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Posted Date: 26 December 2025

doi: 10.20944/preprints202512.2320.v1

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Article

Parental Mental Health, Feeding Practices and Sociodemographic Factors as Determinants of Childhood Obesity in Greece

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Abstract

Background/Objectives: Childhood obesity remains a major public health issue, particularly in Mediterranean countries such as Greece. Although parental influences on children’s weight have been extensively studied, fewer studies have jointly examined parental mental health, feeding practices, sociodemographic factors and biological stress markers. This study aimed to investigate associations between psychological status, educational level, feeding behaviors and children’s Body Mass Index (BMI) in a Greek sample. A pilot assessment of salivary cortisol was included in evaluating its feasibility as an objective biomarker of parental stress. **Subjects and Methods:** A total of 103 parent-child dyads participated in this cross-sectional study. Children’s BMI was classified using World Health Organization (WHO) Growth Standards. Parental stress, anxiety and depressive symptoms were assessed using the Perceived Stress Scale-14 (PSS-14) and the Depression Anxiety Stress Scale-21 (DASS-21) questionnaires. Feeding practices were evaluated with the Comprehensive Feeding Practices Questionnaire (CFPQ). Statistical analyses included Pearson correlations, independent samples t-tests, one-way ANOVA, Mann-Whitney U and Kruskal Wallis tests. A subsample provided saliva samples for cortisol analysis to assess feasibility and explore potential associations with parental stress indicators. **Results:** Parental BMI showed a strong positive association with child BMI ($p = 0.002$). Higher parental anxiety ($p = 0.002$) and depression ($p = 0.009$) were also associated with increased child BMI. Restrictive ($p < 0.001$) and emotion-driven ($p < 0.001$) feeding practices were associated to higher child BMI, whereas monitoring ($p = 0.013$) and health-promoting feeding practices ($p = 0.001$) appeared protective. Lower parental education was related to higher BMI in both parents ($p = 0.001$) and children ($p = 0.002$) and to more frequent use of restrictive feeding strategies ($p = 0.001$). WHO charts identified a greater proportion of children as overweight or obese compared with the Centers for Disease Control and Prevention (CDC) criteria. The analysis showed statistically significant differences between the two classification systems ($\chi^2 (4) = 159.704, p < 0.001$), indicating that BMI categorization varies considerably depending on the reference system used. No significant associations were observed with residential environment or salivary cortisol, likely due to the limited size of the pilot biomarker subsample. **Conclusions:** The findings highlight the combined effect of parental mental health status, educational level and feeding practices on child BMI within the Greek context. The preliminary inclusion of a biological stress marker provides added value to existing research in this area. These results underscore the

importance of prevention strategies that promote parental psychological wellbeing, and responsive feeding practices while addressing socioeconomic disparities to reduce childhood obesity risk.

Keywords: childhood obesity; parental stress; feeding practices; body mass index (BMI); psychosocial determinants; salivary cortisol; World Health Organization (WHO); Greece

1. Introduction

Childhood obesity has emerged as one of the most urgent global public-health challenges, with long-term consequences for children's physical, psychological and metabolic health [1]. According to the World Health Organization (WHO), the worldwide prevalence of overweight and obesity among children and adolescents has dramatically risen in recent years, affecting millions of youths across low-, middle- and high-income countries [2–4]. Europe has experienced similar upward trajectories, with Southern European countries reporting the highest burden [5]. Greece consistently ranks among the countries with the highest prevalence of childhood overweight and obesity, with national surveillance systems indicating persistently elevated rates that render targeted, evidence-based public-health effective approaches of outmost importance.

Children's eating behaviors and weight evolution are shaped largely within the family environment, where parental roles, household dynamics and dietary routines exert profound influence [6]. Parental feeding practices — defined as the strategies parents use to manage, guide, or regulate their child's eating — represent a key component of this environment [7]. These practices are not simply behaviorally driven; they are strongly shaped by parental psychology, stress levels, cultural expectations and socioeconomic pressures [8–10]. Accumulating evidence suggests that parental stress plays a key role in modulating feeding behaviors, often in ways that may compromise children's ability to self-regulate intake and maintain a healthy weight [11–13]. Stress can arise from multiple adversities, including financial strain, professional demands, caregiving burdens, family conflict and limited social support, all of which may modify the consistency, responsiveness and emotional status of parents' feeding interactions with their children [14].

