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Original Article

Family characteristics and children's knowledge of cardiovascular risk factors

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Abstract ***Background*:** Cardiovascular disease has the highest mortality rate than any other disease globally. Some major risk factors seem to be established in the early stages of life, suggesting preventive strategies as a major means to reduce cardiovascular mortality. The aim of the present study was to investigate the role of socioeconomic status and family characteristics on children's knowledge and perceptions concerning cardiovascular disease risk factors.

***Methods*:** A cross-sectional survey was conducted among 1,728 children (46% male) aged 10–12 years, attending Greek primary schools in Athens; Heraklion (capital city of the island of Crete); Kalamata; Pyrgos; and Sparti (Peloponnese peninsula), Greece. Sampling was conducted on school premises, during the school years 2014–15 and 2015–16 (participation rate, 95–100%). Data were collected via self-administered, anonymous questionnaire. Children's knowledge of various issues related to cardiovascular risk, such as nutrition, physical activity and smoking was also examined. Data on family characteristics were collected through another questionnaire completed by parents.

***Results*:** Paternal education level and living with both parents instead of single-parent upbringing, were positively associated with children's knowledge of cardiovascular risk factors (b = 0.42; 95%CI: 0.01–0.83; P = 0.04; and b = 0.78; 95%CI: 0.013–1.43; P = 0.02 respectively). Moreover, children with more siblings seemed to have less sufficient knowledge compared with peers with fewer siblings (b per 1 sibling = −0.24; 95%CI: −0.47 to −0.014; P = 0.04).

***Conclusions*:** The present findings enhance the link between the micro-environment and children's knowledge and perceptions concerning cardiovascular health, providing information to health-care professionals while counseling youths.

Key words cardiovascular risk factor, child health, family determinant, knowledge, public health.

During the last decades, changes in lifestyle habits have led to a rise in the prevalence of chronic diseases such as cardiovascular disease (CVD) and cancer, with the CVD mortality rate being among the highest, on an annual basis.[1–3] By 2030, it is projected that CVD will be responsible for almost 23.6 million deaths worldwide, and the most pronounced increases are expected to occur in the Eastern Mediterranean Region.[4] And, although Greece has traditionally had the lowest CVD risk rates, according to recent evidence, it is considered to be a moderate risk country, with a CVD incidence of 15.7%.[5,6] Moreover, a considerable proportion of Greek adults belong to the high CVD risk group, due to the increased prevalence of conventional risk factors.[7]

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Although atherosclerosis manifests during adulthood, it is well-known that its long asymptomatic phase begins in the early stages of life. Several conditions even during fetal development may lead to a predisposition to CVD in adulthood.[8–10] Most CVD risk behaviors such as tobacco use, unhealthy diet, obesity, physical inactivity and alcohol abuse, are usually adopted during childhood and adolescence and often track into adult life.[8] A high frequency of atherogenic risk factors has been documented in adolescents in Crete, Greece.[11] Moreover, a systematic review on health literacy in adolescents noted the suboptimal health literacy skills leading to adverse health outcomes (i.e. obesity and smoking), and highlighted the need for further research in the field of adolescents' health education.[12]

Children's family status and socioeconomic environment has been found to promote beneficial or harmful habits, given that family members act as role models for children's behaviors.[13,14] For instance, maternal education level is associated

with children's healthy eating behaviors; the number of siblings seems to be associated with weight problems; and low sugar-sweetened beverage consumption has been observed among married or co-habiting families.[15–17] Children's poor knowledge of CVD prevention is documented,[18] but research in the field of children's health literacy is scarce.

Despite the fact that a large number of studies has been focused on the association between family status and children's dietary behaviors, there is a gap in the literature regarding the family impact on children's CVD health-related knowledge and beliefs. Examining the relationship between family status and children's health literacy appears to be of great importance, because children's awareness on health issues will determine their health behaviors during adulthood. Health empowerment, which is grounded in knowledge, is the cornerstone of effective public health policies, in early childhood. Thus, the main goal of the current study was to explore the relationship between demographic, socioeconomic and other family characteristics, and the knowledge and perceptions that children have, in regards to modifiable CVD risk factors. Moreover, a specific scale was developed for the purposes of the current study, providing a unique assessment tool. The aim of this study was therefore to identify sociodemographic and family determinants of knowledge and perception of CVD risk factors among young children, in order to assist policy making and public health strategies to be more effective against the increasing burden of CVD.

