%), chicken (66.7%), legumes (84.6%), rice, and pasta (87.0%) as leftovers.

Table 9. Food disposal by food categories and causes.

Food Categories (n)	Food Disposal			
	Spoilage Before Consumption	Expired Date Passed	During Cooking	As Leftovers
	n (%)	n (%)	n (%)	n (%)
Milk-Yogurts (n=48)	30 (62.5)	27 (56.3)	1 (2.1)	15 (31.3)
Cheese (n =12)	9 (75.0)	3 (25.0)	1 (8.3)	6 (50.0)
Fruits (n =43)	29 (67.4)	11 (25.6)	0 (0.0)	23 (53.5)
Vegetables (n =55)	38 (69.1)	16 (29.1)	0 (0.0)	30 (54.5)
Bread (n =41)	17 (41.5)	8 (19.5)	1 (2.4)	25 (61.0)
Fats-Oils (n =17)	7 (41.2)	4 (23.5)	2 (11.8)	13 (76.5)
Soft Drinks (n=13)	10 (76.9)	8 (61.5)	0 (0.0)	7 (53.8)
Desserts (n=17)	9 (52.9)	9 (52.9)	0 (0.0)	8 (47.1)
Meat (n=14)	5 (35.7)	4 (28.6)	2 (14.3)	11 (78.6)
Chicken (n=6)	4 (66.7)	3 (50.0)	1 (16.7)	4 (66.7)
Fish (n=2)	2 (100.0)	1 (50.0)	0 (0.0)	1 (50.0)
Eggs (n=10)	6 (60.0)	5 (50.0)	0 (0.0)	5 (50.0)
Legumes (n=13)	7 (53.8)	2 (15.4)	2 (15.4)	11 (84.6)
Rice-Pasta (n=23)	7 (30.4)	1 (4.3)	1 (4.3)	20 (87.0)

4. Discussion

The assessment of nutrition literacy using the NLS-Gr tool showed that the mean score for the sample of 149 kindergarten teachers was adequate for the overall 29 questions of the tool. In a previous study of Diamond [46] with 341 patients in the US the NLS tool was used and reported a mean score on the questionnaire of 23.7 (SD±4.1). Additionally, research [47] with 1281 adults in the Greek population, applying the NLS-Gr for the first time, the Greek version of NLS, reported that the mean score of the sample was 22.11 (SD±5.67). According to Sampaio et al. [44] , in a study with 38 individuals in Brazil, the mean NLS-Gr score was 22.7 (SD±3.9). In general, the NLS score in the present research is adequate and higher than previous studies conducted in Greece or other populations. In all cases, nutrition literacy is considered sufficient, as the score falls into the category of 15-29 [43] .

The participants' high levels of nutrition literacy may be explained by their higher educational level. However, our study found no statistically significant correlation between participants' nutrition literacy and holding a postgraduate or doctoral degree. In previous studies, nutrition literacy was higher in individuals with a higher educational level [25]. Additionally, in a study with 1281 adults in Greece, education was positively associated with nutrition literacy, as educated participants had higher nutrition literacy than non-educated ones [49]. Chronic disease is negatively associated with nutrition literacy, and especially nutrition literacy levels in Greeks with chronic disease could help individuals to manage chronic conditions better, thus reducing the overall burden of chronic diseases [50].

Numerous studies have associated nutrition literacy and socioeconomic status in different populations [45–48]. Research conducted in the Greek population [52] reported that participants with medium annual income had significantly higher nutrition literacy than participants with low annual income. Our findings are in line with this study, as it was found that participants with annual income had a lower NLS score than those with medium income at a statistically significant level.

Basic nutrition knowledge is positively associated with healthier eating habits Taylor et al. [9] suggest that a more comprehensive understanding about nutrition is a stronger predictor of dietary choices. Inadequate nutrition literacy leads to less desirable nutritional choices, such as adherence to a Western-type diet, in contrast to high nutrition literacy which is associated with better dietary habits, such as those found in the Mediterranean diet. A study of Italian adults showed a strong correlation between higher nutrition literacy and adherence to the Mediterranean diet, suggesting that a deeper understanding of nutrition empowers individuals to make healthier food choices [47]. They found a strong association between nutrition literacy and the Mediterranean diet, and there was a clear connection between a healthy dietary pattern and the nutrition literacy of the population. In contrast, in our study, nutrition literacy (NLS-Gr) was not associated with adherence to the Mediterranean diet. The percentage of correct answers ranged from 65.1% to 100%, and the mean NLS-Gr was adequate, which may explain the lack of a correlation at a statistically significant level between Mediterranean diet adherence and nutrition literacy. Thus, the target population had a higher educational level, contrary to other studies conducted in different populations of various socioeconomic backgrounds.

