Lower Extremity Pain Is Associated With Reduced Function and Psychosocial Health in Obese Children

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Abstract

Background Childhood obesity is associated with reduced quality of life, physical fitness, and a higher prevalence of lower extremity (LE) pain; however, it is unclear whether and how these factors are related.

Questions/purposes For this study we asked if obese children with LE pain (LE+) had higher BMI-Z scores, lower physical function and psychosocial health, and lower physical fitness compared with obese children without LE pain (LE−). We determined the association of BMI-Z score with physical function, psychosocial health, or physical fitness in obese children.

Methods Medical charts of 183 obese children were reviewed. Recorded data included anthropometrics,

demographics, reports of musculoskeletal pain, Pediatric Quality of Life (PedsQL)-Physical Function score, PedsQL-Psychosocial Health score, and physical fitness levels. Data from 175 individuals were included in the analysis, with 51 in the LE+ group and 124 in the LE− group. Statistical analysis included Mann-Whitney U tests and Spearman's rank order correlations.

Results Between the LE+ and LE− groups, BMI-Z and physical fitness scores were not different. The LE+ group scored worse on the PedsQL-Physical Function scale (LE+: 72.4 [17.1], LE−: 79.5 [15.0]) and PedsQL-Psychosocial Health scale (LE+: 70.0 [16.1], LE−: 75.8 [16.3]). BMI-Z scores negatively correlated with PedsQL-Physical Function scores, PedsQL-Psychosocial Health scores, and physical fitness scores.

Conclusions Our findings indicate that LE pain should be considered in the evaluation and management of children who are obese.

Level of Evidence Level III, prognostic study. See Guidelines for Authors for a complete description of levels of evidence.

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Introduction

The epidemic of childhood obesity has led to the recognition of obesity-related childhood and adolescent morbidities that are commonly seen in adult-onset obesity such as diabetes, hypertension, cardiovascular disease, and respiratory complications [3, 11, 27, 50]. Obesity-related musculoskeletal comorbidities, including joint pain and lower extremity malalignment, are well characterized among adults [16, 17, 47]. In adults, increasing body mass index (BMI) and obesity result in knee pain [19], progressive physical disability [5, 18], diminished health-related quality of life [18], and a clear risk of development of knee osteoarthritis [7, 24, 47]. Recent evidence shows that obesity in young adulthood is associated with a threefold increase in knee osteoarthritis by age 60 years [4, 14, 26]. Musculoskeletal comorbidities have become a recent focus of research in obese children. Obese children report more frequent and severe joint pain [13, 51, 53] and lower extremity malalignment is more prevalent in overweight and obese children [28–30, 52]. Like with obese adults, obese children report lower function and health-related quality of life compared with their healthy peers [38, 41, 53, 63], but less is known about factors in obese children that may contribute to poor function and quality of life.

Obesity in children (2–19 years old) is defined as a BMI (kg/m^2) at or above the 95th percentile for children of the same age and sex, and morbid obesity is considered as having a BMI in the 99th percentile [30, 32, 33]. A healthy weight in children and young adults is defined as a BMI at or below the 85th percentile [54, 67]. BMI-Z scores (BMI SD) are often computed to allow for comparison across age- and sex-specific BMI [8, 23]. Compared with healthy-weight peers, obese children have greater disability and worse quality of life [10, 15, 37, 42, 46]. Obese children and adolescents report lower physical, emotional, social, and school function and are more likely to have impaired physical and psychosocial functioning compared with their nonobese peers [37, 46]. The relationship between function and BMI has been briefly explored showing progressive declines in physical and social functioning with increasing BMI-Z scores [37, 46]. The relationships of other factors that may contribute to lower function in obese children have not been reported.