Methods

Participants and procedure

The survey was conducted in the greater metropolitan Athens area; in Heraklion, the capital City of the Island of Crete; and in three main counties of the Peloponnese peninsula (Sparta, Kalamata, Pyrgos), during the school-years 2014–15 and 2015–16, so as to achieve the required sample. The fact that there was no time gap between the two school periods eliminates the result implications. A total of 1,728 students aged 10–12 years old, attending the 5th and 6th grade of primary school, were enrolled in the study. Schools were selected using random sampling from a list of schools provided by the Greek Ministry of Education. In total, 47 schools were selected (32 from Athens, five from Heraklion-Crete, three from Pyrgos, two from Kalamata, and five from Sparti, Peloponnese). Then, all children of the selected schools were asked to participate, after informing their parents and obtaining their written consent (participation rate varied between 95% and 100% from school to school). Each child completed an anonymous questionnaire and, in order to obtain more accurate responses, trained field investigators provided practical examples in collaboration with children's teachers. Another questionnaire, assessing parental characteristics, was given to the children, in order to be completed by any of their parents at home (participation rate, 68.9%).

Children and parent questionnaires

The children's questionnaire consisted of 53 questions assessing daily activities such as dietary habits, physical activity, knowledge and perceptions of risk factors for chronic diseases, as well as questions about self-perception and stress management. The parental questionnaire consisted of 36 general questions. A team of experts in the field of CVD epidemiology, public health, children's psychology and school performance, were involved in the development of the questionnaires. In particular, the children's questionnaire included questions about: (i) demographic characteristics (age, gender, place of residence, nationality, number of siblings, birth order); (ii) anthropometry (height, weight, for body mass index [BMI] calculation) and waist circumference (using scale and tape measure, over skin-tight clothes); (iii) dietary intake (using semi-quantitative Food Frequency Questionnaire [FFQ]) and lifestyle characteristics such as physical activity, sedentary activities (TV viewing, video games), breakfast consumption and sleep duration; (iv) knowledge and perception of CVD modifiable risk factors (diet, physical activity, lifestyle habits, hypertension, hypercholesterolemia, hypertriglyceridemia); and (v) skills and health self-assessment. The parent questionnaire included questions about (i) family demographic characteristics (place of residence, nationality); (ii) family socioeconomic status (marital status, annual income, education level, occupational status); (iii) perinatal history of the child (type of delivery, history of breast-feeding, prenatal smoking, alcohol consumption during pregnancy, birthweight); (iv) child and parent medical history as regards asthma, hypertension, hypercholesterolemia, diabetes, CVD, cancer; and (v) parent dietary and lifestyle characteristics (using FFQ and physical activity assessment questions).

Family anthropometric and socioeconomic characteristics

Information on the student's family characteristics was obtained through the parent questionnaire regarding general demographic and socioeconomic characteristics, such as nationality, place of birth, age, BMI, education level, occupational, marital, financial status and the responsibility for children's daily care and nutrition. Annual family income was classified into four categories: (i) <12 000€; (ii) 12 000–18 000€; (iii) 18 000–24 000€; and (iv) >24 000€. Parent occupational status was categorized as follows: civil servant; private employee; pensioner; unemployed; and housekeeping (only for mothers). Finally, marital status was recorded into two categories: (i) single (widowed, divorced, unmarried); and (ii) married/cohabitating. Education level was classified as primary–secondary (up to 12 years of school) and tertiary (>12 years of school, academic level). The classification is regulated by the Greek Ministry of Education, Research and Religious Affairs.

Children's evaluation

For evaluating perceptions, children were asked, in closed questions, to report according to their knowledge and beliefs: the optimal frequency of involvement in physical activities (i.e. "How many times a week do you think that we should take exercise?"); the optimal consumption of certain foods and beverages 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 sport 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.), using a 5-point Likert-type scale ranging from very bad to very good.