A literature review reported that nutrition literacy interventions positively influence children's dietary choices and nutrition security. These interventions are most effective when they incorporate technology, use multiple learning modalities, last longer than four weeks, and include face-to-face sessions [48]. Research on teachers' nutrition knowledge at all educational levels is limited [49,50]. The results of a previous study of teachers in Greece [57] were encouraging, because improved nutrition knowledge after implementing an e-learning program was observed.

It should be noted that this research, to the best of our knowledge, is the first study to focus on nutrition literacy, adherence to the Mediterranean diet, and perspectives about the nutrition of a specific population group in Greece with a high educational level, kindergarten teachers, who also affect nutrition and health literacy of young children. Their nutrition literacy skills are crucial for nutrition education, as research shows that interventions to improve food and nutrition literacy can positively affect the food and nutrition skills and dietary patterns and improved diet quality [51]. Kindergarten teachers influence the health of toddlers, either as role models or through the nutritional education of toddlers and the application of age-appropriate educational methods. In the same way, their conscious attitude towards reducing food waste through practices related to sustainable Mediterranean diet can significantly affect the dietary choices of toddlers in conjunction with environmental protection within the sustainability framework. By modeling mindful eating practices, educators can demonstrate how to minimize waste and appreciate the value of food [52]. Furthermore, incorporating nutritional education about the Mediterranean diet, emphasizing unprocessed, seasonal, local products, and explaining its health and environmental benefits, can empower children to make informed food choices that support their well-being and the planet [53].

Nutrition is encompassed in the kindergarten curriculum in Greece, and kindergarten teachers play a significant role in promoting healthy eating in the context of a sustainable school [54]. Kindergarten teachers are responsible for applying nutrition education through various pathways, e.g., school eating routine, pedagogical meals, multidisciplinary approach education, etc. Therefore, research on nutrition literacy among preschool teachers is critical. Teachers serve as mediators in transmitting nutritional knowledge and promoting positive nutrition experiences for preschoolers. Adequate nutrition knowledge is essential to encourage parents and preschoolers to provide high-quality foods in school that meet dietary requirements [29,55].

The National Dietary Guide of Greece [56] is the official manual for nutrition recommendations at all stages of an individual's life. It is addressed to the overall Greek population, emphasizing the

Mediterranean diet's nutritional plan and the Greek population's nutritional requirements. Preschool teachers are responsible for children's nutrition education and, therefore, for searching for appropriate educational material related to nutrition in early childhood. Preschool teachers, except for the National Dietary Guide of Greece [56], also have access to educational material about nutrition within the framework of teaching Skills Labs, educational clubs in school, and health education programs in kindergarten. 'Skills Labs' have been implemented in Greek schools of all levels and have included nutrition and nutrition literacy, targeting students of different ages, starting from preschool (Ministerial Decision F.31/94185/D1, 29-7-2021) [57]. The Institute of Educational Policy in Greece provides relevant educational material online [54]. However, many researchers suggest that when nutrition education is included in the school curriculum, school-based interventions seem more efficacious [58]. A systematic review and meta-analysis study suggests that researchers and government public policies should adopt theory under specific social contexts involving teachers, school staff, family, and environmental choices [59]. In the Greek curriculum in kindergarten, nutrition is mentioned within the context of interdisciplinarity across different fields of knowledge. However, it does not constitute a separate field or subject in the kindergarten curriculum.

The practice of meal planning, as well as understanding the impact of dietary choices on the environment within the framework of sustainability, is encompassed in the concept of "food literacy" rather than "nutrition literacy," as delineated by Krause et al. [60]. Meal planning and management should be promoted using different strategies when it comes to individuals from lower socioeconomic backgrounds compared to those who are economically secure [61]. In our study among kindergarten teachers, meal planning was positively correlated with levels of nutrition literacy, which could be explained by the fact that the concepts of nutrition literacy and food literacy are similar and may even overlap or be included in the broader concept of health literacy [62].

