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FAMILY AND INDIVIDUAL DIETARY AND LIFESTYLE HABITS AS PREDICTORS OF BMI AND KIDMED SCORE IN GREEK AND IMMIGRANT PRESCHOOLERS

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Abstract

Introduction: in our multicultural society the global pandemia of obesity consists in the severest form of overweight, affecting young children, with individual and parental dietary and lifestyle factors being associated with OW/OB among preschoolers.
The objective of the study was to assess the parental dietary and lifestyle trajectories that predict and determine native Greek and immigrant preschoolers' BMI and KIDMED score.
Material and methods: 578 guardian parents and 578 preschoolers (5-6 year-old), both native Greeks (n=451) and other nationalities (n=127) participated in this cross-sectional study. The Food Frequency Questionnaire and KIDMED scores were utilized.
Results: Significantly high level of concordance of guardian parents' and preschoolers' dietary habits (Spearman's rho= 0.94, R^2=0.91, p <0.001) was revealed. The strongest predictors significantly increasing BMI in preschoolers (p <0.05) were: low levels of

Résumé

Les habitudes alimentaires et de style de vie familiale et individuelle en tant que prédicteurs de IMC et de score KIDMED chez les préscolaires grecs et immigrants

Introduction: Dans notre société multiculturelle, la pandémie mondiale d'obésité constitue la forme la plus sévère de surpoids qui touche les jeunes enfants; les facteurs alimentaires et le style de vie individuel et parentel sont associés à la survenue de TA / OB chez les enfants d'âge préscolaire.
L'objectif de l'étude était d'évaluer les trajectoires alimentaires et le style de vie des parents qui permettent de prédire et de déterminer l'IMC et le score de KIDMED pour les enfants grecs et immigrés.
Matériel et méthodes: 578 parents gardiens et 578 enfants d'âge préscolaire (âgés de 5 à 6 ans), des Grecs autochtones (n = 451) et d'autres nationalités (n = 127) ont participé à cette étude transversale. Des

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KIDMED score, low frequency of removing fat from meat prior eating, low parental frequency of following Mediterranean Diet. Contrariwise, regular family's breakfast and brunch consumption, high frequency of consuming vegetables or fruits and physically active parents who control preschoolers' diet, were predictors of diminishing the risk of high BMI in children. Child's increased physical activity and parents' frequency of following the Mediterranean Diet were found to decrease the risk of low KIDMED score in preschoolers.

Conclusions: Both Greek and other nationalities' guardian parents' lifestyle characteristics, dietary habits and choices act as determinants either reinforcing or aggravating preschoolers' health outcomes. Families should promote optimal dietary habits for better health outcomes.

Keywords: preschoolers, immigrants, BMI, KIDMED score, dietary habits, Mediterranean Diet.

Abbreviations list:
WHO = World Health Organization
OW/OB = Overweight/Obesity
MD = Mediterranean Diet
SES = Socio-Economic Status
BMI = Body Mass Index
PA = Physical Activity
MVPA = Moderate to Vigorous Physical Activity
L-VPA = Light to Vigorous Physical Activities
FFQ = Food Frequency Questionnaire
KIDMED = Mediterranean Diet Quality Index

Résumé

Résultats: Un niveau de concordance significativement élevé entre les habitudes alimentaires des parents gardiens et des enfants d'âge préscolaire (rho de Spearman = 0,94, R2 = 0,91, p <0,001) a été révélé. Les prédicteurs les plus puissants augmentant de manière significative l'IMC chez les enfants d'âge préscolaire (p <0,05) étaient: les faibles niveaux du score KIDMED, la faible fréquence d'élimination des graisses de la viande avant l'alimentation, la faible fréquence parentale de la diète méditerranéenne. En revanche, la consommation régulière du petit-déjeuner et du brunch en famille, la consommation fréquente de légumes ou de fruits et les parents physiquement actifs qui contrôlent le régime alimentaire des enfants d'âge préscolaire étaient des prédicteurs de la diminution du risque d'IMC élevé chez les enfants. L'activité physique accrue de l'enfant et la fréquence avec laquelle les parents suivent le régime méditerranéen diminuent le risque du faible score KIDMED chez les enfants d'âge préscolaire.

Conclusions: Les caractéristiques du mode de vie, les habitudes et les choix alimentaires des parents gardiens, grecs et d'autres nationalités, jouent un rôle déterminant dans le renforcement ou l'aggravation des résultats pour la santé des enfants d'âge préscolaire. Les familles devraient promouvoir des habitudes alimentaires optimales pour de meilleurs résultats en matière de santé.

Mots-clés: enfants d'âge préscolaire, immigrants, IMC, score KIDMED, habitudes alimentaires, régime méditerranéen.