Children's knowledge and perceptions of CVD risk factors

For the assessment of children's knowledge and perceptions of CVD risk factors, which was the main goal of the survey, a specific scale was developed (Children's Knowledge and Perceptions of CVD Risk factors; CKPofCVD). The original 53 items of the children's questionnaire were analyzed for content, resulting in 20 items with the highest discriminating value for the evaluation of children's attitude towards CVD risk factors. Additionally, the final 20 items reflect the latest recommendations and guidelines of the European Society of Cardiology (ESC) regarding primary CVD prevention.[19] These items assessed various aspects of children's knowledge and perceptions oft CVD risk factors, in the domains of nutrition, physical activity and other lifestyle factors. The range of answers for these items was further evaluated, according to the extent of agreement with the most recent reported associations with CVD. Each item's answer was recorded as 1 if the participant's answer was correct about the positive or negative association of the item with the development of CVD, and 0 if it was wrong. Thus, the scale that was constructed, consisted of 20 questions (range, 0–20), with higher scores indicating that the student is well-informed on healthy lifestyle habits (0, none; 20, excellent). The parameters used for the score, as well as the points for each question in the questionnaire, are listed in Table 1.

In order to further examine the construct validity of the CKPofCVD instrument, explanatory factor analysis (EFA) was performed in the randomly selected sample of 500 observations from the existing study database. This sample size was selected according to literature findings suggesting that a sample ≥500 observations is necessary for EFA to result in reliable factors, without estimation problems.[20] The principal components extraction method was used and the varimax orthogonal rotation method was applied in the extracted factors, to facilitate their interpretation. In order to determine the optimal number of factors to retain, the scree-plot "elbow" criterion was used. 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). In Table 2 the results of the EFA on the CKPofCVD instrument items are presented. The first extracted factor was positively correlated with items relating mostly to eating and activity patterns, as well as well-known risk factors for CVD diseases such as hypertension and stress, thus expressing a "CVD risk factors positively related lifestyle" pattern. In contrast, the second factor was related to items indicating negative association with CVD risk factors, such as eating legumes, fruits and vegetables, or TV watching and eating breakfast, and it could represent a "CVD risk factors negatively related lifestyle". The final factor was associated with items expressing the perception of children of the effect of CVD risk factors during childhood, thus representing the "CVD risk factors effect perception" latent variable.

Bioethics

The study was approved by the Institute of Educational Policy, of the Ministry of Education and Religious Affairs, and was carried out in accordance with the Declaration of Helsinki (1989). The research protocol was also approved by the Harokopio University Bioethics Committee. The school principals, teachers, parents and students were informed about the aims and procedures of the study. A signed parental consent was obtained before the completion of the questionnaires.

Statistical analysis

Quantitative variables are presented as mean ± SD for normally distributed variables and as median, otherwise. Categorical variables are presented as absolute and relative frequencies. In order to assess the effect of family characteristics on the knowledge and perceptions of CVD risk factors, multiple linear regression analysis was applied using knowledge and perception score as a dependent variable, and parental education status, age and BMI, number of siblings, annual family income, parental occupation status, marital status and daily informal care provided by grandparents as independent (confounding) factors. The assumptions of linear regression were checked with residual analysis, and absence of multi-collinearity was documented with the calculation of a value of tolerance >0.1 and variance inflation factor (VIF) <4 for all the independent variables inserted in the multiple linear model. All tests were two-sided, with significance level set at 0.05. STATA version 14 (MP & Associates, Sparta, Greece) was used for all statistical analyses.

Results

Basic anthropometric, demographic and socioeconomic characteristics for children and parents are listed in Table 3. The