Studies report a disconnect between consumer awareness of food waste and actual waste reduction behaviors. While Greek consumers demonstrate a significant understanding of food waste issues, Greece still ranks highest in Europe for per capita food waste, exceeding the global average by a substantial margin [63–65]. This high level of waste is reflected in kindergarten teachers' responses in the present study, as they report discarding significant amounts of food, primarily fruits, vegetables, milk, and grains. A systematic review by Aloysius et al. [66] found that consumers' food handling skills and knowledge at a household level are key factors determining how much leftover food is wasted. In our study, fruits and vegetables were the leading food group reported to be discarded because they spoiled before consumption or as leftovers. About 13% of fruit and vegetable waste could be prevented, as fresh produce, bakery items, and dairy are often wasted due to unused time. Research suggests improving household food handling skills, knowledge, and better storage techniques could significantly reduce this waste [67]. Interventions targeting consumer behavior and emphasizing practical skills are crucial for translating awareness into actionable change [63,67,68].

According to the responses of kindergarten teachers, the main causes of food rejection are either spoilage before consumption or leftovers. Theodoridis et al. [64] analyzed different types of consumers regarding food waste and revealed a significant level of food waste awareness among Greek consumers. Furthermore, according to a recent study by the United Nations Organization on food waste [69], Greece is reported to have the highest food waste in Europe [63,65]. In the present study, most teachers report discarding vegetables, milk, fruits, and grains. In the US at the consumer level, three food groups comprised 68% of the total food loss: meat (including poultry and fish), vegetables, and dairy products [70]. A systematic review conducted by Aloysius et al. [71] found that consumers' food handling skills and knowledge at a household level are key factors determining how much leftover food is wasted. De Laurentiis et al. [72] report that in the EU, it is estimated that 44% and 47% of the total food waste at household level was fruits and vegetables. Other researchers suggest that vegetable and fruit waste accounts for over 50% of European food waste [73]. In our study, fruits and vegetables were the main food group reported to be discarded, either because they spoiled before consumption or as leftovers. About 13% of fruit and vegetable waste could be prevented, as fresh produce, bakery items, and dairy are often wasted due to not being used in time

[72]. Improving food storage and handling techniques can reduce waste of perishable items such as dairy, meat, fruits, and vegetables. Environmentally conscious teachers can educate students about proper food storage and handling. This is key to minimizing food waste and promoting responsible consumption and healthy eating habits. Teachers through observation and experiential learning using technology or not, could educate children about fruit and vegetable spoilage. Cooperation with local organizations or farmers' markets can give students real-world insights into food production, preservation, healthy dietary habits, and reducing waste.

Sociocultural characteristics affect dietary choices in kindergarten, and the Mediterranean diet is the dietary pattern in line with the customs and traditions of the Greek population. Reduced food waste is linked to the appropriate use of resources and foods and their transformation and processing through traditional techniques [74]. For instance, using stale bread in cooking, making rusks that last longer, salting fish, and many other examples of such customs. Mediterranean diet involves skills, practices, and traditions about food, harvesting, and processing [75]. Maintaining sustainable dietary practices in line with the Mediterranean diet can be achieved through education for sustainable development, with preschool teachers playing a crucial role as mediators of children's nutrition education.

5. Limitations

The study has several limitations. First, weight and height data were self-reported. While self-reporting is a standard method for collecting anthropometric data, it is generally less accurate than measurements taken by trained professionals. Self-reported data tends to underestimate BMI, particularly at higher BMI levels. The self-report method of collecting anthropometric data is considered reliable, but with lower accuracy and a tendency for underestimation as BMI increases might occur [76].

Considering that Greece was under COVID-19 pandemic restrictions, collecting self-reported data was the most feasible method available. Another limitation is that it is a cross-sectional study, and temporal sequence and causal association between exposure and outcome cannot be established. Thus, the results should be further confirmed by a larger sample repeatedly to confirm the study trends.

6. Conclusions

In this study, Greek preschool teachers were found to be adequately nutrition literate, but their nutritional habits regarding the Mediterranean diet need improvement. High nutrition literacy scores aren't related to high adherence to the Mediterranean diet, and the factors that affect their dietary choices should be studied in further research. Preschool teachers are considered role models for their students, and they impart their nutritional knowledge to their students, consequently, their involvement in nutrition education should be promoted. They should be empowered through educational interventions to promote students' health and nutritional behaviors through their respective interventions.

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