Introduction

The World Health Organization (WHO) illustrates the global pandemia of obesity as the severest form of overweight, affecting children both in developed and developing countries.[1] A worldwide increase in levels of overweight/obesity (OW/OB) in preschool age has been reported, while 2020 projections predict a rise to 9.1%.[2] Countries of the Mediterranean region and the British islands report the highest rates of overweight/obesity in preschoolers, while the lowest scores are reported in central, middle, eastern and northern European countries.[3]

The etiology of early childhood OW/OB, which still remains an understudied issue,[4] is multidimensional and encompasses genetic (i.e. gender, age) and environmental factors (i.e. ethnicity, socio-economic status, parental weight status, parental lifestyle and dietary intake habits).[5,6] Parental BMI scores are significantly linked with child's BMI and levels of adherence to the Mediterranean Diet (MD);[7] an important health-promoting pattern for children[8] measured by the Mediterranean Diet Quality Index for children (KIDMED score). Preschool children in the Mediterranean countries of the EU, however, exhibited low adherence to the Mediterranean-like diet, which in turn was associated with early rates of OW/OB.[9,10] Although OW/OB rates are more prevalent in low Socio-Economic Status (SES) and ethnic minority groups,[11] the relationship of these socio-demographic variables with parental feeding practices and culture[12] is still under-examined.

Apart from parental dietary and overall lifestyle, additional individual-level behaviors could directly affect preschoolers' BMI. For instance, preschoolers are believed to be highly physically active,[13] nevertheless, they are highly susceptible to early adoption of obesogenic lifestyles, due to their engagement in fairly low levels of moderate to vigorous physical activity (MVPA).[14] Furthermore, longer periods of TV viewing have been identified as an important modulator of the risk of greater BMI and OW/OB in preschoolers.[15,16]

Although OW/OB rates in preschoolers in Greece are reported[17] among the highest worldwide (17.5% and 16.2%, respectively), empirical data on the individual and parental dietary and lifestyle habits of preschoolers of different ethnicity and their impact on children's BMI are limited.[4,18] The present study constitutes the first cross-sectional study that seeks to fill the gap in the current literature by identifying early determinants of early childhood overweight/obesity in both native Greek and ethnic minority preschoolers in Greece.

The primary objective of the study was to investigate the individual and parental dietary and lifestyle factors associated with OW/OB among preschoolers attending kindergartens in Attica region, Greece. Additional objectives were set to further explore level of potential correlation of guardian parents' and preschoolers' dietary habits, to identify predictors of high and low preschoolers' BMI, as well as predictors of low KIDMED score.

Material and methods

Study design and participants

This cross-sectional study was conducted in Attica region (largest administrative region in Greece, including the capital city), during the school year 2016-2017. The study population consisted of preschoolers aged 5 to 6 years, attending public kindergarten and their guardian parent.

The terms ethnic group or population were determined as „a group of people smaller in number than the majority categories, who by their customs, language, race, values, and group interests differ from the majority population".[19] The framework of ethnicity in our study, similarly to other cross-sectional studies,[20] was defined according to the preschoolers' and their guardian parents' country of birth. Specifically, participants were considered of non-Greek ethnicity if: (1) born outside Greece and at least one parent born outside Greece (i.e. first generation); or (2) born in Greece, but both parents born outside Greece (i.e. second generation) and migrated in Greece.

Several inclusion criteria were formed as follows: a) permanent residents in Attica, b) registered in the selected kindergartens, c) speaking and comprehending the Greek language. Preschoolers not attending the extended educational program (from 8.15 a.m. to 16 p.m.) were excluded in order to ensure that all participants (preschoolers) would eat lunch during school hours. The total number of participants consisted of five hundred and seventy-eight (n=578) preschoolers, five hundred and seventy-eight (n=578) guardian parents, both native Greeks (n=451) and other nationalities (n=127) from 63 public Kindergarten schools in 36 municipalities within Attica region. Schools were situated both at the suburbs and in the center of capital city (Athens) and were randomly selected from a list provided by the Ministry of Education.

Additional information on study design and sampling is presented in another paper which is currently under publication.

Ethical approval

The study was designed according to the principles of Helsinki declaration (1989) and approved by the Research Department of the Education Institute of the Hellenic Ministry of Education (ethical approval F15/1774/222145/2016). Participants (guardian parents) and kindergartens were extensively informed for the purposes and processes of this study and provided written consent forms and a written approval (a/a: 03/10/2016), respectively.

Anthropometrical & Lifestyle Measurements

Data regarding families' demographic characteristics and profile, such as parent's age, ethnic group, employment status and years of education were collected by the use of the validated Food Frequency Questionnaire (FFQ).[21]Additional anthropometrical data were obtained by preschoolers' parents, such as current height and body weight of each parent and his/her child. Parents body height (m) and weight (kg) were self-reported and used to calculate parents BMI (kg/m2) and to define parents overweight (BMI 25–29.9 kg/m2) and obesity (BMI P30 kg/m2), according to the World Health Organization classification for adults. BMI as weight (Kg) ratio to squared height (m2) was calculated for each child. To determine overweight and obesity, BMI percentile and CDC were used. BMI between 85 and 95 percentiles, (for age and sex), was accounted as overweight and greater than 95 is defined as obese.

Evaluation of dietary habits

Two separate but similarly structured questionnaires were used in preschoolers and parents respectively. These questionnaires were a composition of two validated tools; the Food Frequency Questionnaire (FFQ)[21] and the Mediterranean Diet Quality Index (KIDMED).[8] The KIDMED score[10] measured adherence to the Mediterranean style diet among preschoolers, based on the principles sustaining healthful, Mediterranean-style dietary patterns, as well as on those that do not support the Mediterranean-style dietary pattern. Other aspects of eating behavior were also evaluated, such as eating at least one family meal per day, frequency of eating home-delivered food, breakfast consumption, eating while engaged in other sedentary activities.

