



## Adolescent obesity: Confessions of the young mind

Spyros P. Batzios<sup>a</sup>, Maria Provatidou<sup>b</sup>, Athanasios Christoforidis<sup>a,\*</sup>,  
Haralambos Sidiropoulos<sup>b</sup>, Dimitrios C. Cassimos<sup>c</sup>

<sup>a</sup> 1st Pediatric Department, Hippokraton General Hospital, Aristotle University of Thessaloniki, Thessaloniki, Greece

<sup>b</sup> Health Center of Eleftheroupolis, Kavala, Greece

<sup>c</sup> Pediatric Department, University Hospital of Alexandroupolis, Dimokritio University of Thrace, Alexandroupolis, Greece



### ARTICLE INFO

#### Article history:

Received 16 May 2020

Received in revised form

14 June 2020

Accepted 9 July 2020

Available online 11 July 2020

#### Keywords:

Adolescent obesity

Body weight satisfaction

Eating habits

Social relationships

Adolescent's opinions

Physical activity

Dancing

### ABSTRACT

**Background:** Obesity represents a worldwide leading health problem. Although the proportion of adolescent obesity is continuously rising, yet little is known considering adolescent's opinions regarding this condition.

**Aim:** To investigate adolescent's perceptions in relation to various aspects of obesity in a prospective cohort study.

**Subjects and methods:** The study population included primary school adolescents, 11–12 years of age. Anthropometric measurements of participants included height and weight. Overweight and obese participants were classified using the International Obesity Task Force criteria. A structured questionnaire assessing physical activity, dietary habits, parental guidance regarding dietary intake and psychological aspects in relation to social functioning, body weight and image was completed by each adolescent.

**Results:** Three hundred and thirty-five adolescents (181 boys) formed the study group. Obese participants were found to have significantly fewer friends ( $p = .050$ ) and preferred indoor sedentary activities in terms of appetite and hunger. The majority of participants reported frequent consumption of homemade snacks in school resulting in no significant difference within the groups. Finally, body weight satisfaction was recorded for only 5.66% of the obese children, 25.66% and 68.64% of overweight and normal-weight participants respectively.

**Conclusions:** Our findings support the notion that adolescents are perfectly capable of expressing their opinions. When planning interventional programs for the management of adolescent obesity their views should be strongly considered.

© 2020 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

### 1. Introduction

Overweight/obesity among children and adolescents has emerged as a leading public health problem with an increasing worldwide prevalence over the past 3 decades. Obesity is a highly complex condition with numerous contributing variables originating from the genetic, environmental, psychological, socio-economic and cultural background of each individual [1,2]. Adolescent obesity can adversely result in serious physical outcomes, especially in adult life [3]. However, during the past few years, non-physical consequences of obesity have drawn great attention,

since it has been proved that it has a significant impact also on the psychological well-being of this rather “fragile” part of the population [4].

Although the prevalence of adolescent obesity is continuously rising, there is limited information considering adolescent's opinions with regards to this condition. Most studies reflect the perspectives of investigators, health care providers and parents [5,6], while on the other hand little is known about adolescent's views and reactions on being overweight or obese. Although, parental report measures that consider various issues surrounding children obesity are usually validated, it should be taken into account that children and especially adolescents are perfectly capable of expressing their opinion and have a central role in the management of their health issues. Thus, taking into consideration adolescent's perceptions in relation to being obese or overweight, could provide

\* Corresponding author. 1st Department of Pediatrics, Aristotle University of Thessaloniki, 49 Konstantinoupoleos str, 54642, Thessaloniki, Greece.

E-mail address: [christoforidis@auth.gr](mailto:christoforidis@auth.gr) (A. Christoforidis).

insight into many unknown aspects of obesity and probably lead to the adoption of more effective weight management strategies.

The purpose of this study was to investigate adolescent's opinions in relation to various aspects of obesity. Adolescent's perspectives regarding psychosocial functioning, physical activity and dietary habits were assessed in a group of 11–12 years-old adolescents across the spectrum of weight classification.

## 2. Methods

The present study took place in the prefecture of Kavala, a city in the northern part of Greece. The study population included primary school adolescents, 11–12 years of age, recruited from 12 schools. Everyone in the same class was invited to participate in the study to avoid discrimination in the recruitment process. An extended letter explaining the purpose of the study was sent to each parent and an informative speech was made the previous day of the measurements. Guardians and parents gave written consent for the participation of their children in the study. Approval for the study and all the means used was obtained from the Ministry of National Education and Religious affairs, Kavala's public-school supervisor and the head principal of the schools included. The study conformed fully with the Declaration of Helsinki for biomedical research on human subjects.

