



Obesity contributes to lower urinary system voiding dysfunction in childhood

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Abstract

Background Obesity continues to be a leading public health concern in the world.

Aim The aim of our study was to investigate the relationship between obesity, lower urinary tract symptoms (LUTS), and voiding dysfunction.

Methods The study included students aged between 6 and 16 years in Zonguldak. Anthropometric measurements were performed in 404 children using appropriate methods. The body mass index (BMI) of children was calculated. Obesity was defined as a BMI at or above the 95th percentile for age- and sex-specific percentiles of Turkish children. Non-obese children with a BMI below the 85th percentile were defined as the control group. Lower urinary tract voiding dysfunction (LUTVD) was assessed with the dysfunctional voiding and incontinence scoring system (DVISS).

Results Of the children participated in the study, 151 (37.4%) were obese and 253 (62.6%) were at a normal weight. There were no significant differences in gender and mean age between the obese and non-obese children ($p = 0.81$). Monosymptomatic nocturnal enuresis (MSNE) was present in 43 children (10.6%), daytime symptoms were present in 38 children (9.4%), and voiding dysfunction was present in 34 children (8.4%) in the study. These symptoms were more common in the obese group ($p = 0.001$, $p = 0.001$, and $p = 0.0001$, respectively). In our survey study, we found a serious relationship between both bladder emptying symptoms and storage symptoms and obesity ($p = 0.0001$).

Conclusion Obese children are at increased risk for enuresis and voiding dysfunction. Screening and treating obese children for the respective symptoms are significantly important for their quality of life.

Keywords Childhood · Enuresis · Obesity · Voiding dysfunction

Introduction

Obesity in children is an important health problem with increased incidence in recent years, with a potential of leading to secondary diseases [1]. The relationship of obesity has been shown primarily with cardiovascular and renal diseases, and also with gastrointestinal problems including reflux, constipation, and fecal incontinence [2–4]. Lower urinary tract voiding dysfunction (LUTVD) is defined as the overactivity or inability to relax the pelvic floor muscles completely during voiding in the absence of neurological or anatomical impairment

[5–7]. Furthermore, it may lead to emotional and behavioral changes in children, resulting in low quality of life [4]. Several authors have observed an association between obesity and voiding dysfunction [4, 8–10]. The aim of our study was to compare the demographic parameters, lower urinary tract symptoms (LUTS), and dysfunctional voiding symptom scores between obese and normal-weight children.

Methods

We included or evaluated students between 6 and 16 years attending primary and high school in Zonguldak province. Schools from different socioeconomic regions of the province were selected for their participation in the study. Parents of the children were informed about the study and their informed consents on paper were obtained. Among a total of 460 children from 20 schools, obese and normal-weight children were

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divided into groups by using anthropometric measurements performed by the same individuals. The body mass index (BMI) was calculated by dividing the weight (kilograms) of children by their squared height (meter). Our country-specific BMI percentile reference values according to age and gender were used for evaluating obesity [11]. Subjects with a BMI of ≥ 95 th percentile for the respective age and gender were classified as obese. Children with a BMI of < 85 th percentile were defined as non-obese and they were classified as the control group. Underweight and overweight children were excluded from the study. To collect demographic information, a questionnaire including the demographic data of the participants at home was given to family members to fill at home. The criteria of the International Children's Continence Society (ICCS) and the dysfunctional voiding incontinence scoring system (DVISS) questionnaire, validated in Turkish, were used to identify urinary incontinence and voiding dysfunction [12, 13]. DVISS questionnaire symptom scores of ≥ 8.5 points were accepted to indicate the presence of LUTVD [12]. Children with secondary obesity (for example, developing as a result of cranial irradiation or medication) or dysfunctional voiding symptoms due to organic or anatomical disorders were excluded from the study. A total of 56 children were excluded from the study because the questionnaires were not either filled in completely or submitted. Therefore, the study was completed with the participation of a total of 404 children. This study was approved by the Ethics Committee of Bülent Ecevit University Faculty of Medicine (BEU2015/14).