Table 1 Children's Knowledge and Perceptions of CVD Risk factors scale

Knowledge	1 = correct answer	0 = wrong answer
1. How sedentary life affects our health?	Is very bad Is bad	Neither good nor bad Is good Is very good I do not know
2. How obesity affects our health?	Is very bad Is bad	Neither good nor bad Is good Is very good I do not know
3. How fruit/vegetables consumption affects our health?	Is good Is very good	Neither good nor bad Is bad Is very bad I do not know
4. Is high blood pressure dangerous for developing health problems?	Yes	No
5. Is stress dangerous for developing health problems?	Yes	No
6. Are soft drinks unhealthy foods?	Yes	No
7. Will young children develop serious health problems as adults when they don't eat healthily or take exercise?	A lot Quite a lot	None Little A little I do not know
8. Children never have high blood pressure.	False	True I do not know
9. Children never have high cholesterol/triglycerides in their blood.	False	True I do not know
10. Is TV viewing good for our health and our heart health?	No	Yes
11. Smoking is harmful for the heart?	Yes	No
12. Smoking is harmful for the blood vessels?	Yes	No
13. Eating fast food is:	Is very bad Is bad	Neither good nor bad Is good Is very good I do not know
14. Drinking carbonized juices is:	Is very bad Is bad	Neither good nor bad Is good Is very good I do not know
15. Snacks containing too much sugar and fats (e.g. chocolate, sweets, crisps) are:	Are very bad Are bad	Neither good nor bad Are good Are very good I do not know
16. Adding more salt to foods is:	Is very bad Is bad	Neither good nor bad Is good Is very good I do not know
Perception		
17. How many times a week do you think that we should eat legumes?	2–3 times >3 times	Once
18. How many times a week do you think that we should eat fish?	2–3 times >3 times	Once
19. How many times a week do you think that we should take exercise?	>3 times	Once 2–3 times
20. How many times a week do you think that you should have breakfast?	Daily	Once a week 2–3times a week

CVD, cardiovascular disease.

sample consisted of 1,728 children, with a mean age of 11.2 ± 0.8 years, while 46% were boys. Children's mean BMI was in the normal BMI range (19.2 ± 3.5). Regarding the level of knowledge and perceptions, the mean score was 10.5 ± 2.2 and the median score was 11 for both boys and girls.

Of the parents, 1,191 completed the questionnaire, of whom 75.5% were mothers and 24.0% were fathers. The mean paternal age was 45.9 ± 5.4 years and the mean maternal age was 41.4 ± 4.4 years. Mothers more frequently reported higher educational attainment (tertiary education) than fathers; the vast majority of families were two-parent families (88%); and nearly half of the families reported annual income <18 000€, while unemployment was less reported for men than for women. Regarding the parental BMI status, 48.3%

Table 2 Factor loadings for the 20 items of the CKPofCVD scale

	Factor 1	Factor 2	Factor 3
1. How sedentary life affects our health?	**0.361**	−0.089	0.161
2. How obesity affects our health?	0.073	**−0.518**	0.109
3. How fruit/vegetables consumption affects our health?	0.008	**0.712**	0.190
4. How many times a week do you think that we should eat legumes?	−0.397	−0.068	0.360
5.How many times a week do you think that we should eat fish?	−0.283	**−0.475**	0.211
6. How many times a week do you think that we should take exercise?	−0.249	**0.309**	0.077
7. Is high blood pressure dangerous for developing health problems?	**−0.598**	0.037	0.176
8. Is stress dangerous for developing health problems?	**−0.399**	0.089	0.136
9. Are soft drinks unhealthy foods?	−0.144	0.531	0.284
10. Will young children develop serious health problems as adults when they don't eat healthily or take exercise?	−0.203	0.086	**0.402**
11. Children never have high blood pressure.	0.103	0.092	**0.573**
12. Children never have high cholesterol/triglycerides in their blood.	0.272	−0.032	**0.575**
13. Is TV viewing good for our health and our heart health?	−0.001	**−0.545**	0.092
14. How many times a week do you think that you should have breakfast?	−0.102	**0.523**	0.160
15. Smoking harms the heart?	−0.104	**0.369**	−0.026
16. Smoking harms blood vessels?	−0.222	0.052	−0.013
17. Eating fast food is: very good, good, neither good nor bad, bad very bad, I do not know	**0.604**	−0.123	0.030
18. Drinking cartoned juices is: very good, good, neither good nor bad, bad very bad, I do not know	0.274	−0.272	0.323
19. Snacks containing too much sugar and fats (e.g. chocolate, sweets, crisps) are: very good, good, neither good nor bad, bad very bad, I do not know	**0.724**	−0.033	0.157
20. Adding enough salt to foods is: very good, good, neither good nor bad, bad very bad, I do not know	**0.467**	0.077	0.228

Bold, factor loading >0.30. CKPofCVD, Children's Knowledge and Perceptions of CVD Risk factors; CVD, cardiovascular disease.

and 24.7% of the participating fathers and mothers were overweight, and 21.7% and 10.4% were obese, respectively.