All anthropometric measurements were performed in the morning by the same experienced physician. Body weight was measured to the nearest 0.5 kg using a beam-balance scale and subjects were weighed in light clothes without shoes. Standing height was measured without shoes to the nearest of 0.5 cm with the use of a wall-mounted ruler. Physicians of the research group made two sets of measurements and the mean of the readings was used for statistical analysis. Body mass index (BMI) was calculated for each participant as body weight (in kilograms), divided by height (in meters) squared. Overweight and obese participants were classified using the International Obesity Task Force (IOTF) BMI criteria [7].

The physicians and the psychologist of the research group collected information using a structured questionnaire. The questionnaire was completed by each adolescent who participated in the study, the day on which the measurements were made, with the guidance of the members of the research group. It consisted of 12 multiple choice or open-ended questions and assessed physical activity, dietary habits, in both home and school, parental guidance regarding dietary intake and psychological aspects in relation to social functioning, body image and satisfaction.

For data analysis IBM SPSS Statistics (IBM Corp., Armonk, NY) for Windows, version 24.0 was used. Chi-square test was used for the comparison of percentages, whereas means were compared with the use of independent samples Student's *t*-test or Mann-Whitney *U* test for parameters with normal or skewed distribution correspondingly. Univariate and multivariate regression analyses were performed in order to identify the relative strength of the studied variables in the prediction of overweight and obesity among participants. Differences were considered statistically significant when  $p \leq 0.05$ .

## 3. Results

Three hundred and thirty-five adolescents (181 boys and 154 girls) comprised the study group. The mean age of participants was  $11.02 \pm 0.60$  years. According to the IOTF cut-off limits, 33.73% of participants were overweight and 15.82% were classified as obese. No statistically significant differences were found between boys and girls (36.46% and 16.02% was the prevalence of overweight and obesity for boys, and 30.52% and 15.58% for girls respectively).

Descriptive characteristics of anthropometric measurements and overweight/obese frequencies categorized by gender and in total are presented in Table 1.

Table 2 presents the descriptive statistics of the questionnaire variables according to weight status as classified by the IOTF criteria. Although obese participants were found to have fewer friends to trust when compared with normal-weight children (64.15% vs 77.52%,  $p = .05$ ), no differences were demonstrated between the three groups in relation to whether they spend time playing with their friends or alone. In regards to physical activity, no differences have been reported concerning the frequency of playing during the week; yet, obese participants preferred indoor sedentary activities in a significantly increased proportion in comparison to normal-weight and overweight participants (50.94% vs 59.76%,  $p = .041$ , and 50.94% vs 61.06%,  $p = .037$  respectively). Similarly, only 41.51% of obese adolescents were participating in sport activities, while for normal-weight and overweight participants the corresponding frequencies were 67.72% and 69.03% respectively ( $p = .006$  and  $.001$  respectively). In terms of out of school activities, the prevalence of dancing was significantly decreased as the population moved from normal to overweight and obese. In addition, overweight adolescents reported a higher prevalence of parental dietetic advice in comparison to normal-weight and obese participants (94.69% vs 86.98% and 84.9% respectively,  $p = .034$  for both groups). No differences were noted within the groups when asked about their eating habits in terms of appetite and hunger. Nevertheless, overweight adolescents reported that their parents tend to prepare a different meal when they dislike "what's on the menu". Concerning behavioural aspects within the family environment, overweight participants described calmer reactions of their parents in relation to food consumption, when compared to obese participants (94.69% vs 83.02%,  $p = .034$ ). When asked about their dietary habits in school, the majority of participants reported a frequent consumption of homemade snacks resulting in no significant difference within the groups. Finally, body weight satisfaction was recorded in only 5.66% of obese children, 25.66% and 68.64% of overweight and normal-weight participants respectively, resulting in statistically significant differences within all groups. The desire of being thinner was significantly increased as the population moved from normal-weight to overweight and obese.

Table 3A presents variables with statistically significant odds for overweight participants among the study population. Univariate analysis showed that dancing was a protective factor for overweight, while receiving parental advice in relation to food choices and dietary habits was found to be a risk factor. When introduced in a multivariate model only dancing remained a protective factor for obesity among participants.

Logistic regression analysis was performed to estimate the odds ratios (OR) of variables in the prediction of obesity among the study population (Table 3B). Participating in sport activities and dancing were found to have a protective effect. On the contrary, feeling aversion for a specific food increased significantly the risk for obesity. Having friends was proven to have a protective effect on being obese although not in a statistically significant manner. Variables that showed a statistically significant difference in OR for obesity were introduced in a multivariate model. "Picky eating" was positively associated with excess weight, while participating in sport activities and dancing were negatively associated with this outcome.

In the final analysis, univariate and multivariate logistic regression models were employed for the prediction of obesity among overweight participants (Table 3C). Parental nutritional advice, participating in sport activities and a calm family environment were found to be protective factors against obesity. The

**Table 1**

Descriptive characteristics of anthropometric measurements and overweight/obese frequencies categorized by gender.