Data were analyzed using SPSS version 22.0 (IBM SPSS Inc., New York, USA). The continuous numerical variables were summarized as mean \pm standard deviation. The categorical variables were summarized as numbers and percentages. The differences in continuous numerical variables between the obese and control groups were analyzed with the independent samples *t* test. Chi-square or Fisher's exact chi-square tests were used for determining whether there was a difference in categorical variables between the two groups. Mann-Whitney *U* test or Kruskal Wallis test was used to test the variables that did not conform to parametric test assumptions. A *p* value of < 0.05 was considered statistically significant for all statistical data analyses.

Results

Data collected from a total of 404 children aged from 6 to 16 years were recorded for the study. Of these children, 51% were boys and 49% were girls. Table 1 compares the characteristics of children enrolled in this study. In this study, when we grouped the children as obese and non-obese, we found out that there were 151 (37.4%) obese children having a BMI value ≥ 95 th percentile. In contrast, 253 (62.6%) children were at a normal-weight. The mean (\pm SD) age and BMI of children

were 9.79 ± 2.69 years and 20.98 ± 4.94 , respectively. There were no significant differences in gender and mean age between obese and non-obese children ($p = 0.81$) (Table 1).

In this study, there were no statistical differences in the mean age or education level of the parents or in the number of siblings between the obese and control groups ($p = 0.91$). Similarly, there was no significant difference between the abovementioned data and those with and without voiding dysfunction ($p = 0.35$). The frequency of urinary incontinence was higher in the mothers, fathers, and siblings of the patients with MSNE and voiding dysfunction ($p = 0.012$, $p = 0.0001$, $p = 0.012$; respectively). No lower urinary tract symptoms were observed in 300 children (74.3%). MSNE and daytime symptoms were present in 43 (10.6%) and 38 (9.4%) children, respectively. A total of 34 patients (8.4%) were found out to have voiding dysfunction based on the DVISS questionnaire. There were no differences in the mean age and gender in patients with MSNE ($p = 0.27$). Both MSNE (14.6–8.3%) and daytime incontinence symptoms (15.2–5.9%) were higher in obese patients compared to non-obese patients ($p = 0.001$). Incontinence severity scores (leakage frequency multiplied by leakage volume) in patients with LUTS and MSNE were higher in the obese group (symptom scores of 3.8 ± 4.5) compared to the non-obese group (symptom scores of 1.5 ± 2.8) ($p = 0.0001$). In this study, we found 34 (8.4%) patients with LUTDV. The analysis of gender and average age distribution revealed no differences in this group of children ($p = 0.16$). Voiding dysfunction was observed in 67.6% of obese children, whereas this rate was only 32.4% in non-obese children ($p = 0.0001$), (Table 2).

When we analyzed the individual symptoms of the lower urinary tract, the symptoms of urgency (53–21.7%), holding maneuvers (18.5–6.3%), incontinence on the way to the toilet (12.6–3.2%), and intermittently voiding were significantly higher in obese patients compared to non-obese patients ($p = 0.0001$, $p = 0.0001$, $p = 0.001$, and $p = 0.008$, respectively), but these parameters did not show any differences by the mean age or gender. Constipation was more common in the obese group (15.2%) compared to the non-obese group (5.1%) ($p = 0.001$). Of the children with impaired quality of life, 73.5% was identified to have voiding dysfunction ($p = 0.0001$). In obese children with voiding dysfunction, the quality of life symptom score was 1 ± 0.79 , whereas it was 0.07 ± 0.34 in normal-weight children without voiding dysfunction ($p = 0.0001$). Overactive bladder (OAB) symptoms were detected in 21 children. Although there were no differences between boys and girls, 17 patients were in the obese group (85.2%) and only 4 patients (14.8%) were in the non-obese group ($p = 0.001$). All children identified to have pathological findings based on the study findings were called to visit our clinic to undergo examined and treated. One limitation of our study was the use of questionnaires alone for making the diagnoses of LUTVD and constipation.