The FFQ was selected as a validated semi-quantitative food frequency questionnaire designed to assess habitual dietary intake in preschool children.[22] It comprises 118 food items with the following components: food frequency, type of meals during the day (breakfast, morning snack, lunch, afternoon snack, dinner and evening snack), use of dietary supplements, type of fat used for cooking, frequency of meals consumed in restaurants or take away and television viewing during meals.

Physical activity assessment

Information on guardian parents' and preschoolers' physical activity levels was obtained by a valid, structured Physical Activity Questionnaire (developed by the Rhea Study, University of Crete).[23] Questions included information on parents' frequency of physical activity (alone or together with their children), type, duration, and intensity of the child's participation in all typical school outdoor organized or non-organized Light to Vigorous Physical Activities (L-VPA).

Statistical analysis

All tests were two-tailed and performed at a=0.05, in the IBM SPSS 24. Upon testing for distributions by Kolmogorov-Smirnov and binomial chi-square, the majority of variables were found to follow a normal distribution. Descriptive statistics were demonstrated using N (%) and Mean (Standard Deviations, SD). Chi-square, Kruskal Wallis and Mann Whitney tests were utilized.

Furthermore, two new variables were created based on parents' and preschoolers' dietary habits, using empirical grouping of dietary habits questions and checking the final grouping by cluster analysis. Lastly, mathematical weights were provided to rank least and best patterns of dietary habits per category (parents or children). Pearson's rho was applied to assess the level of concordance and correlation of these two variables. Two multivariate regression models were developed to predict preschoolers' BMI and low KIDMED score based on preschoolers' and parents' habits.

Results

Level of concordance of parent's and child's dietary habits

Figure 1 illustrates the level of concordance of parent's and child's dietary habits utilizing the overall diet score in each group. As observed, dietary patterns presented significant correlation (Pearson's rho= 0.94, p <0.001). More than 90% of child's dietary habits could be explained by parent's choices (R2=0.91). Detailed findings on parent's and child's dietary and lifestyle habits per nationality group are presented in Table 1 and Supplementary Tables S1 and S2.

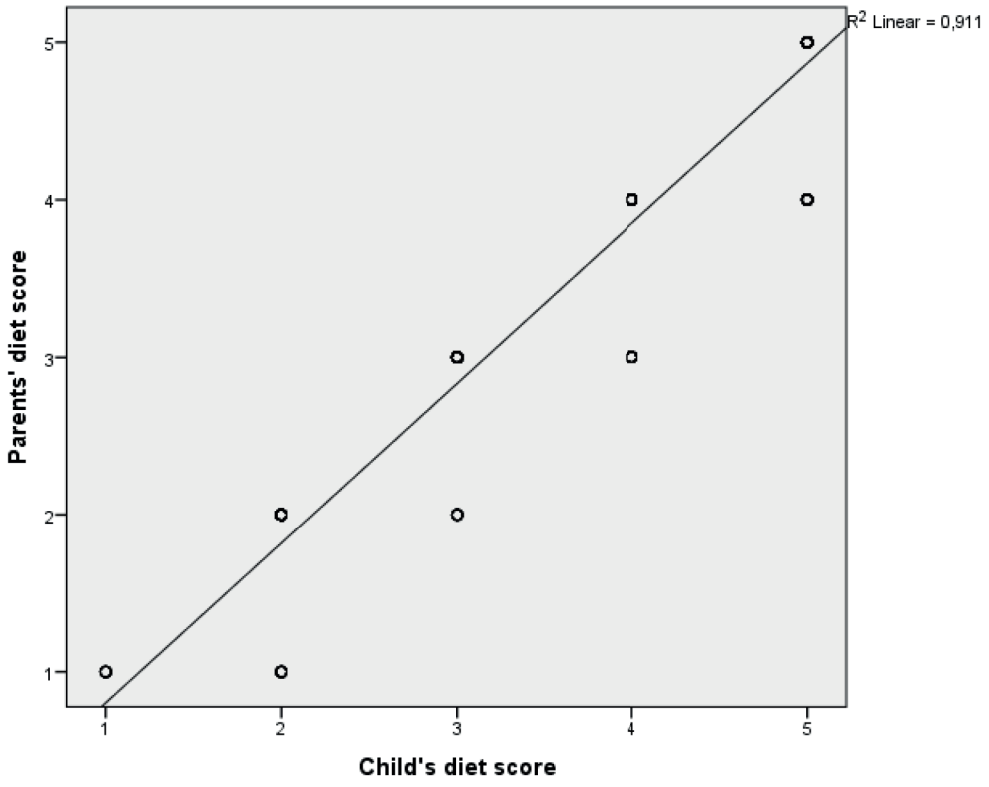

Figure 1: Comparison of parent's and child's dietary patterns

Table 1. Comparison of dietary and other lifestyle characteristics of the participants of different nationality