Research has shown that higher levels of parental stress are associated with less structured and less responsive feeding practices, such as increased pressure to eat, inconsistent limit setting, emotional feeding, greater use of food as reward or comfort and reduced monitoring of unhealthy foods [15–18]. These non-responsive practices have been linked to disinhibited eating, emotional overeating and diminished satiety responsiveness in children, thereby contributing to excess weight gain over time [19–21]. Conversely, responsive feeding — characterized by supportive guidance, modeling healthy choices and providing autonomy — has been consistently associated with healthier dietary habits and more optimal weight trajectories during childhood [22–24].

Stress is a complex biopsychosocial process involving neuroendocrine, cognitive, emotional and behavioral pathways [25]. Central to the biological stress response is the activation of the hypothalamic-pituitary-adrenal (HPA) axis, which leads to the release of glucocorticoids, primarily cortisol [26]. Chronic or dysregulated cortisol secretion has been associated with altered appetite control, preferences for energy-dense foods, increased reward-driven eating, abdominal adiposity, reduced physical activity, sleep disturbances and disruptions in metabolic homeostasis — pathways all implicated in obesity development [27–30]. Stress-related physiological changes can also affect gastrointestinal function, systemic inflammation and energy balance, further supporting the link between chronic stress exposure and weight gain in both adults and children [31–33].

Within the family context, parental stress has both direct and indirect implications for children's health. Increased parental stress can amplify children's own physiological and emotional reactivity, diminish parental emotional availability, reduce positive communication, increase irritability or inconsistency in parenting and contribute to more conflictual or chaotic home environments [34–37]. These conditions may limit opportunities for structured family meals, reduce shared physical activity, increase children's sedentary screen time and weaken routines that support healthy

behaviors [38–40]. Parental stress may further aggravate parental mental health, including symptoms of anxiety and depression, which may provoke difficulties in maintaining supportive feeding practices or establishing predictable household routines [41–43]. Co-parenting quality further moderates these processes, with supportive and cooperative parenting acting as a buffer against stress-related disruptions in family functioning [44].

Given these complex interactions, parental feeding practices represent a critical mechanism linking stress to children's dietary behaviors and weight outcomes. The Comprehensive Feeding Practices Questionnaire (CFPQ) and similar validated tools have been widely used to assess multidimensional aspects of feeding, including positive practices (e.g., monitoring, modeling, healthy-eating guidance) and maladaptive strategies (e.g., pressure to eat, restriction, emotional feeding, food reward) [45–47]. Evidence consistently indicates that responsive and autonomy-supportive feeding promotes healthier eating behaviors and sustainable self-regulation of energy intake among children [48–50]. In contrast, coercive or emotionally driven practices may undermine children's satiety cues, promote overeating and contribute to unhealthy weight gain [51–53].

In parallel with these family-level dynamics, epidemiological evidence underscores the growing global and national burden of childhood obesity. Worldwide, the prevalence of overweight and obesity among school-aged children has increased more than eight-fold from 1975 to 2016, with substantial rises across regions regardless of economic development [54–56]. Socioeconomic inequalities further exacerbate these trends, as children from disadvantaged households face disproportionate exposure to obesogenic environments, reduced access to healthy foods and greater psychosocial stress [57–59]. In Greece, national surveys such as the World Health Organization (WHO) European Childhood Obesity Surveillance Initiative (COSI) and the Greek Examination of Cohorts (GRECO) Study have consistently reported overweight and obesity rates exceeding 35–40% among primary-school children, among the highest in Europe [60–62]. These alarming trends reflect the interplay between biological predispositions, obesogenic environments, family behaviors, sociocultural norms and psychosocial determinants including parental stress and mental health [63–65].

Despite extensive research linking stress, mental health and obesity, fewer studies have thoroughly examined how parental psychological functioning interacts with feeding practices, sociodemographic characteristics and children's anthropometric outcomes within the same analytical framework [66–68]. Even fewer studies have explored these relationships in Mediterranean populations, where traditional dietary habits coexist with rapid lifestyle changes, high obesity prevalence and unique familial caregiving dynamics [69–71]. The integration of biological stress markers, such as salivary cortisol, into family-based pediatric obesity research remains limited, although such biomarkers provide valuable objective insight into physiological stress pathways that may influence parenting behavior and child health [72,73].