To further explore the association between family factors and children's knowledge and perceptions of CVD risk factors, a multiple linear regression model was applied (Table 4). A significant inverse association was observed between the number of siblings and the score of knowledge and perceptions, that is, the higher the number of siblings, the lower the score by −0.24 (95%CI: −0.47 to −0.014; $P = 0.04$). In relation to parental education level a significant association was evident only for father's education status. Specifically, children whose fathers had higher education (tertiary level) had a significantly higher scale score by 0.421 compared with those whose fathers had basic–secondary education (95%CI: 0.010–0.831; $P = 0.04$); this association was not observed, however, for mother's education level ($P = 0.41$). On testing of multicollinearity between father's and mother's education using the VIF criterion, VIF was ≤4 (denoting the presence of collinearity affecting the robustness of the linear regression model). Moreover, the tolerance criterion, calculated for its independent variable entered in the model, was >0.1, the threshold for collinearity. Similarly, no significant association was seen for children whose daily but informal care was mainly provided by grandparents ($P = 0.23$). Regarding marital status, however, children in two-parent families had higher knowledge score by 0.78 than those in single-parent families (95%CI: 0.126–1.435, $P = 0.02$). Finally, no significant associations were observed between parental age and BMI, mother's occupational status, annual family income and children's knowledge and perceptions of CVD risk factors.

Discussion

The present study is one of the very few observational studies on the role of family characteristics in children's knowledge of CVD risk factors. In the present study, knowledge of the aforementioned factors was not high enough. It seems that children lack adequate knowledge on issues related to cardiac health. The importance of family structure on children's knowledge and perceptions regarding health issues, mainly those considered as conventional CVD risk factors, was also noted. Paternal high education level was positively associated with children's knowledge of lifestyle habits such as diet, physical activity, smoking, whereas the maternal education level seemed to have no impact. Similarly, a recent study found that maternal education level did not have a direct effect on dietary habits.[15] A possible explanation could be that children, regarding behavioral issues, are mainly affected by mothers' constructions; while fathers play a major role in cognitive and literacy perspectives. In Greece, high parental education status is associated with less TV time and increased sports participation, in comparison with lower parental education.[21] Additionally, a study of eight European countries found that children with at least one parent having >14 years of education were less likely to be overweight/obese.[22] The level of education was strongly associated with higher diet quality in

Table 3 Subject characteristics (Athens, Heraklion-Crete and Peloponnese peninsula)

	Mean ± SD
n	
Children	1,728
Parents	1,191
Age (years)	11.2 ± 0.8
Sex, boys (%)	46
Knowledge and Perception score (0–20)†	10.5 ± 2.2, median 11 (range, 4–15)
No. siblings	1.3 ± 0.8
Age (years)	
Fathers	45.9 ± 5.4
Mothers	41.6 ± 4.4
BMI (kg/m^2)	
Children	19.2 ± 3.5
Fathers	27.0 ± 3.7
Mothers	24.0 ± 4.0
Education level (%)	
Fathers	
Basic–Secondary	60
Tertiary	40
Mothers	
Basic-Secondary	55
Tertiary	45
Employment status (%)	
Fathers	
Employed	92
Unemployed	8
Mothers	
Employed	81
Unemployed	19
Family status (%)	
Single parent	12
Married	88
Annual family income (%)	
<12 000€	26
12–18 000€	24
18–24 000€	18
>24 000€	32

†Children's Knowledge and Perceptions of CVD Risk factors scale. BMI, body mass index; CVD, cardiovascular disease.

both parents and children, as well as with healthy oral habits.[23,24] Moreover, different types of parental supportive behaviors predict whether children are meeting recommendations for physical activity, healthy eating, screen time and so on.[25] Family environment in general has a significant impact on children's attitudes towards health,[15,26] and parental characteristics are largely intertwined, especially when there are strong family interrelationships during the early stages of life.[27]