Table 1 Characteristics of children participating in the study

	Male	Female	Total	<i>P</i> value
Gender	<i>N</i> , % 206, 51	<i>N</i> , % 198, 49	<i>N</i> , % 404, 100	
Weight (kg) (mean ± SD)	41.8 ± 15.85	42.28 ± 17.04	42.05 ± 16.42	
BMI (mean ± SD)	20.92 ± 4.88	21.03 ± 5.02	20.98 ± 4.94	0.87
Age (years) (mean ± SD)	10.12 ± 2.65	9.76 ± 2.75	9.79 ± 2.69	0.20
Obese (≥ 95th <i>P</i>)	80, 38.8	71, 35.9	151, 37.4	0.81
Normal-weight (< 85th <i>P</i>)	126, 61.1	127, 64.1	202, 62.6	

Discussion

Obesity in children is a public health problem with increasing incidence and short- and long-term complications [7]. It has been shown that children and adolescents with excess weight may not only suffer from metabolic and psychological comorbidities but overactive bladder symptoms as well [4, 14]. Despite the suggested association between LUTVD and obesity in the literature, there are very few studies evaluating the relationship between individual symptoms and obesity [5]. In our study, no differences were found in voiding dysfunction and MSNE between the genders in the two groups. While several studies in the literature report no gender differences [6], some studies reported that MSNE is more common in boys [4, 15]; however, other showed 2 times higher incidence in girls [16]. One of the factors accused in the etiology of enuresis is the positive family history [17]. The studies from our

country reported the rates of a positive family history of enuresis as 40.7% [18], 57.1% [15], and 62% [4]. Other conditions that have been reported to be associated with enuresis in the literature include male gender, attention-deficit/hyperactivity disorder (ADHD), low socioeconomic status, low educational level of parents, poor school performance, separated parents, increased number of siblings, sharing a bedroom, and sleeping disorders [9, 19–21]. In our study, the rate of a positive family history of voiding dysfunction and/or enuresis was found out to be high (39.6%) similarly (*p* = 0.012). However, in contrast to the abovementioned study results, no significant differences were found in male gender predominance, low socioeconomic status, low educational level of parents, mean age of parents, and a higher number of siblings (*p* > 0.05).

Chang et al. [22] found that obesity was an independent risk factor for overactive bladder based on his study, which included 838 children aged from 5 to 12 years. It has been

Table 2 Lower urinary tract symptoms in obese and normal-weight children

	Non-obese <i>N</i> , %	Obese <i>N</i> , %	Total <i>N</i> , %	<i>p</i> value
Voiding dysfunction	11, 32.4	23, 67.6	34, 8.4	<i>p</i> = 0.0001
Quality of life score	Obese (–) and LUTS (–) 0.07 ± 0.34	Obese (+) and LUTS (+) 1 ± 0.79		<i>p</i> = 0.0001
Primary MSNE	21, 8.3	22, 14.6	43, 10.6	<i>p</i> = 0.001
Overactive bladder	4, 14.8	17, 85.2	21, 5.1	<i>p</i> = 0.001
Daytime symptoms	15, 5.9	23, 15.2	38, 9.4	<i>p</i> = 0.001
Constipation	13, 5.1	23, 15.2	36, 8.9	<i>p</i> = 0.001
Urgency	55, 21.7	80, 53	135, 33.4	<i>p</i> = 0.0001
Holding maneuvers	16, 6.3	28, 18.5	44, 10.9	<i>p</i> = 0.0001
Urge incontinency	8, 3.2	19, 12.6	27, 6.7	<i>p</i> = 0.001
Voiding intermittency	10, 4	17, 11.3	27, 6.7	<i>p</i> = 0.008
Voiding more than 7 times per day	16, 6.3	14, 9.3	30, 7.4	<i>p</i> = 0.37
Straining	4, 1.6	5, 3.3	9, 2.2	<i>p</i> = 0.30
Dysuria	9, 3.6	4, 2.6	13, 3.2	<i>p</i> = 0.77
Second time voiding	10, 4	11, 7.3	21, 5.2	<i>p</i> = 0.21
Incontinence severity scores	1.5 ± 2.8	3.8 ± 4.5		<i>p</i> = 0.0001