The present study addresses these gaps by investigating the associations among parental stress, parental mental health, feeding practices and children's weight status in a Greek sample of parent-child dyads. By incorporating both psychosocial assessments and a preliminary biological measure of parental stress (salivary cortisol), this research offers an integrated examination of behavioral, psychological and physiological pathways that may contribute to childhood obesity within contemporary Mediterranean contexts [74,75]. Understanding these interconnected determinants is essential for informing family-centered interventions and public-health strategies aimed at mitigating the childhood obesity epidemic.

2. Subjects and Methods

2.1. Study Design

This cross-sectional study was conducted between 2024–2025 in community settings in the regions of Attica and Corinthia, as well as at the Pediatric Obesity Clinic of the First Department of Pediatrics, Medical School of the National and Kapodistrian University of Athens (NKUA) at “Aghia

Sofia" Children's Hospital, Athens, Greece. The study adhered to the ethical standards described in the Declaration of Helsinki.

2.2. Ethical Approval

The study protocol was approved by the Scientific Committee of the "Aghia Sofia" Children's Hospital (initial approval: Protocol No. 19998/05.08.2024, approved on 11 October 2024; protocol amendment: Protocol No. 13710/05.06.2025, approved on 17 June 2025). Written informed consent was obtained from all participating parents or legal guardians prior to data collection.

2.3. Participants

The study included 103 parent-child dyads with children aged 2-12 years. Participants were recruited either during clinic visits or through community outreach.

Inclusion Criteria

- Parents of children aged 2-12 years.
- Group A: children with normal weight (5th-85th percentile) or underweight (<5th percentile).
- Group B: children with overweight (>85th percentile), obesity (>95th percentile), or severe obesity based on age- and sex-specific BMI percentiles.

Exclusion Criteria

- Secondary causes of obesity (e.g., endocrine disorders such as Cushing syndrome or growth hormone deficiency).
- Genetic syndromes associated with abnormal weight (e.g., Down syndrome, Prader-Willi syndrome, etc.).
- Chronic diseases or severe emotional/behavioral disorders.

Participant Flow

A total of 130 parents were approached; after applying inclusion and exclusion criteria, 103 dyads were included in the final analysis.

Anthropometric Measurements

Child height and weight were obtained either by trained clinical staff at the Pediatric Obesity Clinic or parent-reported for community participants following standardized written instructions. BMI was calculated as weight (kg)/height (m²).

- For ages 2-5 years, BMI-for-age z-scores were computed using the WHO Child Growth Standards (2006) and WHO Anthro software [76].
- For ages 5-12 years, BMI-for-age z-scores were computed using the WHO Growth Reference (2007) and WHO AnthroPlus software [77].

For cross-method comparability, BMI categories were additionally verified using the CDC Child and Teen BMI Calculator [78]

2.4. Measures

Sociodemographic Questionnaire

A structured questionnaire was used to collect information on parental sex, age, education, occupation, BMI, residence and child characteristics (age, sex, height, weight, health history)

Perceived Stress Scale (PSS-14)

Parental perceived stress was assessed using the Greek-validated version of the Perceived Stress Scale-14 (PSS-14) [79], a 14-item measure evaluating frequency of stress-related thoughts and feelings on a 0-4 Likert scale, yielding total scores from 0 to 56. Higher scores indicate greater perceived stress.

Depression Anxiety Stress Scale (DASS-21)

The Greek-validated DASS-21 [80] was used to assess symptoms of depression, anxiety and stress. The scale includes 21 items rated on a 0-3 Likert scale and produces three 7-item subscale scores.

Comprehensive Feeding Practices Questionnaire (CFPQ)

Parent feeding practices were measured using the Greek-validated Comprehensive Feeding Practices Questionnaire (CFPQ) [81], consisting of 42 items across six factors:

1. Healthy Eating Guidance
2. Emotion Regulation / Food as Reward
3. Monitoring
4. Child Control
5. Pressure
6. Restriction

Higher scores reflect greater use of the respective feeding practice.

Permission to Use the Instruments

All psychometric instruments used in this study (PSS-14, DASS-21 and CFPQ) were administered in their officially translated and validated Greek versions. Prior to data collection, a written permission was obtained from the respective developers and/or copyright holders of each instrument.