	Nationality N (%)		*P value*
	Greeks N=451	*Other nationality N=127*	
Parents' frequency of Mediterranean diet			<0.001
Not at all	13 (2.9)	25 (19.8)	
Rarely	83 (18.5)	53 (42.1)	
Often	314 (70.1)	45 (35.7)	
Very often	38 (8.5)	3 (2.4)	
Parents' breakfast consumption (yes)	342 (75.8)	91 (71.7)	0.3
Children's breakfast consumption (yes)	409 (91.1)	109 (85.8)	0.08
Parents' brunch consumption (yes)	301 (67.2)	44 (34.6)	<0.001
Children's brunch consumption (yes)	425 (94.2)	105 (82.7)	<0.001
Parents' meal consumption (yes)	425 (94.7)	122 (96.1)	0.5
Children's consumption of meal in the afternoon (yes)	395 (87.6)	86 (67.7)	<0.001
Parents' Dinner consumption (yes)	357 (79.2)	111 (87.4)	0.03
Children's dinner consumption	404 (89.6)	115 (90.6)	0.7
Parents' time of dinner			0.2
Don't eat	42 (9.3)	8 (6.3)	
Not at specific time	74 (16.4)	28 (22)	
Before 20.00	70 (15.5)	28 (22)	
At 20.00	87 (19.3)	20 (15.7)	
At 21.00	125 (27.7)	35 (27.6)	
At 22.00	44 (9.8)	7 (5.5)	
After 22.00	9 (2.0)	1 (0.8)	
Children's time of dinner consumption			<0.001
No dinner	19 (4.2)	2 (1.6)	
No specific hour	18 (4)	18 (14.2)	
Before 20.00	144 (31.9)	48 (37.8)	
At 20.00	193 (42.8)	44 (34.6)	
At 21.00	70 (15.5)	13 (10.2)	
At 22.00	7 (1.6)	2 (1.6)	
Parents' frequency of eating at fast food restaurants (including souvlakery)			<0.001
Never	104 (23.2)	58 (45.7)	
Rarely	263 (58.6)	58 (45.7)	
Often	82 (18.3)	11 (8.7)	
Once/Twice per month	239 (53)	47 (37)	
Children's Frequency of eating at fast food restaurants			0.4
4 or more times per week	3 (0.7)	2 (1.6)	
2-3 times per week	4 (0.9)	1 (0.8)	
Once per week	76 (16.9)	16 (12.6)	
1-3 times per month	162 (35.9)	47 (37)	
Less than once per month	180 (39.9)	48 (37.8)	
Never	26 (5.8)	13 (10.2)	
Parents' frequency of consuming vegetables and fruits			0.01
Less than once per week	7 (1.6)	-	
At least once per week	41 (9.1)	6 (4.7)	
Three/five times per week	151 (33.5)	31 (24.4)	
Every day	252 (55.9)	90 (70.9)	
Children's frequency of consuming vegetables and fruits			<0.001
Not at all	63 (14)	9 (7.1)	
Once per day	323 (71.6)	82 (64.6)	

Table 1. Comparison of dietary and other lifestyle characteristics of the participants of different nationality *(continued)*

2-3 times per day	54 (12)	27 (21.3)	
More than 3 times per day	11 (2.4)	9 (7.1)	
Removing fat from child's meat (prior consumption)			0.02
No	72 (16)	32 (25.2)	
Yes	379 (84)	95 (74.8)	
Parents controlling child's diet			0.01
Never	2 (0.4)	3 (2.4)	
Rarely	6 (1.3)	6 (4.8)	
Relatively often	49 (10.9)	20 (15.9)	
Often	199 (44.1)	49 (38.9)	
Very often	195 (43.2)	48 (38.1)	
Parents' years of smoking	16.1 (5.5)	12.2 (6.2)	0.03
Parents' alcohol consumption (yes)	150 (33.3)	30 (23.8)	0.05
Parents' physical activity (yes)	191 (42.5)	91 (71.7)	0.004
Watching TV while eating (yes)	2.7 (1.5)	3.6 (2.2)	<0.001
Children's physical activity (yes)	334 (74.1)	51 (40.2)	<0.001

Table 2. Multivariate model of predicting high BMI in preschoolers of different nationalities in Greece (Model 1)

Predictors	β *estimate*[a]	*Standard Error*	*P value*
KIDMED score	-0.8	0.2	<0.001
Physical Activity	-0.8	0.3	0.02
Removing fat from meat prior eating	-0.6	0.2	0.03
Watching TV while eating	0.7	0.3	0.04
Mother's age	0.4	0.03	0.03
Parents' BMI	0.6	0.1	0.01
Parents' frequency of following Mediterranean Diet	-0.5	0.4	0.01
Parents' Smoking habits (pack/years)	0.2	0.1	0.03
Parents' years of smoking	0.3	0.02	<0.001
Parents' Alcohol consumption (glasses/week)	0.1	0.03	0.04
Parents' Physical Activity	-0.2	0.09	0.03

