Mediterranean Journal of Nutrition and Metabolism 14 (2021) 57–67
DOI:10.3233/MNM-200470
IOS Press

Research Report

Parental health status in relation to the nutrition literacy level of their children: Results from an epidemiological study in 1728 Greek students

Aikaterini Kanellopoulou[a], Angeliki Katelari[a], Venetia Notara[b], George Antonogeorgos[a], Andrea Paola Rojas-Gil[c], Ekaterina N. Kornilaki[d], Rena I. Kosti[e], Areti Lagiou[b] and Demosthenes B. Panagiotakos[a,f,*]

[a]*Department of Nutrition and Dietetics, School of Health Science and Education, Harokopio University, Athens, Greece*
[b]*Department of Public and Community Health, Laboratory of Hygiene and Epidemiology, School of Public Health, University of West Attica, Athens, Greece*
[c]*Department of Nursing, Faculty of Health Sciences, University of Peloponnese, Tripoli, Greece*
[d]*Department of Preschool Education, School of Education, University of Crete, Rethymnon, Greece*
[e]*Department of Nutrition and Dietetics, School of Physical Education, Sports and Dietetics, Trikala, Greece*
[f]*Faculty of Health, University of Canberra, ACT, Australia*

Received 8 July 2020
Accepted 3 November 2020

Abstract.
BACKGROUND: Children's dietary behaviors seem tract into adulthood and as a result preventing strategies to establish healthy behaviors from early stages of life are needed. Nutrition knowledge is essential for behavioral change.
OBJECTIVE: To examine whether the status of parental health related to their children's nutrition literacy level through their perceptions mainly of healthy eating attitudes
METHODS: A cross-sectional survey was conducted in Greece among 1,728 schoolchildren aged 10–12 years old. The sample was collected in the school setting during the school years of 2014–2016. Children completed anonymously a self-administered questionnaire about their knowledge and perceptions of a healthy diet while their parents completed another suitable questionnaire about family health status.
RESULTS: Paternal BMI status and hypertension were inversely associated with the level of nutrition literacy of their children by $b = -0.043$ (95% CI: (–0.082, –0.003; $p = 0.036$) and by $b = -0.600$ (95% CI: –1.181, –0.019; $p = 0.043$), respectively. Parental health status, specifically, paternal diabetes and maternal dyslipidemia were associated with children's higher level of nutrition literacy by $b = 0.729$ (95% CI: 0.002, 1.456; $p = 0.049$) and by $b = 0.730$ (95% CI: 0.086, 1.374; $p = 0.026$), respectively.

*Corresponding author: Prof. Demosthenes B. Panagiotakos, Department of Nutrition and Dietetics, School of Health Science and Education, Harokopio University, Athens 176 71, Greece. E-mail: dbpanag@hua.gr.

ISSN 1973-798X/$35.00

CONCLUSIONS: Parental health status partially affects, either negatively or positively, the level of nutrition literacy of their children. This impact depends on whether parents follow nutritional recommendations to improve their health.

Keywords: Parental health, nutrition literacy, childhood obesity, dietary behaviors, health literacy

1. Introduction

Childhood obesity is a major public health problem and one of the most serious challenges of the 21st century. Childhood obesity has been associated with an increased risk of developing several non-communicable diseases such as cardiovascular diseases, type 2 diabetes later in life [1]. Childhood and adolescence health-related behaviors, unhealthy diet, obesity and physical inactivity are often tracked into adulthood [2]. Inadequate knowledge on healthy food choices in young adults, leads to unhealthy food habits, resulting in adverse health and nutritional status [3]. As a result, nutrition knowledge is a way to combat the rise of nutrition-related diseases and by enhancing nutrition knowledge will possibly evoke changes in nutrition attitudes [4]. Nowadays, issues such as nutrition knowledge and healthy food choices have ignited an interest in tackling obesity and diet related diseases [5].

According to World Health Organization (WHO), health literacy (HL) is defined as "*The cognitive and social skills which determine the motivation and ability of individuals to gain access to understand and use information in ways which promote and maintain good health*"[6]. Nutrition literacy (NL) refers to the set of abilities to understand nutrition information, which can be seen as a necessary prerequisite for understanding the importance of good nutrition in maintaining health and it is linked directly to the definition and concept of health literacy, [7] and has been defined as an essential part of behavioral change [8]. Therefore, NL is defined as "the degree to which individuals have the capacity to obtain, process, and understand nutrition information and skills needed in order to make appropriate nutrition decisions [9]. Hence, HL is a key element for better health outcomes and better management of body weight. Specifically, it is documented that low HL is associated with higher Body Mass Index (BMI) among children and adolescents [10–12].