Overweight and obese children have a higher prevalence of musculoskeletal pain [13, 53], particularly in the lower extremity (LE) [13, 51, 53]. A cross-sectional study in 2459 children showed that overweight and obese children more frequently report LE pain and problems and more frequently visit their family physician for pain and problems in the LE compared with healthy-weight children [22]. Pain in the back, knee, and foot are the most prevalent regions of pain complaints in obese children and adolescents [51] and compared with healthy-weight peers,

overweight children have a higher prevalence of knee pain [53]. In obese children and adolescents, pain in the hips and knees is associated with increased BMI [51]. Despite the prevalence of LE pain among obese children and young adults, the impact of pain on function or psychosocial health has not been reported.

Increasing physical activity is a primary recommendation in the management of obesity and associated morbidities [68] and in improving quality of life [35], especially in children [54]. Despite these recommendations, the time spent in physical activity and participating in sports is low in obese and overweight children when compared with healthy-weight children [21, 49]. In a recent cohort study of over 7000 5 to 17 year olds, of whom 40% were classified as overweight (18%) or obese (22%) by BMI, obese children demonstrated lower physical fitness levels (measured by the Progressive Aerobic Cardiovascular Endurance Run [PACER]) compared with healthy-weight children [20]. The relationships of factors such as musculoskeletal pain that may interfere with physical fitness or physical activity levels are unclear.

Therefore, we asked whether: (1) obese children with LE pain have higher BMI-Z scores than obese children without LE pain; (2) obese children with LE pain report lower physical function and psychosocial health than obese children without LE pain; (3) obese children with LE pain have lower physical fitness than obese children without LE pain; (4) the BMI-Z score in obese children is associated with physical function, psychosocial health, or physical fitness.

Materials and Methods

Retrospective, cross-sectional data were collected from 183 patient medical charts at the time of initial referral to a weight management program at the Center for Healthy Weight and Nutrition at Nationwide Children's Hospital from 2009 to 2011 (Table 1). The program is a multidisciplinary medical weight management program for children, adolescents, and young adults (ages 8–19 years) with a BMI equal to and above the 95th percentile. At the time of enrollment into the weight management program, participants undergo a comprehensive medical and physical fitness evaluation from which the data for this study were extracted. A majority of those enrolled in the program are English-speaking, and if not, they were provided with an interpreter at the visit to assist with communication and questionnaires. English as a primary language was not an inclusion criteria for this study. No patients were recalled for this study; all data were extracted from the medical charts. Medical charts were excluded from further analysis if there was a documented history of orthopaedic surgery, neuromuscular disease, or inflammatory or chronic

Table 1. Data collected from medical record review of children and adolescents referred to a weight management program*

Category	Specific variables recorded	Initial method of collection
Demographic information	Age	Obtained through clinic visit
	Sex	
	Race	
Anthropometric information	Tanner stage	Obtained through clinic visit
	Height	
	Weight	
	BMI	
	BMI Z-score	
Medical history information	Surgical history	Parent/patient report through medical history questionnaire
	Musculoskeletal injury history	
	Musculoskeletal conditions (joint swelling)	
	Neuromuscular conditions	
	Arthritis conditions	
Musculoskeletal pain reports	Location	Parent/patient report through medical history questionnaire
	Frequency	
Physical function	Pediatric Quality of Life Inventory 4.0	Patient report (Peds QL) and Patient performance (PACER)
	Generic Core (Peds QL)	
	Physical component	
	Psychosocial components	
	Progressive Aerobic Cardiovascular Endurance Run test (PACER score)	
	Level of physical fitness	

* All data were collected from the initial assessment; BMI = body mass index.

arthritis. This study was approved by the institutional review board at Nationwide Children's Hospital.

Eight charts were excluded from further review as a result of exclusion criterion. Data from 175 medical charts were included in the analysis and two investigators (SBT, MB) were responsible for the extraction and quality control of the data. Data extraction from both electronic and paper medical charts was performed to maximize completeness of the data set. Demographic information of age, sex, race, and Tanner stage [65] was recorded to describe sample characteristics. Age and sex data were obtained from all 175 charts and Tanner stage was available from 151 charts.