a model adjusted for age, parents' profession, nationality

Predictors of high preschoolers' BMI

Two core multivariate models were developed to estimate high BMI in children. Table 2 presents the first multivariate model of the joint impact of eleven indicators in preschoolers of different nationalities in Greece. Low levels of KIDMED score (β estimate= –0.8, SE=0.2), low levels of physical activity (β estimate= –0.8, SE=0.3), removing fat from meat prior eating (β estimate= –0.6, SE=0.2) and parents' low frequency of following MD (β estimate= –0.5, SE=0.4) seem to increase the risk of high child's BMI, significantly (all p<0.05). Moreover, high frequency of watching TV while eating (β estimate= 0.7, SE=0.3), mother's age (β estimate= 0.4, SE=0.03) and BMI (β estimate= 0.6, SE=0.1) also increase the risk, significantly (all p<0.05). Similarly, higher risk is observed in children whose parents are long-term smokers (β estimate= 0.2, SE=0.1), (β estimate= 0.3, SE=0.02), alcohol consumers (β estimate= 0.1, SE=0.03) and physically inactive (β estimate= –0.2, SE=0.09) (all p<0.05).

In the second multivariate model (Table 3), several indicators were identified as significant (p<0.05). Similarly to the first model, the following parents' characteristics were found to increase BMI risk: high BMI and years of smoking, decreased physical activity, low frequency of following the Mediterranean nutritional scheme and removing fat from meat prior eating. In addition to these factors, the latest the time of dinner consumption (β estimate= 0.8, SE=0.2) and the highest the number of meals consumed at

Table 3. Multivariate model of predicting high BMI in preschoolers of different nationalities in Greece (Model 2)

Predictors	β *estimate*[a]	*Standard Error*	*P value*
Removing fat from meat prior eating	-0.5	0.1	0.02
Consumption of breakfast	-0.9	0.1	<0.001
Consumption of brunch	-0.8	0.1	0.01
Time of dinner consumption	0.8	0.2	<0.001
Frequency of eating at fast food restaurants	0.7	0.1	0.02
Frequency of vegetables or fruits consumption jointly with parents	-0.6	0.02	0.01
Parents controlling child's diet	-0.6	0.4	0.03
Parents' Physical Activity	-0.5	0.1	<0.001
Parents' BMI	0.5	0.2	<0.001
Parents' frequency of following Mediterranean Diet	-0.6	0.03	0.03
Parents' years of smoking	0.4	0.01	<0.001
Parents' Physical Activity	-0.1	0.05	0.04

a model adjusted for age, parents' profession, nationality

fast food restaurants (β estimate= 0.7, SE=0.1), the greatest is the risk of high BMI in children. On the contrary, consumption of breakfast (β estimate= –0.9, SE=0.1) and brunch (β estimate= –0.8, SE=0.1), high frequency of consuming vegetables or fruits (β estimate= –0.6, SE=0.02) and physically active parents (β estimate= –0.5, SE=0.1) seemed to diminish the risk for high BMI in children. Lower risk was also presented when parents control child's diet (β estimate= –0.6, SE=0.4).

Predictors of preschooler's KIDMED score

Table 4 summarizes the joint effect of low KIDMED score predictors, adjusting for child's age, BMI and nationality. Child's increased physical activity (β estimate= –0.6, SE=0.3) and parents' frequency of following the Mediterranean Diet (β estimate= –0.9, SE=0.03) were observed to decrease the risk for low KIDMED score, while watching TV when eating, increased children's risk of low KIDMED score (β estimate= 0.5, SE=0.08). Similar trends were observed to preschoolers whose parents have a high BMI (β estimate= 0.7, SE=0.01) and are long-term smokers (β estimate= 0.5, SE=0.4). All p<0.05.

Table 4. Multivariate model of predicting low KIDMED score in preschoolers of different nationalities in Greece

Predictors	β *estimate*[a]	*Standard Error*	*P value*
Children's Physical Activity	-0.6	0.3	0.02
Watching TV while eating	0.5	0.08	<0.001
Parents' BMI	0.7	0.1	0.01
Parents' frequency of following Mediterranean Diet	-0.9	0.03	<0.001
Parents' years of smoking	0.5	0.4	0.03

a model adjusted for age, BMI, nationality

Discussion

Our study revealed that low levels of parental PA and frequency of following MD, eating out in fast food restaurants, mother's age and child's BMI operate as predictors of high preschoolers' BMI. To the contrary, breakfast, brunch and early dinner consumption, vegetables and fruits intake, removing fat prior eating, parental control of preschoolers' diet have a positive effect on maintaining preschoolers' normal BMI or decreasing obesity/overweight . Additionally, parents and preschoolers frequently following MD, child's increased physical activity were depicted as predictors of positive preschoolers' KIDMED score, whereas, reverse outcome was found with parents with high BMI. Watching TV while eating, parental smoking and alcohol consumption, were found to be predictors negatively associated with preschoolers' BMI and KIDMED score. Lastly, ethnicity seemed to play an integral role on lifestyle trends, yet it had no diverse impact on the under-study outcomes (e.g. child's BMI and adherence to the Mediterranean diet).

Parental characteristics and habits as predictors of high preschoolers' BMI

Considerable evidence supports the fundamental role parents play in shaping the development of child eating habits, behaviors[24] and their weight status.[25] The current study revealed significantly similar

dietary habits between parents and preschoolers. These findings presented trends based on a generalized pattern of their habits, concluding on the high impact of parental choices on children.