Childhood and adolescence are two periods of life where knowledge and beliefs are being developed, however, little is known about the factors that affect children's health knowledge and perceptions. In a school-based survey in Greece, which examined whether gender affects children's knowledge and perceptions of cardiovascular risk factors, findings showed that girls had higher percentage of correct answers compared to boys regarding the weekly consumption of legumes, breakfast and the effects of soft drinks on health [13]. Furthermore, a cross-sectional survey that was also conducted in Greece aimed to investigate the impact of family characteristics and the socioeconomic status on children's knowledge on cardiovascular risk factors. Authors concluded that, children with fewer siblings had more enough knowledge than their peers with more siblings. Moreover, the higher the parental educational level, and living with both parents instead of single parent had a positive impact on children's knowledge on cardiovascular risk factors [14].

There is a large number of studies examining the influence of family characteristics, parental supportive behaviors, and their children's dietary behaviors and weight status [15–17]. Undoubtedly, children's dietary behaviors are under the influence of parental feeding practices [18]. Family members act as role models for children's behaviors and parenting practices has been found to promote beneficial or harmful habits [19, 20].

There is limited evidence on the effect of parental health status on children's knowledge relevant to healthy dietary habits. However, only few studies have investigated how parental health status is associated with children's and young adult's dietary habits [21, 22]. Examining the relationship between parental health status and children's nutritional knowledge is of great importance since children's health and nutrition literacy will affect their dietary behaviors during adulthood. Therefore, the aim of the present study was to evaluate parental health status in relation to the nutrition literacy level of their children.

2. Methods

2.1. Design

This was a cross-sectional, observational epidemiological study.

2.2. Setting

In the school years 2014-2015 and 2015-2016, data were collected from 47 schools from 5 different Greek cities, i.e. Athens area, Heraklion the capital city of the island of Crete, and three counties of the Peloponnese peninsula (Sparta, Kalamata and Pyrgos). The regions represented large urban and rural municipalities, while the specific schools were randomly selected from the Greek Ministry of Education list of schools. The schools were located as follows: 37 in Athens, 5 in Heraklion, 3 in Pyrgos, 2 in Kalamata, and 5 in Sparta.

2.3. Study sample

In total 1728 students (795 boys) aged 10–12 years old were enrolled in the study. All children's parents were also invited to participate, with a 68.9% response rate being achieved ($n = 1190$). The rate of participation ranged from 95% to 100% between schools and no significant differences between the studied areas, were observed. However, for the purposes of the present analysis, the examined sample was $n = 1150$ students (boys 459) who had completed information about their parent's health status.

2.4. Power analysis

The working sample was adequate to evaluate effect size measures' differences of 20% at $< 5\%$ level of significance, achieving 85% statistical power.

2.5. Measurements

2.5.1. Children's questionnaire

A specially developed for the aim of this study questionnaire was completed by each child. A personal code was noted to each child's completed questionnaire by the school principal, in order to be cross-referenced to their parent's one's respective questionnaires. For better accuracy of the answers, teachers and study investigators collaborated and assisted by using practical examples.

The questionnaire consisted of 53 questions regarding socio–demographic characteristics (age, sex, place of residence, nationality, number of siblings, birth order), dietary habits, dietary intake (by using a validated semi-quantitative Food Frequency Questionnaire FFQ regarding the information on a daily or weekly basis about the frequency of consumption of the main food groups and beverages by using descriptive questions with details) [23], and questions, among others, about knowledge and perceptions on risk factors for chronic diseases (diet, hypertension, hypercholesterolemia, hypertriglyceridemia). It also included anthropometric characteristics such as height (in m) and weight, (in Kg) that were measured and recorded by a trained investigator using a scale and a measuring-tape, over skin-tight clothes with no shoes. Then the BMI was calculated using the specific International Obesity Task Force (IOTF) cut-off criteria [24].

2.5.2. Parental health status score

The parental health status was evaluated through the use of a cumulative risk score that developed for the purposes of this study. Specifically, the score included four variables concerning the presence of cardiometabolic risk factors, i.e., overweight/obesity (BMI ≥ 25 kg/m^2, according to the WHO categorization; BMI was calculated

as weight in Kg divided by height in m squared), diabetes mellitus (fasting glucose ≥126 mg/dl or use of anti-diabetic medication), hypertension (systolic/diastolic blood pressure ≥90/140 mmHg or use of antihypertensive medication), dyslipidemia (LDL-cholesterol >100 mg/dL or total cholesterol >200 mg/dl or special medication). All information on health status by the parents was self-reported. For the presence of each of the aforementioned conditions, a value of +1 was assigned. Thus, a total score ranged from 0 to 4 was created. A score equal to 4 indicates the highest cardiometabolic risk profile and refers to an obese adult with all the aforementioned comorbidities, whereas score equal to 0 indicates the absence of the aforementioned health conditions.