Height (meters) and weight (kilograms) were extracted from all 175 medical charts. Per the weight management program clinical protocol, height and weight were measured on a Seca Model 240 stadiometer (Hanover, MD,

USA) and a Scale—tronix ST scale (White Plains, NY, USA), respectively. Height and weight were used to calculate BMI. Age- and sex-specific BMI Z-scores were generated in STATA 12.0 (STATA Corp, College Station, TX, USA) using Centers for Disease Control and Prevention 2002 data.

The exposure variable of LE musculoskeletal joint pain, along with specific pain location and pain frequency, was extracted from a detailed medical problem and history questionnaire completed by the patients and parents (Table 1). Pain data were available from all 175 medical charts. We categorized reports of pain by location into upper extremity pain, back pain, and LE pain. LE pain was considered pain reported in the feet, ankles, knees, and hips. For the analysis, the sample was divided into two groups, those reporting LE pain (LE+ group) and those who did not report LE pain (LE− group). Current or recent musculoskeletal pain was determined as any positive or affirmative report in the musculoskeletal systems review of the medical chart. Subjects checked a box indicating if they had pain (eg, “pain in hip,” “pain in back,” “pain in legs,” etc). Answers were frequently qualified by exact location. Only one incidence of pain for each respective body region was included for each subject (eg, if the subject reported recurrent knee pain, this was only counted once). However, if a subject reported pain in different body regions, these were counted separately (eg, one knee pain, one hip pain, one elbow pain, etc). Reports of nonmusculoskeletal discomfort or pain were not included (eg, stomach pain, head ache, etc).

Physical function and psychosocial health scores were extracted from the medical charts from the Pediatric Quality of Life Inventory 4.0 Generic Scales (PedsQL) score [59, 60]. The PedsQL is a valid measure of physical function and psychosocial health in many groups of children aged 2 to 18 years [55–61], including those with chronic disease [9, 34, 43, 55, 58, 59, 61]. In children with musculoskeletal conditions, the PedsQL is responsive and accurately shows change over time [12, 56–59]. The 23-item questionnaire assesses physical, emotional, social, and school functioning from which physical function and psychosocial health summary scores are derived [58]. The questionnaire asks how much of a problem each item has been during the past month with a 5-point Likert response scale. Scores are transformed into a 0 to 100 scale with higher scores indicating better function. The PedsQL was administered and completed by all children in English and for non-English speakers was translated through an official interpreter. The PedsQL physical function summary score (PedsQL-Physical Function) and the PedsQL psychosocial health summary score (PedsQL-Psychosocial Health) from the child report were recorded for analysis and used as continuous variables similar to other studies investigating

obesity and chronic disease [46, 57, 61, 63]. The clinically meaningful difference of the PedsQL physical function and psychosocial health summary scores are 5.9 and 6.7 points, respectively [56]. PedsQL data were available from 145 medical charts.

A measure of physical fitness, the PACER score, was extracted from the medical charts. The PACER is a common tool to assess aerobic fitness in children and involves running between two lines (20 meters apart) in pace with recorded audible cues [31]. Poorer aerobic or cardiovascular fitness is reflected as a lower PACER score [2, 31]. The PACER is multistage as the time between the audible cues becomes progressively shorter each minute requiring a progressive increase in running pace as time progresses. The test is stopped if the participant tires or cannot maintain the required speed to keep up with the audible cues. For our study, the PACER score was recorded as the number of laps completed and was used as a continuous variable [2]. The PACER score was available from 146 medical charts.