Parameters	Males	Females	p value	Total
<b>N</b>	181	154		335
<b>Age, years</b>	11.03 ± 0.58 (9.74–12.16)	11.00 ± 0.62 (9.86–12.63)	0.547	11.02 ± 0.60 (9.74–12.63)
<b>Weight, kilograms</b>	46.51 ± 12.76 (23–101)	46.69 ± 11.36 (27–87)	0.728	46.59 ± 12.12 (23–101)
<b>Height, cm</b>	147.94 ± 8.06 (131–168)	149.48 ± 7.61 (128–169)	0.074	148.65 ± 7.88 (128–169)
<b>BMI, kg/m<sup>2</sup></b>	21.01 ± 4.40 (13.40–39.45)	20.75 ± 4.15 (14.08–32.95)	0.632	20.89 ± 4.28 (13.40–39.45)
<b>Obese, n (%)</b>	29 (16.02)	24 (15.58)	0.913	53 (15.82)
<b>Overweight, n (%)</b>	66 (36.46)	47 (30.52)	0.250	113 (33.73)

BMI: Body Mass Index. Values represent mean ± standard deviation (range) or n (%).

**Table 2**

Descriptive statistics of questionnaire parameters according to weight status.

Parameters	Normal (n = 169)	Overweight (n = 113)	Obese (n = 53)
<b>Age, years</b>	11.07 ± 0.58 (9.86–12.63)	11.03 ± 0.61 (9.74–12.40)	10.81 ± 0.59 <sup>a,b</sup> (9.77–12.08)
<b>Males, n (%)</b>	86 (50.89)	66 (58.41)	29 (54.72)
<b>Having a friend to tell secrets, n (%)</b>	131 (77.51)	82 (72.57)	34 (64.15) <sup>a</sup>
<b>Playing with friends, n (%)</b>	167 (98.82)	113 (100)	51 (96.23)
<b>Frequency of playing, times/week</b>	3.70 ± 2.06 (0–7)	3.61 ± 2.14 (1–7)	3.64 ± 2.33 (0–7)
<b>Outdoor playing, n (%)</b>	101 (59.76)	69 (61.06)	27 (50.94) <sup>a,b</sup>
<b>Doing sports, n (%)</b>	106 (67.72)	78 (69.03)	22 (41.51) <sup>a,b</sup>
<b>Out of school activities, n (%)</b>			
<b>Scouts</b>	7 (4.14)	6 (5.31)	3 (5.66)
<b>Dancing</b>	58 (34.32)	26 (23.00) <sup>a</sup>	7 (13.20) <sup>a</sup>
<b>Playing music</b>	40 (23.67)	22 (19.47)	9 (16.98)
<b>Parental advice for diet, n (%)</b>	147 (86.98)	107 (94.69) <sup>a</sup>	45 (84.9) <sup>b</sup>
<b>Eat with appetite, n (%)</b>	45 (26.63)	23 (20.35)	16 (30.19)
<b>Eat only when hungry, n (%)</b>	157 (92.90)	110 (97.35)	51 (96.22)
<b>Eat other when dislike food, n (%)</b>	78 (46.15)	39 (34.51) <sup>a</sup>	20 (37.73)
<b>Calmness in relation to food, n (%)</b>	151 (89.35)	107 (94.69)	44 (83.02) <sup>b</sup>
<b>Homemade snack for school, n (%)</b>	126 (74.56)	81 (71.68)	37 (69.81)
<b>“Like my body”, n (%)</b>	116 (68.64)	29 (25.66) <sup>a</sup>	3 (5.66) <sup>a,b</sup>
<b>“Want to be thinner”, n (%)</b>	38 (22.49)	85 (75.22) <sup>a</sup>	51 (96.23) <sup>a</sup>

Values represent mean ± standard deviation (range) or n (%).

Statistically significant.

<sup>a</sup> Compared to normal-weight participants.<sup>b</sup> Compared to overweight participants.**Table 3**

Logistic regression models (Univariate and Multivariate, Stepwise) for prediction of overweight (A.) and obesity (B.) among the study population and for prediction of obesity (C.) among the overweight population.