2.6. Development of a scale for the assessment of children's knowledge and perceptions on a healthy diet

To assess children's knowledge and perceptions of their daily healthy habits close questions were used about: the optimal frequency of involvement in physical activities; the optimal consumption for certain foods and beverage intake per week; the optimal consumption for certain foods and beverage intake per week (i.e. "How many times a week do you think that we should eat/consume: meat, fish, fruits–vegetables and legumes, bottle juice and sports drinks compared with fresh juice?"); their beliefs about eating habits and behaviors (i.e. number of meals per day, the duration a meal should have, the importance of breakfast, the role of hydration etc.); as well as the risk factors that may originate even in childhood (i.e. obesity, smoking, unhealthy diet, alcohol consumption, inactivity, etc.). A 5-point Likert-type scale ranging from "very bad" to "very good" was used. Subsequently, a specific instrument was developed. Out of the 53 items of the children's questionnaire, the study investigators resulted in 20 items with the most discriminating value of the evaluation of children's knowledge and perceptions. The parameters of nutrition literacy were assessed through the domains of nutrition, physical activity, and lifestyle factors were assessed in these 20 items. Each item's answer was recorded as 1 if the participant's answer was correct about a healthy diet/lifestyle, and 0 if it was wrong. As a result, a scale has been established that ranged from 0 to 20. The higher the score was, the better the children's perception/information on healthy lifestyle habits, with 0 = none 20 = excellent. Then, the nutrition literacy scale was categorized to tertiles as follows: low (<7), medium (8 to 14) and high (>14).

For the validity of the scale, Exploratory Factor Analysis was performed (EFA) in 500 randomly selected observations. Indeed, literature findings, suggest that for the application of EFA at least 500 observations are necessary for the identification of reliable factors without estimation problems [25]. The principal component extraction method was used, to facilitate the interpretation of the varimax orthogonal rotation method that was applied in the extracted factors. The scree plot "elbow" criterion was used in order to determine the optimal numbers of factors to retain. Scree plot is a graph representing the eigenvalues of the extracted factors, and the elbow criterion suggests retaining the number of factors above the inflection point (the point where the graph curve is starting to leveling off). The analysis revealed good construct properties of the aforementioned proposed score [14].

3. Bioethics

The study was approved by the Institute of Educational Policy, of the Ministry of Education and Religious Affairs (code approval F15/396/72005/CI), and was carried out in accordance with the Declaration of Helsinki (1989). The school principals, teachers, parents, and students were informed about the aims and procedures of the study. Signed parental consent was obtained before the completion of the questionnaires.

4. Statistical analysis

Quantitative variables are presented as mean ± standard deviation for normally distributed variables and as median, otherwise. Categorical variables are presented as absolute and relative frequencies. The association

among nutrition literacy level and categorical variables was investigated using Chi-square Pearson's statistical test of independence or Student's *t*-test, for normally distributed continuous variables. In order to assess the effect of parental health status on the knowledge and the perceptions about healthy diet/lifestyle, multiple linear regression was applied using knowledge and perception score as a dependent variable, parental health status as the main independent factor, and child's age and sex as confounding factors. The assumptions of linear regression were checked with residual analysis, and the absence of multicollinearity was documented with the calculation of a value of variance inflation factor < 4 for all the independent variables inserted in the multiple linear models. All tests are two-sided with a significance level set to 0.05. The STATA 15.0 was used for all statistical analyses (M. Psarros & Assoc., Sparti, Greece).

5. Results

Children's characteristics, regarding anthropometric and social status are presented in Table 1. The mean age of the studied sample was $11.2 \pm (0.82)$, (43.4% were boys).

In Tables 1 and 2 children's and parental characteristics, respectively, by nutrition knowledge levels are depicted. A significant association between children's BMI and their nutrition literacy level was observed ($p = 0.001$). Children with a medium level of nutrition literacy had lower BMI. A negative association between children's nutrition literacy level and their birth order was revealed, with first-born children being more literate than their siblings ($p = 0.003$). No significant association was observed between parents' characteristics and children's nutrition literacy level.

To further explore the influence of parental health status on children's nutrition literacy, multiple linear regression model was applied, adjusted for age and sex (Table 3). A significant inverse association was observed between paternal BMI and the level of children's nutrition literacy; the higher the BMI of their father the lower

Table 1
Children's characteristics in total and per nutrition literacy category

	Overall ($n = 1150$)	Low level of nutrition literacy ($n = 193$)	Medium level of nutrition literacy ($n = 862$)	High level of nutrition literacy ($n = 95$)	p - value
Age (years)	11.20 (0.82)	11.33 (0.89)	11.18 (0.80)	11.11 (0.81)	0.030
Sex (Boys/Girls)					
Boys	499 (43.4%)	95 (19.0%)	357 (71.5%)	47 (9.4%)	0.509
Girls	651 (56.6%)	98 (15.1%)	505 (77.6%)	48 (7.4%)	
Body Mass Index (kg/m^2)	19.03 (3.23)	19.73 (3.73)	18.83 (3.10)	19.48 (3.23)	0.001
Children's BMI Categorization					0.335
Underweight	100 (8.8%)	15 (15.0%)	79 (79,0%)	6 (6.0%)	
Normal	748 (66.0%)	115 (15.4%)	574 (76.7%)	59 (7.9%)	
Overweight	238 (21.0%)	45 (18.9%)	171 (71.8%)	22 (9.2%)	
Obese	47 (4.1%)	13 (27.7%)	29 (61.7%)	5 (10.6%)	
Number of siblings	1.15 (0.8)	1.19 (0.94)	1.15 (0.86)	1.06 (0.84)	0.528
Birth order					0.003
1st	611 (53.8%)	83 (13.6%)	472 (77.3%)	56 (9.2%)	
2nd	399 (35.2%)	80 (20.1%)	290 (72.7%)	29 (7.3%)	
3rd	108 (9.5%)	23 (21.3%)	76 (70.4%)	9 (8.3%)	
4th	14 (1.2%)	5 (35.7%)	9 (64.3%)	0 (0.0%)	
5th	3 (0.3%)	1 (33.3%)	1 (33.3%)	1 (33.3%)	