*p** Chi-square or Fisher’s exact chi-square tests and Mann-Whitney U test. Lower urinary tract symptoms were statistically higher in obese than non-obese patients

suggested that obesity leads to increased intraabdominal and intravesical pressure via the pelvic floor, leading to impaired functional bladder capacity [23]. Similarly, we found out that both MSNE, voiding dysfunction, and OAB were more common in obese children. In the literature, the mean prevalence of MSNE in children is reported in the range from 2 to 10% [9, 19, 20]. Although the frequency of MSNE is usually high in obese people, a study conducted in our country reported that the anthropometric measurements of children with MSNE did not result in different values compared to those found in the control group [15]. However, there is not an established objective evaluation system for staging the symptoms of incontinence and dysfunctional voiding in children, treatment planning and evaluation of the treatment response are mainly based on the clinical picture and the presence of symptoms. For this purpose, symptom scoring systems have been suggested [24]. In our study, we used the DVISS questionnaire validated by Akbal et al. in our country [12]. We found voiding dysfunction in 34 (8.4%) patients and found out that the frequency of voiding dysfunction was significantly high in obese patients ($p = 0.0001$). A study on 251 children in performed by Erdem [3] found similar results to those of our study. Furthermore, they reported that voiding dysfunction was associated with constipation [3]. A recent study in our country also included advanced diagnostic techniques and reported significantly higher voiding symptom scores in the obese patient group compared to the control group. Again in that study, the rates of urinary tract infection and constipation were higher in the obese group [4].

Fraga et al. [25] conducted a similar survey study with a similar design to that of our study and found the prevalence of LUTVD to be 7.1%. Constipation and MSNE were found in the participants at rates of 5.9% and 10.8%, respectively. In a multivariate analysis, the investigators found an independent and significant positive relationship of DVISS with constipation and obesity.

In our survey study, we found that obesity was related to both bladder-emptying symptoms and storage symptoms. The prevalence of LUTVD was 8.4% in total. Again, from our country, Erdem et al. [3] found that 62–86% of the children suffering from voiding dysfunction (loss of daytime sphincter control and the presence of nocturnal enuresis) were obese. Schwartz et al. [14] reported the incontinence severity scores as 1.3 in the obese group and 0.3 in the non-obese group. In our study, we found the incontinence severity scores as 3.8 ± 4.5 and 1.5 ± 2.8 in the obese and non-obese groups, respectively ($p = 0.0001$). A majority of children with overactive bladder symptoms (85.2%) were in the obese group ($p = 0.001$). In the literature, it is reported that obese children have higher urgency symptom scores compared to the children at a normal weight [26].

We found that the rate of constipation (15.2%) was higher in the obese group. Two study reported a rate of 24% and 23% as the prevalence of constipation in the obese children [3, 27]. Although the etiology of constipation in these patients is unknown, it may be a combination of a learned “retention” type of behavior and poor dietary habits associated with the consumption of less fiber-containing food. This may explain a relationship between obesity, constipation, and voiding dysfunction [27]. Studies demonstrated the association between treatment failure and obesity, children with obesity, nocturnal enuresis, or dysfunctional voiding were associated with low rates of completing the voiding diaries and lower efficacy of treatment [8, 28]. In this study, we assessed only the pathological findings and we plan to present our results on the treatment outcomes in a further study. We believe that obese adolescents suffering from incontinence are often reluctant to seek medical advice because they are ashamed of this problem. Therefore, we suggest that urinary incontinence and constipation are more common especially in adolescents.

Conclusion

In conclusion, MSNE, daytime incontinence symptoms, and voiding dysfunction were found to be higher in the obese children compared to the normal-weight children in our study. Furthermore, the symptom severity scores are higher in obese children. This study is one of the few studies in the literature using the symptom scoring system. It is essential to screen obese children for voiding dysfunction because it can easily be overlooked despite the high rates of treatment success in the presence of an early diagnosis.

Authors' contributions Mehmet Karacı conceived paper, oversaw data collection, conducted data analysis, wrote manuscript, and approved final version. MK participated in study design, data analysis, and interpretation, critically revised manuscript, and approved final version.

Compliance with ethical standards

Conflict of interest The author declares that there is no conflict of interest

Ethical approval Ethics Committee of Bülent Ecevit University Faculty of Medicine (BEU2015/14).

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