The study sample ($n = 175$) was mostly female (69%) with a mean age of 13 years, and 84% of the sample was at Tanner Stage 3 or higher (Table 2). A majority of the sample was distributed between blacks (46%) and whites (43%) (Table 2). The mean BMI for the sample was 36 kg/m² (SD 7) and the mean BMI Z-score was 2.41 (SD 0.32). For the 145 charts with PedsQL data, the mean PedsQL-Physical Function score and PedsQL-Psychosocial Health score were 77.6 (SD 15.9) and 74.2 (SD 16.4), respectively. For the 146 charts with PACER score, the mean score of the cohort was 13.4 (SD 6.3). Musculoskeletal pain was reported by 70 individuals (40% of the sample) with pain in the LEs being the most common location (51 individuals, 73% of those reporting pain) (Fig. 1). Pain in the back or upper extremities was reported by 19 individuals (27% of those reporting pain) (Fig. 1). Pain was reported in one body location by 29% of the sample and in more than one location by 10% of the sample (Fig. 1). Because some individuals reported pain in more than one location, the total number of pain reports by body region was also examined. There were 82 total reports of musculoskeletal pain with a majority of them (55 reports) in the LE (Fig. 1).

Lower extremity pain was reported by 29% (51 of 175 individuals) of the sample. Accordingly, the 51 individuals with LE pain were categorized in the LE+ group and the 124 individuals without LE pain were categorized in the LE− group (Table 3). Potentially confounding variables that may influence LE pain group categorization such as age, sex, and Tanner stage were compared between the LE+ and LE− groups [25, 36, 44]. We compared age between the LE+ and LE− groups using independent samples t-tests and found the mean age for both groups as approximately 13 years old (Table 3) ($t = 0.037$,

Table 2. Characteristics of study sample ($n = 175$)*

Characteristic	Number
Number of females/males	121/54
Number of Tanner stage	
I	7
II	17
III	39
IV	43
V	45
NR	24
Race	
Asian/Pacific Islander	2
Black	81
White	76
Hispanic	10
Other	14
NR	1
Age (years) (range)	13 (2) (9–19)
Height (m) (range)	1.62 (0.09) (1.42–1.88)
Weight (kg) (range)	96.2 (25.2) (46.8–198.2)
BMI (kg/m ²) (range)	36 (7) (23–62)
BMI Z-score (range)	2.41 (0.32) (1.28–3.13)
PedsQL-Physical Function	$N = 145^{\dagger}$ 77.6 (15.9)
PedsQL-Psychosocial Health	$n = 145^{\dagger}$ 74.2 (16.4)
PACER score, Mean (SD)	$n = 146^{\dagger}$ 13.4 (6.3)

* Continuous variables are reported as mean (SD); [†]group sample size differs as a result of missing data of variable; NR = not reported; BMI = body mass index; PedsQL = Pediatric Quality of Life Inventory 4.0 Generic Core; PACER = Progressive Aerobic Cardiovascular Endurance Run test.

$p = 0.970$). We also compared proportions of males/females and Tanner stage between the LE+ and LE− groups using the chi square test for independence. Females comprised 70% and 68% of the LE+ and LE− groups, respectively (Table 3) and a chi square test for independence indicated no association between sex and the LE pain group ($\chi^2 = 0.020$, $p = 0.791$). Given the small number of individuals with Tanner Stage I in the sample, we grouped Tanner stage into prepubescent (Tanner Stage I-II) and pubescent/postpubescent (Tanner Stage III-IV) [62, 65, 66] for the chi square analysis. A majority of the individuals were at Tanner Stage III or greater (Table 3), 89% in LE+ group and 82% in the LE− group, and a chi square test for independence indicated no association between Tanner stage group and LE pain group ($\chi^2 = 0.102$, $p = 0.209$). Given that obesity is more common in females [1], we expected females to make up a

Fig. 1 Number of individuals reporting pain and number of pain locations (left). Some individuals reported pain in more than one location, so the total number of pain reports by body region is shown on the right. UE = upper extremity.