A. Parameters	Univariate			Multivariate		
	OR	95% CI	P	OR	95% CI	P
Dancing	0.572	0.333–0.982	<b>0.043</b>	0.553	0.319–0.957	<b>0.034</b>
Parental advice for diet	2.669	1.046–6.808	<b>0.040</b>			
Eat other when dislike food	0.615	0.376–1.005	0.053			
Eat the same when dislike food	1.582	0.978–2.561	0.062			
B. Parameters	Univariate			Multivariate		
	OR	95% CI	P	OR	95% CI	P
Having a friend	0.519	0.266–1.012	0.054			
Doing sports	0.422	0.225–0.791	<b>0.007</b>	0.478	0.246–0.929	<b>0.029</b>
Playing football	2.242	0.884–5.689	0.089			
Dancing	0.291	0.124–0.686	<b>0.005</b>	0.261	0.105–0.651	<b>0.004</b>
Eat nothing when dislike food	3.252	1.245–8.498	<b>0.016</b>	4.145	1.437–11.959	<b>0.009</b>
Indifference of parents in relation to diet	3.417	0.949–12.296	0.060			
C. Parameters	Univariate			Multivariate		
	OR	95% CI	P	OR	95% CI	P
Parental advice for diet	0.315	0.104–0.961	<b>0.042</b>			
Doing sports	0.318	0.162–0.626	<b>0.001</b>	0.341	0.168–0.695	<b>0.003</b>
Indifference of parents in relation to diet	5.781	1.084–30.847	<b>0.040</b>			
Calmness of parents in relation to diet	0.274	0.092–0.816	<b>0.020</b>			
Eat nothing when dislike food	3.097	1.086–8.837	<b>0.035</b>	3.539	1.157–10.822	<b>0.027</b>

CI, confidence interval; OR, odds ratio. P values in bold face indicate statistical significance (p &lt; 0.05).

indifference of parents regarding children's diet and "picky eating" were risk factors for obesity. Nevertheless, in the multiple

regression analysis none of the above-mentioned variables related to the family environment has been associated with becoming

obese when being overweight in a statistically significant way. All analyses were performed after adjusting for potential confounders such as age, gender and residential area.

#### 4. Discussion

Childhood obesity has already reached epidemic levels in many parts of the world and Greece represents a country with a leading prevalence in the worldwide setting [8,9]. This study examined the relationship between adolescents' weight status and their perspectives regarding various parameters related to overweight/obesity, such as psychosocial functioning, physical activity and dietary habits. Most of the previous studies have examined these relationships by comparing normal-weight participants to non-normal weight participants. In our study all the assessments were done in a group of 11–12-year-old adolescents using the weight classification recommended by IOTF criteria. This categorization might shed light to important differences between normal-weight, overweight and obese subjects and may have serious clinical implications for the adoption of different prevention and interventional measures within these groups of adolescents. In addition, although most of the previous studies have been based on parental views, in this study participants' perspectives have been considered. Adolescents proved themselves sentient and rational, with a great ability to react, respond and reflect their experiences in relation to being overweight or obese.

Peer relationships are important for adolescents since they provide a unique context for the acquisition of social skills and the promotion of the psychological well-being. During the last decades it has been recognized how significant impact obesity has on the emotional development and the psychosocial status of adolescents [4]. Obese and overweight children are usually stigmatized and socially excluded, while also they become victims of both overt and relational types of peer bullying [10]. Such negative behavioural experiences create feelings of inferiority, depression and low self-esteem. Park et al., have shown that obese children experience 4.5 times higher stress when compared to non-obese participants [11]. In that context the weight status has been demonstrated to greatly influence social relationships with other children [12,13]. In addition to that, a systematic review demonstrated that increased figure size negatively affects popularity, since obese children appear to be lonely, less popular, have friends only with the same size as them or need to lose weight in order to make friends [14]. We have found that obese adolescents have fewer friends than normal-weight ones, while overweight subjects did not seem to share the same problem. This is in agreement with the study performed by Strauss & Pollack which has shown that obese children tend to have fewer friends and are half as likely to be named as friends by their peers [15]. On the contrary, Phillips and Hill have previously shown that obese and overweight girls are as popular as normal-weight participants [16]. Social isolation may impose some constraints and current research has shown that obese children avoid taking part in social activities [17]. In contrast to the aforementioned studies we have not found a statistically significant difference in relation to the time spent in social activities.

Our study has shown that obese adolescents preferred sedentary activities to outdoor physical activities in comparison to normal-weight and overweight participants. This shift towards a more sedentary lifestyle with abolishment of exercise from children's lives is considered as one of the major risk factors for childhood obesity. Thus, it is not surprising that physical activity interventional programs are highly recommended for the management of obesity. Many studies are in absolute agreement with our results showing that normal-weight children are more physically active than obese subjects [18,19]. Those differences were

related to lower self-efficacy scores, less pleasure and increased difficulty in participating in this kind of activity because of excess weight [13]. Nevertheless, literature linking physical inactivity with increased risk for obesity has not been always consistent and the relationship between those parameters remains unclear. There are scientific reports demonstrating that a sedentary lifestyle neither necessarily reflects the amount of physical activity nor it always relates to obesity [20]. In terms of organized sport activities, we have demonstrated that normal weight and overweight adolescents are more often engaged in this kind of exercise compared to obese adolescents and that participating in sport activities represents a protective factor for becoming obese. Correspondingly, with the use of parental reports though, Deforche et al., have found that only 23% of normal-weight children were not involved in any kind of sports, compared with 46% of obese participants [21]. Nevertheless, this study found no difference in regards to sedentary behaviour within the groups of participants. In a similar study from Switzerland there were no significant differences regarding the involvement in sport activities between the research subjects [22]; yet, this study divided participants into 2 groups, normal-weight and overweight. In a recent study of Greek origin, Antonogeorgos et al. have shown that the participation in sport activities for more than 3 h/week was negatively associated with being overweight or obese in girls but not in boys [23]. An interesting observation of our study was that the prevalence of dancing was significantly increased as the population moved from obese to overweight and normal weight and represents a protective factor for obesity. This finding suggests that leisure activities which are enjoyable may help children become more active and is in absolute agreement with existing data regarding the preventive role of dancing [24].