Low socioeconomic status is associated with increased health problems, obesity and overweight, as well as well as with parents' unfavorable attitudes and perceptions.[21] Furthermore, financial parameters seem to be associated with children's sports participation,[28] and an annual family income of 12 000–20 000€ is related to an increased prevalence of childhood overweight and obesity compared with an annual family income of >30 000€.[29] In the current study, however, family financial and occupation status were not associated with children's knowledge. Despite the recent financial crisis that Greece has undergone, it seems that parents support and encourage children's healthy habits. In line with the aforementioned finding, in a recent review, no significant association between socioeconomic status and physical activity in children and adolescents was evident,[30] whereas children with both working parents were less likely to become overweight or obese.[22] Additionally, an increase in income inequalities and in the number of children living in unemployed families, did not have an impact on their health.[31]

In the present study it was also observed that children living with both parents had higher awareness of CVD risk factors. Similarly, consumption of fruits and vegetables was significantly greater among children with married or cohabiting parents, whereas consumption of sugary drinks was greater for children with single parents.[23] In addition, the school setting seems to be very effective in providing health messages (i.e. healthy eating practices), but this information should be implemented in children's daily life through parental support.[32] Therefore, given that parental modeling and familiarity play an important role in children's developing food preferences, successful intervention efforts must involve and work directly with parents from the earliest stages of child development, to support favorable practices both in and outside the home.[33]

An interesting finding, which has not been examined previously in detail, was that children with many siblings had less knowledge of cardiovascular health and healthy lifestyle habits. It is possible that the presence of many children in the family imposes extra demands on the parents and limits the interactions they have with their children on health-related issues. Previous studies have focused on the number of siblings in relation to BMI, finding that sibship size had a protective effect against overweight.[34,35]

Regarding the role of grandparents in children's knowledge and perceptions of health issues, no significant results were found. Multi-generational living, however, seems to play a significant role in children's eating behaviors. Apart from the benefits gained for both parties (i.e. grandparents and children), there are also negative effects,including mainly improper feeding practices,[36] poor academic performance, especially when grandparents' education level is low.[37] Grandparents as main, but informal, caregivers may have a controversial impact on offspring characteristics, in regards to healthy behaviors and positive health values.[36,38] A fivefold higher percentage of obese children compared with non-obese stated that they were eating their grandmother's food;[39] and grandmother as the child's primary caregiver was significantly associated with higher odds of childhood overweight and obesity.[29] Grandparents tend to overindulge their grandchildren, while young mothers in Greece usually complain that they cannot persuade their own mothers not to overfeed their children because grandmothers are mainly responsible for preparing the family's food. Older people in Greece still possess the so called "war syndrome", in other words the notion that "food should be consumed in abundance whenever it is

Table 4 Association between family factors and CKPofCVD score (n = 1,191)

Independent variables	b	95%CI (b)	P-value	Tolerance	VIF
Model constant	9.324	6.864–11.785	<0.001	–	–
Mother's BMI (1 kg/m^2)	0.017	−0.033 to 0.068	0.030	0.830	1.204
Father's BMI (1 kg/m^2)	−0.003	−0.056 to 0.051	0.921	0.872	1.147
No. siblings (per 1 sibling)	**−0.243**	**−0.472 to −0.014**	**0.038**	**0.956**	**1.046**
Father's tertiary education (Yes/No)	**0.421**	**0.010–0.831**	**0.045**	**0.743**	**1.346**
Mother's tertiary education (Yes/No)	−0.172	−0.585 to 0.240	0.413	0.729	1.371
Working mother (Yes/No)	0.115	−0.389 to 0.618	0.655	0.846	1.181
Married/cohabitating parents (Yes/No)	**0.781**	**0.126–1.435**	**0.020**	**0.883**	**1.132**
Grandmother/grandfather responsible for the children's care(Yes/No)	−0.284	−0.749 to 0.182	0.232	0.961	1.040
Annual family income					
<12 000€ (reference category)	–	–	–	–	–
12 000–18 000€	0.011	−0.565 to 0.533	0.970	0.533	1.877
18–24 000€	−0.364	−0.264 to 0.528	0.255	0.528	1.893
>24 000€	0.315	−0.269 to 0.898	0.290	0.383	2.612
Mother's age (per 1 year)	0.043	−0.015 to 0.102	0.148	0.517	1.933
Father's age (per 1 year)	−0.036	−0.085 to 0.012	0.139	0.552	1.811