Table 2
Parents' characteristics in total and per children's nutrition literacy category

	Overall	Low level of nutrition literacy	Medium level of nutrition literacy	High level of nutrition literacy	*p*-value
Paternal weight status					0.274
Underweight	20 (1.9%)	4 (20.0%)	13 (65.0%)	3 (15.0%)	
Normal	292 (28.3%)	39 (13.4%)	230 (78.8%)	23 (7.9%)	
Overweight	497 (48.2%)	87 (17.5%)	367 (73.8%)	43 (8.7%)	
Obese	223 (21.6%)	35 (15.7%)	175 (78.5%)	13 (5.8%)	
Maternal weight status					0.852
Underweight	126 (11.5%)	18 (14.3%)	99 (78.6%)	9 (7.1%)	
Normal	582 (53.3%)	92 (15.8%)	445 (76.5%)	45 (7.7%)	
Overweight	270 (24.7%)	52 (19.3%)	192 (71.1%)	26 (9.6%)	
Obese	113 (10.4%)	19 (16.8%)	83 (73.5%)	11 (9.7%)	
Paternal Health Status					
Diabetic	52 (6.5%)	4 (7.7%)	42 (80.8%)	6 (11.5%)	0.082
Hypertensive	172 (17.8%)	33 (19.2%)	122 (70.9%)	17 (9.9%)	0.654
Dyslipidemic	156 (19.5%)	31 (19.9%)	112 (71.8%)	13 (8.3%)	0.294
Maternal Health Status					
Diabetic	49 (6.1%)	5 (10.2)	41 (83.7%)	3 (6.1%)	0.612
Hypertensive	78 (7.9%)	10 (12.8%)	61 (78.2%)	7 (9.0%)	0.577
Dyslipidemic	68 (8.4%)	9 (13.2%)	51 (75.0%)	8 (11.8%)	0.296

the nutrition literacy score by $b = –0.043$ (95% CI: (–0.082, –0.003; $p = 0.036$). The association remained consistent even when parental health status (*Model 5*) was taken into consideration, by $b = –0.065$ (95% CI: (–0.120, –0.010; $p = 0.022$). In relation to parental health status, paternal diabetes was associated with a higher level of nutrition literacy of their children by $b = 0.729$ (95% CI: 0.002, 1.456; $p = 0.049$) (*Model 2*). Similarly, maternal dyslipidemia was also associated with a higher level of nutrition literacy of their children by $b = 0.730$ (95% CI: 0.086, 1.374; $p = 0.026$) (*Model 4*). As for hypertension, there was no statistically significant association with the level of nutrition literacy neither for fathers or mothers (*Model 3*). However, after Model 5 was applied and total health status was considered, paternal hypertension was inversely associated with the children's nutrition literacy by $b = –0.600$ (95% CI: –1.181, –0.019; $p = 0.043$).

6. Discussion

This is one of the very few observational studies aimed to examine the relationship between parental health and weight status in relation to nutrition literacy/ healthy lifestyle knowledge and perceptions of children aged 10–12 years. Our study found a significant association between children's BMI and their level of nutrition literacy. As regards parental health status, specifically, paternal diabetes and maternal dyslipidemia were positively associated with a higher level of nutrition literacy of their children. Furthermore, paternal hypertension and high BMI were inversely associated with their children's nutrition literacy.

Moreover, children with a medium level of nutrition literacy had a lower BMI. This finding is similar to another cross-sectional survey in which children's health literacy was significantly correlated with lower BMI z-score adjusted for age and gender [11]. Moreover, a systematic review indicated a significant association of low level of health literacy with overweight and obesity among children and adolescents [12]. Similarly, it was revealed that a high level of food and nutrition knowledge had a positive impact on adolescents' dietary behaviors [26]. It

Table 3
Results from linear regression analyses b-coefficients, (95% CI) that evaluated the association of parental health status with children's nutrition knowledge and perception scale