Among the multitude of modifiable factors that have been proposed to play a significant role in various aspects regarding childhood obesity, family environment attracted great attention lately. Family represents the primary context for children's normal development. It is widely acknowledged that parents shape the dietary, behavioural and physical activity habits of their children with the use of various practices such as role modelling, reinforcement, supportive encouragement, restriction and monitoring. Surprisingly, we have found that parents of obese participants are not more concerned regarding the dietary intake of their children compared to parents of overweight participants. In accordance to our results it has been shown that girls with a higher weight status did not experience a higher degree of parental restriction [25]. Additionally, in a recent longitudinal study from China, parents reported different preferred ideal body image for boys than for girls, being about 3 times more likely to select overweight or obese as ideal for boys than for girls [26]. Nevertheless, most of the evidence suggests that the higher the weight status of the child, the bigger the parental concern is [27,28], although a significant percentage of caregivers with overweight/obese children tend to underestimated their children's weight status [29]. In addition, none of the parameters related to the family environment has been positively associated with becoming obese when already overweight, in the multivariate regression analysis. This finding could be at least partly attributed to the high degree of independence adolescents have, which results in increased decision-making power concerning dietary and physical activity habits and decreased compliance to parental instructions and advices. Nevertheless, there are also scientific supporting the hypothesis that parental behaviours do not necessarily show significant associations with children's dietary habits and weight status [30]. Additionally, we have demonstrated that in terms of behavioural aspects, parents of obese participants tend to be less calm and react with pressure and restriction concerning the dietary habits of their children when compared with overweight and normal-weight participants. This is

in agreement with the results of the study performed by Costa et al., which has shown that parents of obese children had higher scores of pressure and restriction regarding their children's food choices [28]. Nevertheless, it is widely acknowledged that the relationship between restriction and obesity is rather bidirectional, since this practice was found to implicate a higher risk for excess weight [30,31]. Thus, our finding could be also attributed to a reverse causality phenomenon. Finally, overweight children reported that their parents tend to prepare a different meal when they dislike "what's on the menu", while the analysis indicated that "picky eating" was positively associated with excess weight. These parental practices probably demonstrate a higher degree of reliance on "fast-foods" when children are unwilling to consume the meals that have been prepared for them [32].

Eating behaviour in association with weight status represents a research field of great interest and current data revealed that appetitive traits are genetically predisposed and differ significantly between normal weight and obese subjects [33,34]. Recent studies have shown that hormones regulating food intake are differentially expressed in obese and normal-weight people [35], while childhood obesity has been considered as a risk factor for the later development of disordered eating behaviours [36]. In terms of appetite and hunger no differences have been observed within the groups when asked about their eating habits. The majority of participants reported that they consume food with appetite and stop eating when they don't feel hungry anymore. In contrast to our results which have shown that overweight and obese participants were not restraint eaters, a study by Goldfield et al. has demonstrated a positive relationship between dietary restraint and increased weight status [37]. In addition, no loss-of-control eating episodes or eating in the absence of hunger have been reported by the study in either of the two excess weight status groups, as opposed to other studies where these behaviours have been a frequent finding and have been often linked to parental dietary restriction [38–40]. Our data might have been influenced by social desirability resulting in the under-reporting of disordered eating behaviours.

School environment is thought to play also a critical role in addressing the problem of childhood obesity, by both providing education regarding beneficial lifestyle choices and supporting healthy dietary habits. Concerning our data, no significant differences have been found within the groups of participants when asked whether they consume snacks homemade or bought from school canteens. Most recent studies regarding the consumption of competitive foods within the school setting have pointed out the negative role of vending machines which increase the consumption of sugar-sweetened beverages and chips [41,42]. Nevertheless, this attitude was not significantly associated with overweight or obesity [43]. Regarding our study, vending machines were not available in any of the 12 schools included. Although homemade snacks are traditionally considered healthier our results might show a shift of Greek school cafeterias towards better dietary choices.