Model's R^2 = 4.6%. Bold, $P < 0.05$. BMI, body mass index; CKPofCVD, Children's Knowledge and Perceptions of CVD Risk factors (dependent variable); VIF, variance inflation factor.

available", and grandparents tend to believe that overweight signifies wellbeing.[39] Similar patterns have been observed among Hispanic families, with parents reporting disagreement between themselves and grandparents regarding feeding and physical activity of children emerging as the only significant predictor of children's weight. No adverse association, however, has been observed between grandparent involvement and children's BMI.[40] Still, the evidence remains inconclusive: grandmother as the child's primary caregiver was significantly associated with higher odds of childhood overweight and obesity, while a study in China showed that grandparental caregiving is not associated with an increased risk of obesity among preschoolers.[41,42]

As aforementioned, the present study is one of the very few studies exploring the factors related to children's knowledge and perceptions of healthy habits, and the results can be used for planning effective interventions within the public health framework. The essential role of family characteristics in children's health literacy has been confirmed in the present study. This claim is of major importance, considering that CVD risk factors are established early in life. The fact that family members and mainly parents have a significant influence on children's cognitive development, emotional competence, behavioral habits and aspirations, is beyond dispute. Hence, it is important for parents, as well as those who are involved in children's caregiving, to be properly informed about cardiovascular risks, diet, physical activity, smoking, alcohol use, stress, and so on. Efforts to improve health literacy should start while children are developing their health behaviors, before adult-onset chronic diseases are established.[43] In addition, health literacy could empower children to be more informed and more engaged with their health choices.[44] Therefore, countries should develop national strategic plans in order to promote health literacy among children and therefore promote healthy lifestyles.

Further attention should also be given to vulnerable social groups such as families with middle and low annual income, parents with low education level as well as large families, a family type that has emerged in the current study as having poor health literacy. The paternal model should be taken under consideration, given that fathers' knowledge and behaviors have either a positive or negative impact on the family's and the child's lifestyle.

Limitations

This study, as an observational one, has limitations that should be considered before interpreting the results. The sample originated from a small number of areas in Greece, limiting the generalizability of the findings to the entire Greek population aged 10–12 years. Due to the stratified random sampling scheme and the large size of the final sample, however, its representativeness could be considered high. Furthermore, there is a possibility of reporting bias during the completion of the questionnaire by the children in the school setting. The presence of a trained investigator throughout the completion of the questionnaire in order to address any potential misconceptions about it, increases the validity of the given responses. The scale has not been tested for reliability and validity, given that it was developed specifically for this study's purposes; nevertheless, the results should not be underestimated. The construct validity of the scale, however, was examined using EFA in a random sample of 500 observations, which identified three factors (Table 2).

In conclusion, early public health interventions to provide proper health information and promote healthy lifestyle habits are needed during the early years of life in order to reduce CVD burden. Health-care professionals should implement effective public health interventions so as to enhance healthy behaviors. The present results indicate that family environment

and parent characteristics should be taken into consideration when planning public health interventions in order to have a positive impact on children's knowledge of cardiovascular risk factors.

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Disclosure

The authors declare no conflict of interest.

Author contributions

V.N. conceived the research idea, designed the entire study, and revised the manuscript critically for technical details; M-E.K. made a substantial contribution to the data collection and the study's organizational structure; G.A. performed data analyses and interpreted the results; E.S. made a substantial contribution the interpretation of data; C.P. has made a substantial contribution to the study design, data collection and study organizational structure; A.V. has made substantial contribution to the study design and organizational structure, and interpreted the data; E.M. has made substantial contribution to interpretation of the results; A.P.R-G. made a substantial contribution to the data collection and the study organizational structure; E.N.K. and A.L. made a substantial contribution to the article drafting and revised the manuscript for important intellectual content; D.B.P. conceived of the research idea, designed the entire study, supervised data analysis and gave the final approval of the version to be published. All authors read and approved the final version of the manuscript.

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