	Model 1	Model 2	Model 3	Model 4	Model 5
Age (per 1 year)	–0.126	–0.049	–0.054	–0.036	–0.016
	(–0.299, 0.047)	(–0.250, 0.153)	(–0.238, 0.130)	(–0.237, 0.165)	(–0.235, 0.204)
Sex (boys vs. girls)	0.347	0.190	0.201	0.129	0.216
	(0.062, 0.632)*	(–0.139, 0.519)	(–0.095, 0.496)	(–0.196, 0.454)	(–0.147, 0.580)
Paternal BMI	–0.043				–0.065
	(–0.082, –0.003)*				(–0.120, –0.010)*
Maternal BMI	–0.013				–0.033
	(–0.050, 0.023)				(–0.084, 0.017)
Paternal diabetes		0.729			0.498
(yes vs. no)		(0.002, 1.456)*			(–0.429, 1.424)
Maternal diabetes		0.266			–0.002
(yes vs. no)		(–0.541, 1.072)			(–1.061, 1.056)
Paternal hypertension			–0.124		–0.600
(yes vs. no)			(–0.536, 0.289)		(–1.181, –0.019)*
Maternal hypertension			0.036		–0.092
(yes vs. no)			(–0.579, 0.650)		(–1.066, 0.882)
Paternal dyslipidemia				–0.331	–0.355
(yes vs. no)				(–0.763, 0.101)	(–0.886, 0.176)
Maternal dyslipidemia				0.730	0.719
(yes vs. no)				(0.086, 1.374)*	(–0.266, 1.704)

*$p < 0.05$ is considered as significant level.

has been also documented that there is a correlation between nutrition knowledge and eating behavior in 11–13 years old girls [27]. In a cross-sectional survey in Denmark, it was observed that a higher knowledge score was associated with healthier dietary habits [28]. In addition, poor fat knowledge in adolescents aged 17-18 years was associated with increased consumption of fat [29]. Furthermore, a survey in Greek adolescents (15–17 years) indicated that actual Mediterranean Dietary Pattern (MDP) knowledge was an important predictive factor for Mediterranean Dietary Pattern (MDP) adherence [30].

Another interesting finding, which has not been examined extensively, was that the first-born child showed higher level of nutrition knowledge. This result is consistent with another study which indicated that the probability of low critical literacy in later-birth children was higher than first-birth children [31]. Previous studies that have focused on birth order in relation to BMI, found that third-born girls from three-child families had higher odds of being obese [32]. Moreover, being the youngest child of the family was associated with overweight [33].On the contrary, some studies indicated that being a firstborn child was positively associated with adiposity or overweight, probably due to gestational and postnatal factors, or both [34, 35].

In the present study, it was observed that paternal BMI was inversely associated with children's nutrition literacy. Higher father's BMI was associated with lower children's nutrition knowledge scores. It is indicated that children's dietary preferences are influenced by parental dietary habits, and consequently, parental nutrition knowledge is associated with a lower prevalence of overweight children [16]. Moreover, children (aged 4-5 years) with overweight or obese parents had a higher preference for fatty foods, lower preference for vegetables, overeating behaviors and preference for sedentary activities [36]. A cross-sectional survey that was conducted in 23.183 Iranian Students (6–18 years old), revealed that obese parents had obese children, and parental feeding

practices were associated with child weight disorders and eating behaviors [37]. Our study did not find any association between maternal BMI and children's dietary knowledge, which can be attributed to the fact that mothers mainly affect children's eating behaviors, while fathers affect mostly in the aspect of cognitive and literacy perspectives [14].

Moreover, our study indicated that paternal hypertension was inversely associated with children's nutrition literacy, after adjustment for several health cofounders. There is a limited amount of studies that examined the influence of parental health status on their children's health behavior. Thomas et al. [21] conducted a cross-sectional survey where they aimed to examine whether a parent with increased cardiovascular disease (CVD) risk influences a child's dietary intake. The results showed that there was no difference in selected nutrients among children living with high-risk parents compared to those whose parents were risk-free. The fact that patients with metabolic syndrome are unaware of the dietary recommendations for preventing CVD risk factors provides a possible explanation to our results that parents with several co-morbidities may not be well informed or there is poor adherence to dietary recommendations and therefore not prone to any lifestyle changes [38, 39]. As a result, they cannot transmit to their children healthy dietary knowledge. It has been found that mainly mothers' knowledge can affect dietary behaviors of preschool children, and their increased dietary knowledge can result in a reduction in children's intake of dietary cholesterol and respectively in an increase of fiber consumption; however, this influence is minimized as children grow older [38].

A significant association was found between paternal diabetes and the level of children's nutrition literacy. A possible explanation could be that diabetic patients recognize the importance of following dietary recommendations for better control of the disease [39]. Diabetic parents may follow dietary recommendations and as a result, they may educate their children about healthy eating habits and increase their children's nutrition literacy.

Moreover, maternal dyslipidemia was also correlated with the level of children's nutrition literacy. A cross-sectional survey which was conducted in Greece indicated that people with hypercholesterolemia followed healthy nutritional behaviors. The results showed that they consumed more fish, fruits and juices, cereals, and low-fat milk and yogurt rather than red meat, pork, egg, full-fat dairy products and desserts [40]. It can be assumed that mothers with dyslipidemia have changed their nutritional behaviors and therefore their children may be more literate about healthy eating habits. A mother's high level of food and nutrition knowledge potentially acts as a protective factor against low food and nutrition knowledge of children [31, 38]. This can be explained by the fact that mothers are mainly involved in activities including meal planning, grocery shopping and cooking and in daily food-related decisions [41]. According to Herman et.al study, mothers influence their children's eating behaviors as they systematically determine and typically provide their children's meals [42].