One of the major psychosocial functioning correlates of childhood obesity is body image and satisfaction. It is widely accepted that the social stigma and the devaluation of obese people engender feelings of shame and body dissatisfaction. A recent study in undergraduate females showed that weight stigmatization significantly mediated the relationships between body mass index and body dissatisfaction, body mass index and depressive symptoms, and childhood overweight and depressive symptoms [44]. Regarding the results of our study, obese participants reported higher body dissatisfaction compared to overweight adolescents, while the rate of dissatisfaction that has been recorded for normal-weight subjects was even lower. These results are in accordance with existing literature [25,37,45,46]. The desire of being thinner

was significantly increased as the population moved from normal-weight to overweight and obese. Similarly, a recent meta-analysis has shown that children assess their body figures and express the desire to be thinner and the anxiety of gaining weight [14]. A worrying conclusion extracted from this study's results is that almost 1 out of 3 adolescents with optimal weight does not like his/her body and 1 out of 4 wants to be thinner, depicting the society's pressure for the achievement of the "thin ideal".

Although the present study has some limitations and our results must be interpreted with caution, this has been taken into consideration and all the appropriate statistical corrections and adjustments for potential confounders have been made. First of all, the cross-sectional design of this study does not allow the examination of causal relationships between the various risk/protective factors and childhood obesity, and reverse causality may always exist. In addition, social desirability might have had an impact in the study results, since self-reported questionnaires are often vulnerable to errors due to over-reporting or under-reporting of children's perspectives. The voluntary character of the study may have been a reason for selection bias. Nevertheless, most of our results are consistent with previous publications and this study comes to add more data to the limited already published studies on the perspectives of adolescents in relation to obesity.

In conclusion, the present study reveals the alarming magnitude of childhood obesity and examines participants' perspectives regarding physical activity, dietary habits, behavioural and psychosocial aspects in relation to social functioning, body weight and image. Our findings support that adolescents are perfectly capable of expressing their opinion and their views should always be taken into consideration when planning the implementation of intervention programs for the management of childhood obesity. Dancing and other activities that shape and smoothen, not only the body but also the brain, the soul and the feelings, might represent the appropriate tools that can address the problem of childhood obesity and support child health in a holistic way.

## Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## CRediT authorship contribution statement

**Spyros P. Batzios:** Conceptualization, Methodology, Data curation, Software, Writing - original draft. **Maria Provatidou:** Data curation, Writing - original draft. **Athanasios Christoforidis:** Software, Writing - review & editing. **Haralambos Sidiropoulos:** Methodology, Data curation. **Dimitrios C. Cassimos:** Methodology, Supervision, Writing - review & editing.

## Declaration of competing interest

None to declare.

## Acknowledgment

The authors would like to thank the adolescents for their willing participation in the study.

## References

- [1] Han JC, Lawlor DA, Kimm SYS. Childhood obesity. *Lancet* 2010;375:1737–48. [https://doi.org/10.1016/S0140-6736\(10\)60171-7](https://doi.org/10.1016/S0140-6736(10)60171-7).
- [2] Kumar S, Kelly AS. Review of childhood obesity: from epidemiology, etiology, and comorbidities to clinical assessment and treatment. *Mayo Clin Proc* 2017;92:251–65. <https://doi.org/10.1016/j.mayocp.2016.09.017>.