Low levels of parental physical activity and adherence to the Mediterranean diet

Studies examining the associations between PA and body fat in young children are scarce,[26,27] and to the best of our knowledge, few studies have estimated the associations between objectively measured PA and BMI in preschoolers.[28,29] Our study addressed, as well, the strong relationship between high levels of parental physical activity and children's active engagement in physical activities, with the positive, beneficial effect of their lower BMI, a pattern also observed in other studies on preschoolers.[30-31] Concerning the relationship of the MD with young children's BMI, although the relevant epidemiological studies do not always show the same protective effect, it could be claimed that higher adherence to the MD reduces the risk of children's OW/OB. [32]

High frequency of watching TV while eating

The significant correlation between time spent on TV watching and BMI has been repeatedly shown since the eighties [33-34] suggesting that increased levels of children's TV viewing increase the overweight epidemic among children.[1,2] Similarly to our study, the GENESIS study[35] found that children's BMI status, physical activity status, their maternal educational status and the region of residence were significantly associated with the time children spent in TV viewing.

Mother's age and child's BMI

Our study evidenced that mother's age and BMI significantly increase the risk of high BMI in preschoolers, which is consistent with previous studies in preschoolers, also revealing a higher prevalence of OW/OB in children with overweight/obese parents compared to their peers' parents with normal weight.[7,36,37] Similarly, according to the GRECO Study [5] and the Toy Box Study[38] in preschoolers, mother's age was a protective predictor for both girls' and boys' OW/OB status.

Parental smoking and alcohol consumption

Our study depicted the increased risk of high BMI in preschoolers whose parents are long-term smokers and alcohol consumers. In line with previous research, higher maternal alcohol consumption during pregnancy is associated with a slightly lower likelihood of 14-month-old infants following a relatively healthy dietary pattern.[23] Maternal smoking during pregnancy or early infancy and paternal smoking during the prenatal period are predominantly associated with infants or children up to age 7 years following unhealthier diets and/or being less likely to adhere to healthier diets [23].

Eating out in fast food restaurants

Eating outside home has been associated with higher intake of dietary fat and energy compared to home eating, and as frequency of eating at fast-food restaurants has increased, consumption of fruit, vegetables, and dairy has decreased.[39] Our research study, also pointed out that the risk of obesity and high BMI score in children is elevated the more often they eat outside home, in fast food restaurants.

Parental characteristics and habits decreasing risk of high BMI in preschoolers.

Breakfast consumption as determinant of young children's BMI

Promoting breakfast eating among children is multi-beneficial, including improved cognitive and physical abilities, increased likelihood of meeting the recommendations for fruit and vegetable intake, and decreased unhealthy snacking.[29] Our finding echoes those of the Greek PANACEA Study in 10-12-year-old Greek children,[40] in which daily consumption of breakfast was also inversely associated with prevalence of OW/OB in both genders.[41]

Brunch and early dinner and their relation to preschoolers' BMI

Parental dynamics strongly influence the incidence and regularity of family meals having a protective effect in young children's BMI.[42-43] Regular family meals are related with a lower risk of OW/OB, higher average of fruit and vegetable intake, lower fast food and soft drink consumption and an overall better diet quality.[44] Our research demonstrated that brunch consumption and the latest time of dinner consumption are inversely associated with high BMI and occurrence of OW/OB in preschoolers, regardless of gender and ethnic background. According to a relevant review,[44] significant associations between higher family meal frequency and better overall diet quality, less unhealthy diet and lower BMI were revealed.

Parental control of preschoolers' diet as determinant of BMI

Associations between parental structural strategies and child's lower BMI score and promotion of healthy eating are more frequently adopted at preschool age, while they seem to be of less value at older child ages probably due to the degree of child's independence.[45] Existing literature with low-income minority samples suggests that certain parental feeding

practices, such as an indulgent feeding style, were associated with child overweight.[46] A cross-sectional study of ethnically diverse, low-income preschoolers and their mothers [47] exhibited that neither child race nor maternal pressure to eat and restriction were linked to child overweight based on child BMI.

Predictors associated with preschoolers' KIDMED score

Parental and children's frequency of following the Mediterranean diet are depicted, in our study, as positive predictors of preschoolers' higher KIDMED score. Similarly, the Greek Childhood Obesity (GRECO) study showed that children with higher KIDMED score presented more frequent consumption of foods sustaining the MD pattern (fruits, vegetables, legumes, dairy products, fish, bread, nuts) and a less frequent consumption of foods that undermine the MD scheme, and should be consumed in moderation or rarely.[48] Moreover, breakfast consumption, the habit of having family meals during the week, and higher adherence of parents to the MD increased the odds of a child presenting higher KIDMED score.[48] The adverse association between low adherence to the MD dietary patterns and a non-optimal KIDMED score was similarly addressed in another study of Greek children,[49,50] as well as Cypriot children.[51]

Study limitations

The current findings should be discussed under some limitations and be carefully translated into further research and actions. Power analysis was not conducted since we addressed all active kindergartens and managed to have satisfying response rates. This may lead to underestimation of preschoolers BMI and should be taken into consideration. Additionally, no clinical and somatometric measurements were performed, since all data were self-reported; potentially hiding slight information or/and recall bias.