It is undeniable that children's dietary behaviors are affected by those of their parents. There is a positive association between parental eating attitudes and the nutritional adequacy and diet quality of preschoolers [43]. The family environment is where children gain their first knowledge about food and therefore family plays a pivotal role in preschoolers' healthy or unhealthy behavior and nutrition knowledge [44]. In a French study that was contacted in children aged 9-10 years old, children reported that parents were their main source of nutrition education [45]. Moreover, Gibson et. al. indicated that among 9-10-year-old children's total knowledge and specific knowledge on foods fat and sugar content was positively associated with mothers' knowledge, similarly, adolescents indicated family as the major source of nutrition education [29, 46]. The parental adoption of healthy behavior may induce corresponding changes in children's behavior as well. Moreover, nutritional programs that focus on parental behavioral changes may be more efficient than those provided only in children.

7. Limitations

Due to the cross-sectional nature of the study, there are some limitations that should be taken into account. The findings of the study cannot be generalized in the entire child population since the study sample was taken from a small number of areas in Greece. However, the final sample of the study was adequate enough and the

collection of the sample was randomly taken, as a result, the representativeness of the results could be considered high. Additionally, during the completion of the questionnaire by the children in the school setting a possible bias might have been reported. However, a trained investigator was available to clarify any misconceptions of the questionnaire, which increased the validity of the answers. Moreover, the scale of the level of nutrition knowledge had as reference another survey with the same study sample [14].

8. Conclusions

Parental health status seems to partially affect children's nutrition knowledge and consequently their nutritional behavior. However, evidence of the specific association of parental health status and their children's nutritional knowledge is scarce. It can be assumed that this association depends on whether parents follow the dietary recommendations for prevention or disease treatment. It is therefore recommended that health promotion strategies and community intervention programs should aim to encourage parental healthy eating habits in order to avoid health risk factors and recognize their crucial role in shaping their children's nutrition knowledge.

Acknowledgments

The authors would like to thank all the parents for their given consent and the students, who participate in this study. Moreover, they would like to thank the school principals and all the teachers, who contributed to the sampling process and data collection. Moreover, the authors would like to acknowledge and thank the field investigators of the study: Elias Kokoris, Athina Fregoglou, Vasiliki Maragou, Marialena Kordoni, Anna Velentza, Magdalini Mesimeri, Marina Mitrogiorgou, Rania Baroucha, and Dimitra Kroustalli for their support with the data collection.

Conflict of interest

The authors have no conflict of interest to report.

References

[1] Reilly JJ, Kelly J. Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: systematic review. International Journal of Obesity. 2011;35(7):891-8. doi:10.1038/ijo.2010.222

[2] FOR EPOIG, CHILDREN RRI. Expert panel on integrated guidelines for cardiovascular health and risk reduction in children and adolescents: summary report. Pediatrics. 2011;128(Suppl 5):S213. doi:10.1542/peds.2009-2107C

[3] Kalkan I. The impact of nutrition literacy on the food habits among young adults in Turkey. Nutr Res Pract. 2019;13(4):352-7. doi:10.4162/nrp.2019.13.4.352

[4] Wardle J, Parmenter K, Waller J. Nutrition knowledge and food intake. Appetite. 2000;34(3):269-75. doi:10.1006/appe.1999.0311

[5] Carbone ET, Zoellner JM. Nutrition and health literacy: a systematic review to inform nutrition research and practice. Journal of the Academy of Nutrition and Dietetics. 2012;112(2):254-65. doi:10.1016/j.jada.2011.08.042

[6] WHO. Health promotion,Track 2: Health literacy and health behaviour,7th Global Conference on Health Promotion: track themes, 2018 [Available from: https://www.who.int/healthpromotion/conferences/7gchp/track2/en/.

[7] Krause C, Sommerhalder K, Beer-Borst S, Abel T. Just a subtle difference? Findings from a systematic review on definitions of nutrition literacy and food literacy. Health Promotion International. 2016;33(3):378-89. doi:10.1093/heapro/daw084

[8] Worsley A, Crawford D, Campbell K. Children's Healthy Eating. Report to the Victorian Department of Human Services, Melbourne. 2002.

[9] In: Nielsen-Bohlman L, Panzer AM, Kindig DA, editors. Health Literacy: A Prescription to End Confusion. Washington (DC)2004.