- [3] Kelsey MM, Zaepfel A, Bjornstad P, Nadeau KJ. Age-related consequences of childhood obesity. *Gerontology* 2014;60:222–8. <https://doi.org/10.1159/000356023>.
- [4] Rankin J, Matthews L, Cobley S, Han A, Sanders R, Wiltshire HD, et al. Psychological consequences of childhood obesity: psychiatric comorbidity and prevention. *Adolesc Health Med Therapeut* 2016;7:125–46. <https://doi.org/10.2147/ahmt.s101631>.
- [5] Latzer Y, Stein D. A review of the psychological and familial perspectives of childhood obesity. *J Eat Disord* 2013;1. <https://doi.org/10.1186/2050-2974-1-7>.
- [6] Borges F, Barreto M da S, Decesaro M das N, Viera CS, Marcon SS. Family perspective on childhood obesity and its forms of coping: a descriptive study. *Online Braz J Nurs* 2017;16:460–70. <https://doi.org/10.17665/1676-4285.20175655>.
- [7] Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ* 2000;320:1240–3. <https://doi.org/10.1136/bmj.320.7244.1240>.
- [8] Hassapidou M, Tzotzas T, Makri E, Pagkalos I, Kaklamanos I, Kapantais E, et al. Prevalence and geographic variation of abdominal obesity in 7- and 9-year-old children in Greece; world health organization childhood obesity surveillance initiative 2010. *BMC Publ Health* 2017;17. <https://doi.org/10.1186/s12889-017-4061-x>.
- [9] Spinelli A, Buoncristiano M, Kovacs VA, Yngve A, Spiroski I, Obreja G, et al. Prevalence of severe obesity among primary school children in 21 European countries. *Obes Facts* 2019;12:244–58. <https://doi.org/10.1159/000500436>.
- [10] Palad CJ, Yarlagadda S, Stanford FC. Weight stigma and its impact on paediatric care. *Curr Opin Endocrinol Diabetes Obes* 2019;26:19–24. <https://doi.org/10.1097/MED.0000000000000453>.
- [11] Park C-M, Kim M-D, Hong S-C, Kim Y, Hyun M-Y, Kwak Y-S, et al. Effects of obesity and obesity-induced stress on depressive symptoms in Korean elementary school children. *Int J Soc Psychiatr* 2009;55:322–35. <https://doi.org/10.1177/0020764008094646>.
- [12] Marzi I, Reimers AK. Children's independent mobility: current knowledge, future directions, and public health implications. *Int J Environ Res Publ Health* 2018;15. <https://doi.org/10.3390/ijerph15112441>.
- [13] Snethen J a, Broome ME. Weight, exercise, and health: children's perceptions. *Clin Nurs Res* 2007;16:138–52. <https://doi.org/10.1177/1054773806298508>.
- [14] Rees R, Oliver K, Woodman J, Thomas J. The views of young children in the UK about obesity, body size, shape and weight: a systematic review. *BMC Publ Health* 2011;11:188. <https://doi.org/10.1186/1471-2458-11-188>.
- [15] Strauss RS, Pollack HA. Social marginalization of overweight children. *Arch Pediatr Adolesc Med* 2003;157:746–52. <https://doi.org/10.1001/archpedi.157.8.746>.
- [16] Phillips RG, Hill AJ. Fat, plain, but not friendless: self-esteem and peer acceptance of obese pre-adolescent girls. *Int J Obes* 1998;22:287–93. <https://doi.org/10.1038/sj.ijo.0800582>.
- [17] Storch EA, Milson VA, DeBraganza N, Lewin AB, Geffken GR, Silverstein JH. Peer victimization, psychosocial adjustment, and physical activity in overweight and at-risk-for-overweight youth. *J Pediatr Psychol* 2007;32:80–9. <https://doi.org/10.1093/jpepsy/sj113>.
- [18] De Bourdeaudhuij I, Lefevre J, Deforche B, Wijndaele K, Matton L, Philippaerts R. Physical activity and psychosocial correlates in normal weight and overweight 11 to 19 year olds. *Obes Res* 2005;13:1097–105. <https://doi.org/10.1038/oby.2005.128>.
- [19] Ghosh A. Association of anthropometric, body composition and physiological measures with physical activity level among the children and adolescents of Asian Indian origin: the Calcutta obesity study. *J Nutr Health Aging* 2010;14:731–5. <https://doi.org/10.1007/s12603-010-0096-8>.
- [20] Marshall SJ, Biddle SJH, Gorely T, Cameron N, Murdey I. Relationships between media use, body fatness and physical activity in children and youth: a meta-analysis. *Int J Obes* 2004;28:1238–46. <https://doi.org/10.1038/sj.ijo.0802706>.
- [21] Deforche B, Bourdeaudhuij I de, D'Hondt E, Cardon G. Objectively measured physical activity, physical activity related personality and body mass index in 6- to 10-yr-old children: a cross-sectional study. *Int J Behav Nutr Phys Activ* 2009;6. <https://doi.org/10.1186/1479-5868-6-25>. 14 May 2009.
- [22] Aeberli I, Kaspar M, Zimmermann MB. Dietary intake and physical activity of normal weight and overweight 6 to 14 year old Swiss children. *Swiss Med Wkly Off J Swiss Soc Infect Dis Swiss Soc Intern Med Swiss Soc Pneumol* 2007;137:424–30. 2007/29/ismw-11696.
- [23] Antonogeorgos G, Papadimitriou A, Panagiotakos DB, Priftis KN, Nicolaidou P. Association of extracurricular sports participation with obesity in Greek children. *J Sports Med Phys Fit* 2011;51:121–7.
- [24] Tanas R, Renzo M. What can we do for childhood obesity? Let's go dancing! *Educ Health (Abingdon)* 2006;19:388–9. <https://doi.org/10.1080/13576280600937937>.