Pilot Salivary Cortisol Assessment

A subsample of 13 parents provided four salivary cortisol samples (awakening, +30-45 min, evening, midnight) collected using Salivette® (Sarstedt) devices. Samples were centrifuged, stored at -20 °C, and analyzed in batch using a validated immunoassay at the Clinical and Translational Endocrinology Laboratory, “Aghia Sofia” Children’s Hospital. This assessment served as a feasibility pilot to explore biological markers of parental stress.

2.5. Statistical Analysis

Quantitative variables are presented as means $\pm$ standard deviation or medians (interquartile range), depending on distribution. Categorical variables are presented as frequencies (%). Normality was assessed using the Kolmogorov-Smirnov test. Group comparisons were conducted using independent samples t-tests and one-way ANOVA for normally distributed variables, and Mann-Whitney U and Kruskal Wallis tests for non-normally distributed variables.

Associations between continuous variables were examined using Pearson correlation coefficients. Chi-square tests were used to compare BMI classification between WHO and CDC criteria. The significance level was set at $p < 0.05$. Analyses were performed using IBM SPSS Statistics, Version 29.

3. Results

3.1. Participants Characteristics

Table 1 presents the demographic and psychological characteristics of the 103-participating parent-child dyads. Most parents were women (77.7%), married (88.3%) and residents of urban areas (67.0%). Regarding parental weight status, 5.8% of parents were underweight, 40.8% had normal weight, while 35.9% were overweight and 17.5% were classified as obese. The educational level was relatively high, with more than 70% of parents having completed higher or postgraduate education.

Among children, 55.3% were girls and 44.7% boys. According to the World Health Organization (WHO) Growth Standards, 4.9% of children were classified as underweight, 48.5% had normal weight, 17.5% were overweight, 10.7% were obese and 18.4% were classified as severely obese. Similar distributions were observed using the Centers for Disease Control and Prevention (CDC) criteria. Regarding parental psychological status assessed with the Depression Anxiety Stress Scale-21 (DASS-21), the majority of parents reported scores within the normal range for stress (68.9%), anxiety (72.8%) and depression (75.7%). The prevalence of severe or very severe symptomatology was low across all three subscales, remaining below 8% for each domain.

3.2. Correlations Between Parental Factors and Child BMI

Table 2 summarizes the correlations between parental characteristics and children’s BMI (WHO classification). Parental BMI showed a significant positive association with child BMI ($r = 0.304$, $p = 0.002$), indicating that higher parental weight status was correlated with higher child BMI values.

Child BMI was also positively associated with parental anxiety ($r = 0.297$, $p = 0.002$) and depression ($r = 0.255$, $p = 0.009$), suggesting that parental psychological distress may play a role in children’s weight trajectory.

Regarding feeding practices (CFPQ; Comprehensive Feeding Practices Questionnaire), restrictive strategies ($r = 0.558$, $p < 0.001$), emotional feeding/food as reward ($r = 0.466$, $p < 0.001$) and child control ($r = 0.278$, $p = 0.004$) were positively associated with higher child BMI. Conversely, monitoring ($r = -0.244$, $p = 0.013$), pressure to eat ($r = -0.204$, $p = 0.039$) and healthy eating guidance ($r = -0.318$, $p = 0.001$) were negatively associated with child BMI.

No significant correlations were found between child BMI and salivary cortisol indices (AUCg, AUCi).

3.3. Associations Between Parental BMI, Psychological Factors and Feeding Practices

Table 3 displays the relationship between parental BMI, psychological status and feeding practices. Higher parental BMI was associated with greater perceived stress ($r = 0.196$, $p = 0.048$), anxiety ($r = 0.352$, $p < 0.001$), depression ($r = 0.262$, $p = 0.008$), and more restrictive feeding ($r = 0.310$, $p = 0.001$).

Parental stress (DASS-21) was positively correlated with child control feeding practices ($r = 0.218$, $p = 0.027$). Parental anxiety was associated with both emotional feeding ($r = 0.307$, $p = 0.002$) and restriction ($r = 0.218$, $p = 0.027$). Depression correlated negatively with monitoring ($r = -0.215$, $p = 0.029$) and healthy eating guidance ($r = -0.331$, $p = 0.001$) and, positively with emotional feeding ($r = 0.199$, $p = 0.044$).