Conclusions

Parents, as nutritional gatekeepers, influence and shape, especially in the early years, their child's eating behavior both directly, through the food they prepare and consuming at home, and indirectly, through their behavior, attitudes and the nutritional environments they choose for their children inside, or outside home. The present findings could represent a stepping stone for the formulation of nominal early life obesity curbing family, as well as school-based interventions and public health policies in Greece.

Declarations

Authors' contributions

MC conceptualized and designed the study, formulated the research questions, carried out the study, drafted the article and revised it critically for important intellectual content and final approved the final version to be submitted. IT formulated the research questions, analyzed the data, drafted the article, revised it critically for important intellectual content and approved the final version to be submitted. DSP analyzed the data, drafted the article, revised it critically for important intellectual content and approved the submission of the final version. NT formulated the research questions, designed the study, reviewed the manuscript and approved the final version to be submitted.

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Appendix

Table S1: Comparison of parents' dietary habits between ethnicity groups (n=578)

	Nationality N (%)		P value
	Greeks N=451	Other nationality N=127	
Aware of Mediterranean diet's principles			<0.001
Not sure	59 (13.1)	42 (18.9)	
Not aware	7 (1.6)	24 (18.9)	
Aware	385 (85.4)	61 (48.0)	
Frequency of Mediterranean diet			<0.001
Not at all	13 (2.9)	25 (19.8)	
Rarely	83 (18.5)	53 (42.1)	
Often	314 (70.1)	45 (35.7)	
Very often	38 (8.5)	3 (2.4)	
Breakfast consumption (yes)	342 (75.8)	91 (71.7)	0.3
Brunch consumption (yes)	301 (67.2)	44 (34.6)	<0.001
Meal consumption (yes)	425 (94.7)	122 (96.1)	0.5
Consumption of meal in the afternoon (yes)	254 (56.3)	55 (43.3)	0.009
Dinner consumption (yes)	357 (79.2)	111 (87.4)	0.03
Consumption of meal overnight (yes)	14 (3.1)	4 (3.1)	0.9
Time of dinner			0.2
Don't eat	42 (9.3)	8 (6.3)	

Table S1: Comparison of parents' dietary habits between ethnicity groups (n=578) *(continued)*

	Nationality N (%)		P value
	Greeks N=451	Other nationality N=127	
Not at specific time	74 (16.4)	28 (22)	
Before 20.00	70 (15.5)	28 (22)	
At 20.00	87 (19.3)	20 (15.7)	
At 21.00	125 (27.7)	35 (27.6)	
At 22.00	44 (9.8)	7 (5.5)	
After 22.00	9 (2.0)	1 (0.8)	
Reasons for food consumption			<0.001
Mainly for pleasure	30 (6.7)	24 (18.9)	
Mainly for survival	50 (11.1)	13 (10.2)	
Both	365 (80.9)	83 (65.4)	
None	6 (1.3)	7 (5.5)	
Frequency of out-home meal			<0.001
Never	10 (2.2)	12 (9.4)	
Rarely per year	209 (46.4)	70 (55.1)	
Rarely per month	204 (45.3)	37 (29.1)	
Rarely per week	26 (5.8)	4 (3.1)	
Every day	1 (0.2)	4 (3.1)	
Frequency of eating at restaurants			<0.001
Never	33 (7.3)	45 (35.4)	
Rarely	244 (54.2)	64 (50.4)	
Often	173 (38.4)	18 (14.2)	

Table S1: Comparison of parents' dietary habits between ethnicity groups (n=578) *(continued)*

	Nationality N (%)		P value
	Greeks N=451	Other nationality N=127	
Frequency of eating at fast food restaurants (including souvlakery)			<0.001
Never	104 (23.2)	58 (45.7)	
Rarely	263 (58.6)	58 (45.7)	
Often	82 (18.3)	11 (8.7)	
Frequency of eating at "ouzeri"			<0.001
Never	244 (54.3)	113 (89)	
Rarely	157 (35)	12 (9.4)	
Often	48 (10.7)	2 (1.6)	
Frequency of eating at pizza restaurants			0.4
Never	305 (68.1)	93 (73.8)	
Rarely	125 (27.9)	30 (23.8)	
Often	18 (4)	3 (2.4)	
Frequency of ordering from delivery			0.01
Never	143 (31.7)	67 (52.8)	
Once per week	63 (14.1)	12 (9.5)	
Twice per week	6 (1.3)	1 (0.8)	
Once/Twice per month	239 (53)	47 (37)	
Frequency of homemade food consumption			0.01
Once/twice per week	2 (0.4)	5 (3.9)	
Three/four times per week	61 (13.5)	20 (15.7)	
Every day	388 (86)	102 (80.3)	
Frequency of vegetables and fruits consumption			0.01
Less than once per week	7 (1.6)	-	
At least once per week	41 (9.1)	6 (4.7)	
Three/five times per week	151 (33.5)	31 (24.4)	
Every day	252 (55.9)	90 (70.9)	
Aware of number of optimum consumption of vegetables and fruits			<0.001
No	129 (28.7)	57 (45.2)	
Yes	321 (71.3)	69 (54.8)	
Number of optimum consumption of vegetables and fruits			<0.001
1 part per week	1 (0.3)	1 (1.4)	
1 part per day	75 (22.9)	38 (51.4)	
3 parts per day	155 (47.4)	24 (32.4)	
5 parts per day	96 (29.4)	11 (14.9)	