- [25] Davison KK, Birch LL. Weight status, parent reaction, and self-concept in five-year-old girls. *Pediatrics* 2001;107:46–53. <https://doi.org/10.1542/peds.107.1.46>.
- [26] Gao L, Ma L, Xue H, Min J, Wang H, Wang Y. A 3-year longitudinal study of effects of parental perception of children's ideal body image on child weight change: the Childhood Obesity Study in China mega-cities. *Prev Med* 2020;132. <https://doi.org/10.1016/j.jpmed.2019.105971>.
- [27] Spruijt-Metz D, Lindquist CH, Birch LL, Fisher JO, Goran MI. Relation between mothers' child-feeding practices and children's adiposity. *Am J Clin Nutr* 2002;75:581–6.
- [28] Costa FS, Pino DL Del, Friedman R. Caregivers' attitudes and practices: influence on childhood body weight. *J Biosoc Sci* 2011;43:369–78. <https://doi.org/10.1017/S0021932011000022>.
- [29] Tang A, Ji M, Zhang Y, Zou J, Li M, Yang L, et al. Dietary behaviors and caregiver perceptions of overweight and obesity among Chinese preschool children. *Int J Environ Res Publ Health* 2018;15. <https://doi.org/10.3390/ijerph15040716>.
- [30] Faith MS, Scanlon KS, Birch LL, Francis L a, Sherry B. Parent-child feeding strategies and their relationships to child eating and weight status. *Obes Res* 2004;12:1711–22. <https://doi.org/10.1038/oby.2004.212>.
- [31] Fisher JO, Birch LL. Restricting access to palatable foods affects children's behavioral response, food selection, and intake. *Am J Clin Nutr* 1999;69:1264–72.
- [32] Pocock M, Trivedi D, Wills W, Bunn F, Magnusson J. Parental perceptions regarding healthy behaviours for preventing overweight and obesity in young children: a systematic review of qualitative studies. *Obes Rev An Off J Int Assoc Study Obes* 2010;11:338–53. <https://doi.org/10.1111/j.1467-789X.2009.00648.x>.
- [33] Bray I, Slater A, Lewis-Smith H, Bird E, Sabey A. Promoting positive body image and tackling overweight/obesity in children and adolescents: a combined health psychology and public health approach. *Prev Med* 2018;116:219–21. <https://doi.org/10.1016/j.jpmed.2018.08.011>.
- [34] Syrad H, Llewellyn CH, Van Jaarsveld CHM, Johnson L, Jebb SA, Wardle J. Energy and nutrient intakes of young children in the UK: findings from the Gemini twin cohort. *Br J Nutr* 2016;115:1843–50. <https://doi.org/10.1017/S0007114516000957>.
- [35] Weltens N, Iven J, Van Oudenhove L, Kano M. The gut–brain axis in health neuroscience: implications for functional gastrointestinal disorders and appetite regulation. *Ann N Y Acad Sci* 2018;1428:129–50. <https://doi.org/10.1111/nyas.13969>.
- [36] Fairburn CG, Harrison PJ. Eating disorders. *Lancet* 2003;361:407–16. [https://doi.org/10.1016/S0140-6736\(03\)12378-1](https://doi.org/10.1016/S0140-6736(03)12378-1).
- [37] Goldfield GS, Moore C, Henderson K, Buchholz A, Obeid N, Flament MF. Body dissatisfaction, dietary restraint, depression, and weight status in adolescents. *J Sch Health* 2010;80:186–92. <https://doi.org/10.1111/j.1746-1561.2009.00485.x>.
- [38] Morgan CM, Yanovski SZ, Nguyen TT, McDuffie J, Sebring NG, Jorge MR, et al. Loss of control over eating, adiposity, and psychopathology in overweight children. *Int J Eat Disord* 2002;31:430–41. <https://doi.org/10.1002/eat.10038>.
- [39] Fisher JO, Birch LL. Eating in the absence of hunger and overweight in girls from 5 to 7 y of age. *Am J Clin Nutr* 2002;76:226–31.
- [40] Faith MS, Berkowitz RI, Stallings V a, Kerns J, Storey M, Stunkard AJ. Eating in the absence of hunger: a genetic marker for childhood obesity in prepubertal boys? *Obesity* 2006;14:131–8. <https://doi.org/10.1038/oby.2006.16>.
- [41] Hua SV, Ickovics JR. Vending machines: a narrative review of factors influencing items purchased. *J Acad Nutr Diet* 2016;116:1578–88. <https://doi.org/10.1016/j.jand.2016.06.378>.
- [42] Thompson OM, Yaroch AL, Moser RP, Finney Rutten LJ, Agurs-Collins T. School vending machine purchasing behavior: results from the 2005 YouthStyles survey. *J Sch Health* 2010;80:225–32. <https://doi.org/10.1111/j.1746-1561.2010.00494.x>.
- [43] Park S, Sappenfield WM, Huang Y, Sherry B, Bensyl DM. The impact of the availability of school vending machines on eating behavior during lunch: the Youth Physical Activity and Nutrition Survey. *J Am Diet Assoc* 2010;110:1532–6. <https://doi.org/10.1016/j.jada.2010.07.003>.
- [44] Stevens SD, Herbozo S, Morrell HER, Schaefer LM, Thompson JK. Adult and childhood weight influence body image and depression through weight stigmatization. *J Health Psychol* 2017;22:1084–93. <https://doi.org/10.1177/1359105315624749>.
- [45] Shin NY, Shin MS. Body dissatisfaction, self-esteem, and depression in obese Korean children. *J Pediatr* 2008;152:502–6. <https://doi.org/10.1016/j.jpeds.2007.09.020>.
- [46] Vander Wal JS. Eating and body image concerns among average-weight and obese African American and Hispanic girls. *Eat Behav* 2004;5:181–7. <https://doi.org/10.1016/j.eatbeh.2004.01.007>.