3.4. Differences by Parental Education Level

As shown in Table 4, parental education was significantly related to parental BMI ($p = 0.001$), child BMI ($p = 0.002$) and restrictive feeding practices ($p = 0.001$). Parents with lower educational attainment (high school graduates, graduates from technical schools) had higher BMI ($p = 0.001$), children with higher BMI ($p = 0.002$) and used more restrictive feeding practices ($p = 0.001$) compared with parents holding postgraduate or doctoral degrees.

3.5. Differences by Parental Gender

Table 5 presents comparisons between mothers and fathers. Mann–Whitney U tests were used due to non-normal variable distributions. Fathers had significantly higher BMI than mothers ($p = 0.006$). Mothers reported significantly greater monitoring of their child’s eating ($p = 0.020$). No significant gender differences were observed for stress, anxiety, depression or most feeding practice subscales.

3.6. Differences by Child Gender

According to Table 6, parents of boys had significantly higher BMI than parents of girls ($p = 0.006$). Parents of girls demonstrated higher monitoring of their children’s dietary behaviors ($p = 0.020$). All other variables, including child BMI, parental stress, anxiety and depression, did not significantly differ between boys and girls.

3.7. Comparison Between WHO and CDC BMI Classification

Table 7 compares BMI categorization based on WHO versus CDC criteria for 94 children. Of the initial 103 participants, 94 were included because the “underweight” category contained limited number of cases and was excluded from statistical analysis. WHO identified slightly higher proportion of overweight and obese children compared with CDC charts. The analysis showed statistically significant differences between the two classification systems ($\chi^2(4) = 159.704, p < 0.001$), indicating that BMI categorization varies considerably depending on the reference system used.

4. Discussion

This study examined the associations between parental psychological functioning, feeding practices, sociodemographic characteristics and children’s BMI in a Greek sample of 103 parent-child pairs. Moreover, a pilot study that included 13 parents, investigating the use of salivary cortisol as a biological stress marker was also conducted in a small number of participants. Overall, the findings support the multifactorial nature of childhood obesity and highlight the central role of the family environment, particularly parental mental health and feeding practices in shaping children’s weight outcomes.

Consistent with extensive international evidence, parental BMI was strongly associated with child BMI, reinforcing the well-established intergenerational transmission of obesity risk. This link reflects both shared genetic predisposition and shared behavioral and environmental factors within families. Notably, parental anxiety and depression were also positively related to child BMI. These results suggest that beyond behavioral modeling, the emotional milieu of the household may influence children’s eating patterns and weight status. Previous studies have reported similar associations, indicating that psychological distress can disrupt parental capacity for consistent and responsive feeding practice and may contribute to unstructured food environment.

Feeding practices demonstrated clear and meaningful associations with children’s BMI. Restrictive feeding, emotional feeding and greater child control were positively associated with higher child BMI, whereas monitoring and healthy eating guidance were inversely associated. These findings align with previous research showing that restrictive and emotionally driven strategies may undermine children’s ability to self-regulate food intake, increase the desirability of high- fat, high-calorie foods, or encourage maladaptive emotional eating behaviors. In contrast, responsive practices—such as encouraging healthy eating and monitoring unhealthy food intake—have been linked to healthier dietary patterns and lower obesity risk. Notably, the observed patterns also mirror cultural dynamics in Mediterranean settings, where food is often intertwined with emotional expression, reward and parental care.

Educational level emerged as a strong determinant of parental and child weight status as well as feeding practices. Parents with lower educational attainment exhibited higher BMI, had children with higher BMI and used more restrictive feeding practices. These gradients have already been

documented in numerous European cohorts and reflect broader socioeconomic inequalities regarding access to health information, nutrition literacy and lifestyle opportunities. In Greece, where disparities in health literacy remain prominent, these results underscore the relevance of social determinants in shaping obesity risk.

The comparison between WHO and CDC classification systems revealed that WHO charts identified a greater proportion of children as overweight or obese. This is consistent with existing literature reporting higher sensitivity of WHO references, which are based on optimal growth standards rather than population-based norms. For clinical and public health practice, this finding highlights the importance of selecting a classification system aligned with the aims of screening and early identification of at-risk pediatric population.