Table S2: Comparison of preschoolers' dietary habits between ethnicity groups (n=578)

	Nationality N (%)		P value
	Greeks N=451	Other nationality N=127	
Consumption of breakfast			0.08
No	40 (8.9)	18 (14.2)	
Yes	409 (91.1)	109 (85.8)	
Consumption of brunch			<0.001
No	26 (5.8)	22 (17.3)	
Yes	425 (94.2)	105 (82.7)	
Consumption of lunch			0.4
No	1 (0.2)	1 (0.8)	
Yes	449 (99.8)	126 (99.2)	
Consumption of meal in the afternoon			<0.001
No	56 (12.4)	41 (32.3)	
Yes	395 (87.6)	86 (67.7)	
Consumption of dinner			0.7
No	47 (10.4)	12 (9.4)	
Yes	404 (89.6)	115 (90.6)	
Consumption of other additional meals			0.4
No	418 (92.9)	115 (90.6)	
Yes	32 (7.1)	12 (9.4)	
Time of dinner consumption			<0.001
No dinner	19 (4.2)	2 (1.6)	
No specific hour	18 (4)	18 (14.2)	
Before 20.00	144 (31.9)	48 (37.8)	

Table S2: Comparison of preschoolers' dietary habits between ethnicity groups (n=578) *(continued)*

	Nationality N (%)		P value
	Greeks N=451	Other nationality N=127	
At 20.00	193 (42.8)	44 (34.6)	
At 21.00	70 (15.5)	13 (10.2)	
At 22.00	7 (1.6)	2 (1.6)	
Breakfast frequency at kindergarten			<0.001
1-2 days	27 (6)	18 (14.2)	
3-4 days	154 (34.3)	51 (40.2)	
5 days	235 (52.3)	39 (30.7)	
Skips breakfast	33 (7.3)	19 (15)	
Frequency of eating at fast food restaurants			0.4
4 or more times per week	3 (0.7)	2 (1.6)	
2-3 times per week	4 (0.9)	1 (0.8)	
Once per week	76 (16.9)	16 (12.6)	
1-3 times per month	162 (35.9)	47 (37)	
Less than once per month	180 (39.9)	48 (37.8)	
Never	26 (5.8)	13 (10.2)	
Parents controlling child's diet			0.01
Never	2 (0.4)	3 (2.4)	
Rarely	6 (1.3)	6 (4.8)	
Relatively often	49 (10.9)	20 (15.9)	
Often	199 (44.1)	49 (38.9)	
Very often	195 (43.2)	48 (38.1)	
Frequency of vegetables or fruits consumption			<0.001
Not at all	63 (14)	9 (7.1)	
Once per day	323 (71.6)	82 (64.6)	
2-3 times per day	54 (12)	27 (21.3)	
More than 3 times per day	11 (2.4)	9 (7.1)	
If child refuses consumption:			0.3
Don't insist	166 (36.9)	50 (39.7)	
Insist	237 (52.7)	58 (46)	
Offers alternative	47 (10.4)	18 (14.3)	
Informed about food labeling			0.6
Not at all	22 (4.9)	11 (8.7)	
A little	85 (18.8)	24 (18.9)	
So and so	170 (37.7)	45 (35.4)	
Enough	143 (31.7)	38 (29.9)	
A lot	31 (6.9)	9 (7.1)	
Allergy in specific food/products			0.04
No	434 (96.2)	117 (92.1)	
Yes	17 (3.8)	10 (7.9)	
Parents' assessment of child's weight			0.8
More than normal	24 (5.3)	7 (5.5)	
Normal	364 (80.9)	105 (82.7)	
Less than normal	62 (13.8)	15 (11.8)	
Parents' assessment of child's amount of food consumption			0.04
Eats too little	5 (1.1)	6 (4.7)	
Eats little	72 (16)	25 (19.7)	
Eats normal amounts	341 (75.6)	87 (68.5)	
Eats more than normal	31 (6.9)	8 (6.3)	
Eats too much	2 (0.4)	1 (0.5)	
Child under diet during the last year			0.8
No	441 (98)	124 (97.6)	
Yes	9 (2)	3 (2.4)	
Reason of child being under diet			0.5
Loosing weight	3 (33.3)	-	
Gaining weight	2 (22.2)	1 (33.3)	
Medical reasons	4 (44.4)	2 (66.7)	
Removing fat from child's meat (prior consumption)			0.02
No	72 (16)	32 (25.2)	
Yes	379 (84)	95 (74.8)	
Type of oil used for cooking			<0.001
Olive oil	447 (99.1)	117 (92.1)	
Seed oil	2 (0.4)	5 (3.9)	
Butter	-	2 (1.6)	
Margarine	2 (0.4)	3 (2.4)	
Consumption of food supplements or vitamins			0.01
No	387 (85.8)	114 (89.8)	
Yes	64 (14.2)	13 (10.2)	
Change in buying food products during last year			0.3
No	229 (50.9)	58 (45.7)	
Yes (main reason: products prizes)	221 (49.1)	69 (54.3)	