[10] Sansom-Daly UM, Lin M, Robertson EG, Wakefield CE, McGill BC, Girgis A, et al. Health Literacy in Adolescents and Young Adults: An Updated Review. Journal of Adolescent and Young Adult Oncology. 2016;5(2):106-18. doi: 10.1089/jayao.2015.0059

[11] Sharif I, Blank AE. Relationship between child health literacy and body mass index in overweight children. Patient Education and Counseling. 2010;79(1):43-8. doi:10.1016/j.pec.2009.07.035

[12] Michou M, Panagiotakos DB, Costarelli V. Low health literacy and excess body weight: A systematic review. Central European Journal of Public Health. 2018;26(3):234-41. doi:10.21101/cejph.a5172

[13] Notara V, Antonogeorgos G, Prapas C, Velentza A, Kordoni ME, Manifava E, et al. Gender impact on children's knowledge and perceptions regarding cardiovascular disease risk factors: A school-based survey in Greece. Journal of Education and Health Promotion. 2018;7:102. doi:10.4103/jehp.jehp_28_18

[14] Notara V, Antonogeorgos G, Kordoni ME, Sakellari E, Prapas C, Velentza A, et al. Family characteristics and children's knowledge of cardiovascular risk factors. Pediatrics International : Official Journal of the Japan Pediatric Society. 2018;60(12):1081-9. doi:10.1111/ped.13710

[15] Pyper E, Harrington D, Manson H. The impact of different types of parental support behaviours on child physical activity, healthy eating, and screen time: a cross-sectional study. BMC Public Health. 2016;16(1):568. doi:10.1186/s12889-016-3245-0

[16] Variyam JN. Overweight children: is parental nutrition knowledge a factor? Food Review/National Food Review. 2001;24(1482-2016-121499):18-22.

[17] Moschonis G, Tanagra S, Vandorou A, Kyriakou AE, Dede V, Siatitsa PE, et al. Social, economic and demographic correlates of overweight and obesity in primary-school children: preliminary data from the Healthy Growth Study. Public Health Nutrition. 2010;13(10A):1693-700. doi:10.1017/S1368980010002247

[18] Michou M, Panagiotakos DB, Mamalaki E, Yannakoulia M, Costarelli V. Development and validation of the Greek version of the comprehensive parental feeding questionnaire. Mediterranean Journal of Nutrition and Metabolism. 2019;12:211-21. doi:10.3233/MNM-180275

[19] Natale RA, Messiah SE, Asfour L, Uhlhorn SB, Delamater A, Arheart KL. Role modeling as an early childhood obesity prevention strategy: effect of parents and teachers on preschool children's healthy lifestyle habits. Journal of Developmental and Behavioral Pediatrics : JDBP. 2014;35(6):378-87. doi:10.1097/DBP.0000000000000074

[20] Philips N, Sioen I, Michels N, Sleddens E, De Henauw S. The influence of parenting style on health related behavior of children: findings from the ChiBS study. The International Journal of Behavioral Nutrition and Physical Activity. 2014;11:95. doi:10.1186/s12966-014-0095-y

[21] Thomas J, Chan L, Wray A, Miller J, Mehta K, Yaxley A, et al. Does the presence of cardiovascular disease risk factors or established disease influence the dietary intake of affected adults and their children residing in the same household? A secondary analysis of the Australian Health Survey (2011-2013). BMC Cardiovasc Disord. 2017;17(1):146. doi:10.1186/s12872-017-0578-2

[22] Osadnik T, Pawlas N, Lonnie M, Osadnik K, Lejawa M, Wadolowska L, et al. Family History of Premature Coronary Artery Disease (P-CAD)-A Non-Modifiable Risk Factor? Dietary Patterns of Young Healthy Offspring of P-CAD Patients: A Case-Control Study (MAGNETIC Project). Nutrients. 2018;10(10). doi:10.3390/nu10101488

[23] Antonogeorgos G, Grigoropoulou D, Papadimitriou A, et al. Validation of a food frequency questionnaire designed for children 10-12 years: the PANACEA-FFQ,. Perioperative Nursing 2013;2:40-54.

[24] Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. British Medical Journal. 2000;320(7244):1240. doi:10.1136/bmj.320.7244.1240

[25] Pohlmann JT. Use and Interpretation of Factor Analysis in The Journal of Educational Research: 1992-2002. The Journal of Educational Research. 2004;98(1):14-22. doi:10.3200/JOER.98.1.14-23

[26] Vaitkeviciute R, Ball LE, Harris N. The relationship between food literacy and dietary intake in adolescents: a systematic review. Public Health Nutrition. 2015;18(4):649-58. doi:10.1017/S1368980014000962

[27] Pirouznia M. The association between nutrition knowledge and eating behavior in male and female adolescents in the US. International Journal of Food Sciences and Nutrition. 2001;52(2):127-32. doi: 10.1080/713671772

[28] Osler M, Hansen ET. Dietary knowledge and behaviour among schoolchildren in Copenhagen, Denmark. Scandinavian Journal of Social Medicine. 1993;21(2):135-40. doi:10.1177/140349489302100214

[29] Venter I, Winterbach A. Dietary fat knowledge and intake of mid-adolescents attending public schools in the Bellville/Durbanville area of the city of Cape Town. South African Journal of Clinical Nutrition. 2010;23(2). doi:10.1080/16070658.2010.11734285