No significant associations were detected between salivary cortisol indices and psychological or behavioral variables. This is likely attributable to the limited number of samples obtained during the pilot phase, which severely constrained statistical power. However, the successful implementation of the saliva-collection protocol supports the feasibility of this research approach in future obesity studies. Incorporating biological stress markers may be particularly valuable in stress-related obesity research, providing a measurable biological marker to assess the impact of stress on human behavior and its consequences.

Overall, the findings point to the importance of addressing parental mental health in the context of childhood obesity prevention frameworks. Interventions that support parents in managing their own stress, enhancing emotional wellbeing and adopting responsive feeding practices may yield substantial benefits for children's weight trajectories. Health-promotion programs in Greece should consider integrating parental psychosocial support with traditional nutritional guidance, particularly among families with lower educational attainment. Future research should expand biomarker assessment, incorporate qualitative approaches to capture cultural nuances in feeding practices and adopt longitudinal designs to disentangle causal mechanisms. By capturing the interplay between psychological, behavioral and social determinants, this study contributes to a more comprehensive understanding of childhood obesity within the Greek context.

5. Conclusions

This study highlights the multifactorial nature of childhood obesity, demonstrating that parental mental health, educational level and feeding practices jointly influence children's BMI. Higher parental anxiety, depression and restrictive or emotion-driven feeding behaviors were associated with increased child BMI, whereas monitoring and health-oriented guidance appeared protective. These findings underscore the need for family-centered prevention strategies that support parental psychological wellbeing and promote responsive, non-restrictive feeding approaches. Although the exploratory salivary cortisol sub study did not yield significant associations, its feasibility suggests potential value for future biomarker-driven research. Further longitudinal and large-scale studies are required to clarify causal pathways and inform more targeted public health interventions in Greece and comparable settings.

6. Strengths and Limitations

Strengths

This study simultaneously examined parental mental health, feeding practices and sociodemographic factors in relation to childhood BMI, offering a comprehensive biopsychosocial perspective rarely addressed in Greek populations. The use of validated Greek versions of all psychometric tools (PSS-14, DASS-21, CFPQ), standardized anthropometric methods and WHO/CDC growth references strengthens the robustness of the findings. An additional strength is the pilot inclusion of salivary cortisol, which, although exploratory, demonstrates the feasibility of integrating biological stress markers in family-based obesity research.

Limitations

The cross-sectional design limits the assessment of causal inferences and the sample—although diverse—was not nationally representative. Self-reported psychological and behavioral measures may be influenced by reporting bias. The relatively small biomarker subsample in the pilot study assessing salivary cortisol as stress biomarker limited the extraction of meaningful results. Finally, parental measurements collected at home for part of the sample may have introduced measurement variability.

Author Contributions: Conceptualization, V.S. and C.K.-G.; methodology, V.S., M.M., E.A. and X.T.; formal analysis, V.S. and M.M.; investigation, V.S.; resources, C.K.-G.; data curation, V.S. and M.M.; writing—original draft preparation, V.S.; writing—review and editing, Y.M., O.A., M.M., E.A., X.T., P.P., S.K. and C.K.-G.; visualization, V.S.; supervision, C.K.-G.; project administration, C.K.-G. All authors have read and agreed to the published version of the manuscript.

Funding: This study received no external funding and was conducted as part of the requirements for the MSc program “*Science of Stress and Health Promotion*” at the National and Kapodistrian University of Athens.

Institutional review board statement: The study was conducted in accordance with the Declaration of Helsinki and has been approved by the Scientific Council and the Ethics and Deontology Committee of “Aghia Sofia” Children’s Hospital, Athens, Greece. The initial protocol was approved on 11 October 2024 (approval number: 19998/05.08.2024) and subsequently amended and approved on 17 June 2025 (approval number: 13710/05.06.2025).

Informed consent statement: Written informed consent was obtained from all parents or legal guardians involved in the study. All participants were fully informed about the study procedures, objectives, confidentiality measures and their right to withdraw at any time without consequences.

Data availability statement: The data supporting the findings of this study are not publicly available due to ethical and privacy restrictions involving minors. De-identified datasets may be provided by the corresponding author upon reasonable request and subject to approval by the institutional ethics committee.

Acknowledgments: The first author, V. Stymfaliadi, would like to express her heartfelt gratitude to her family for their continuous support during the preparation of this manuscript.

Conflicts of interest: The authors declare no conflict of interest.

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