[30] Tsartsali PK, Thompson JL, Jago R. Increased knowledge predicts greater adherence to the Mediterranean diet in Greek adolescents. Public Health Nutrition. 2009;12(2):208-13. doi:10.1017/S1368980008003170

[31] Doustmohammadian A, Keshavarz Mohammadi N, Omidvar N, Amini M, Abdollahi M, Eini-Zinab H, et al. Food and nutrition literacy (FNLIT) and its predictors in primary schoolchildren in Iran. Health Promotion International. 2019;34(5):1002-13. doi:10.1093/heapro/day050

[32] Sgaramella LZ, Galante A, Jayakar SD, Pennetti V. Obesity in a group of Italian elementary school children: family structure. J Biosoc Sci. 1980;12(4):487-93. doi:10.1017/s0021932000013079

[33] Ochiai H, Shirasawa T, Ohtsu T, Nishimura R, Morimoto A, Obuchi R, et al. Number of siblings, birth order, and childhood overweight: a population-based cross-sectional study in Japan. BMC Public Health. 2012;12:766. doi:10.1186/1471-2458-12-766

[34] Celi F, Bini V, De Giorgi G, Molinari D, Faraoni F, Di Stefano G, et al. Epidemiology of overweight and obesity among school children and adolescents in three provinces of central Italy, 1993–2001: study of potential influencing variables. European Journal of Clinical Nutrition. 2003;57(9):1045-51. doi:10.1038/sj.ejcn.1601640

[35] Stettler N, Tershakovec AM, Zemel BS, Leonard MB, Boston RC, Katz SH, et al. Early risk factors for increased adiposity: a cohort study of African American subjects followed from birth to young adulthood. The American Journal of Clinical Nutrition. 2000;72(2):378-83. doi: 10.1093/ajcn/72.2.378

[36] Wardle J, Guthrie C, Sanderson S, Birch L, Plomin R. Food and activity preferences in children of lean and obese parents. International journal of obesity and related metabolic disorders : journal of the International Association for the Study of Obesity. 2001;25(7):971-7. doi:10.1038/sj.ijo.0801661

[37] Bahreynian M, Mozafarian N, Motlagh ME, Qorbani M, Heshmat R, Kelishadi R. Association between parental feeding practices and later body mass index in children and adolescents: The Weight disorder survey of the CASPIAN-IV Study. Mediterranean Journal of Nutrition and Metabolism. 2019;12(1):119-30. doi:10.3233/MNM-180242

[38] Variyam JN, Blaylock J, Lin BH, Ralston K, Smallwood D. Mother's nutrition knowledge and children's dietary intakes. American Journal of Agricultural Economics. 1999;81(2):373-84. doi:10.2307/1244588

[39] Ausili D, Bulgheroni M, Ballatore P, Specchia C, Ajdini A, Bezze S, et al. Self-care, quality of life and clinical outcomes of type 2 diabetes patients: an observational cross-sectional study. Acta diabetologica. 2017;54(11):1001-8. doi:10.1007/s00592-017-1035-5

[40] Milias GA, Panagiotakos DB, Pitsavos C, Xenaki D, Panagopoulos G, Stefanadis C. Prevalence of self-reported hypercholesterolaemia and its relation to dietary habits, in Greek adults; a national nutrition & health survey. Lipids in health and disease. 2006;5(1):5. doi:10.1186/1476-511X-5-5

[41] Parmenter K, Waller J, Wardle J. Demographic variation in nutrition knowledge in England. Health Education Research. 2000;15(2):163-74. doi:10.1093/her/15.2.163

[42] Herman CP, Polivy J. Normative influences on food intake. Physiology & Behavior. 2005;86(5):762-72. doi:10.1016/j.physbeh.2005.08.064

[43] Romanos-Nanclares A, Zazpe I, Santiago S, Marín L, Rico-Campá A, Martín-Calvo N. Influence of parental healthy-eating attitudes and nutritional knowledge on nutritional adequacy and diet quality among preschoolers: The SENDO Project. Nutrients. 2018;10(12):1875. doi:10.3390/nu10121875

[44] Zarnowiecki D, Sinn N, Petkov J, Dollman J. Parental nutrition knowledge and attitudes as predictors of 5–6-year-old children's healthy food knowledge. Public Health Nutrition. 2012;15(7):1284-90. doi:10.1017/S1368980011003259

[45] Bellisle F, Rolland-Cachera M. Three consecutive (1993, 1995, 1997) surveys of food intake, nutritional attitudes and knowledge, and lifestyle in 1000 French children, aged 9-11 years. Journal of Human Nutrition and Dietetics: The Official Journal of the British Dietetic Association. 2007;20(3):241-51. doi:10.1111/j.1365-277X.2007.00773.x

[46] Gibson EL, Wardle J, Watts CJ. Fruit and vegetable consumption, nutritional knowledge and beliefs in mothers and children. Appetite. 1998;31(2):205-28. doi:10.1006/appe.1998.0180