substantial portion of our sample. Despite reports that females more frequently report pain in the general population, we found an equal distribution of females and males in the LE+ and LE− groups in our sample of obese children. Given the similarities in the demographics between the LE+ and LE− groups, we proceeded with analysis of our study questions using group comparison and correlation analysis. Given that the LE pain group categorization did not occur through random sampling and that the Kolmogorov-Smirnov statistic did not indicate normality of PedsQL or PACER data in the LE+ and LE− groups, we proceeded with the nonparametric techniques. We determined differences in the BMI-Z scores between the LE+ and LE− groups and differences in the PedsQL-Physical Function score and PedsQL-Psychosocial Health scores between the LE+ and LE− groups using the Mann-Whitney U test. We determined differences in the PACER scores between the LE+ and LE− groups using the Mann-Whitney U test. We determined the association between BMI-Z score and PedsQL-Physical Function score, PedsQL-Psychosocial Health score, and PACER score using Spearman's rank order correlation. All statistical analyses were done with IBM SPSS Statistics Version 19.0 (SPSS Inc, Chicago, IL, USA).

Results

We found no differences in the BMI-Z scores between the LE+ and LE− groups ($p = 0.331$) (Table 3).

The LE+ group reported lower PedsQL Function and PedsQL-Psychosocial Health scores compared with the

LE− group ($p = 0.018$ and $p = 0.050$, respectively) (Table 3).

We found no differences in the PACER scores between the LE+ and LE− groups ($p = 0.378$) (Table 3).

We found negative correlations between BMI-Z scores and PedsQL-Physical Function scores ($\rho = -0.222$, $p = 0.007$), PedsQL-Psychosocial Health scores ($\rho = -0.226$, $p = 0.006$), and PACER scores ($\rho = -0.427$, $p < 0.001$) (Table 4). The negative association indicates that as BMI-Z scores increase, there is a decline in the PedsQL-Physical Function, PedsQL-Psychosocial Health, and PACER scores.

Discussion

Obese children show diminished function, reduced psychosocial health, lower physical fitness, and activity compared with healthy-weight peers [21, 38, 41, 49, 53] and more frequently report LE pain [13, 51, 53]. However, the relationships of factors such as musculoskeletal pain that may interfere with function, physical fitness, or physical activity levels are unclear. We therefore asked whether: (1) obese children with LE pain have higher BMI-Z scores than obese children without LE pain; (2) obese children with LE pain report lower physical function and psychosocial health than obese children without LE pain; (3) obese children with LE pain have lower physical fitness than obese children without LE pain; and (4) the BMI-Z score is associated with physical function, psychosocial health, or physical fitness in obese children.

Table 3. Characteristics of sample by reports of lower extremity (LE) pain

Characteristic	LE pain (LE+) (n = 51)	No LE pain (LE-) (n = 124)	95% CI	p value
Female/male, number	36/15	85/39		0.791
Tanner stage				
Number, I/II/III/IV/V	1/4/16/13/14	6/13/23/30/31		—
Number, I-II/III-V	5/43	19/84		0.209
Age (years), mean (SD)	13.06 (2.45)	13.07 (2.14)	−0.72 to 0.75	0.970
Height (m), mean (SD)	1.62 (0.09)	1.63 (0.09)		—
Weight (kg), mean (SD)	100.71 (29.55)	94.39 (23.03)		—
BMI (kg/m ²), mean (SD)	37.05 (8.12)	35.83 (6.54)		—
BMI Z-score, mean (SD)	2.45 (0.37)	2.40 (0.29)	−0.15 to 0.06	—
Median	2.44	2.43		0.331
PedsQL-Physical Function score	n = 39*	n = 106*		
Mean (SD)	72.4 (17.1)	79.5 (15.0)	1.3–12.8	—
Median	71.4	82.4		0.018
PedsQL-Psychosocial Health score	n = 39*	n = 106*		
Mean (SD)	70.0 (16.1)	75.8 (16.3)	−0.18 to 11.9	—
Median	70.8	76.9		0.050
PACER score	n = 43*	n = 103*		
Mean (SD)	13.5 (4.9)	13.4 (6.9)	−2.3 to 2.2	—
Median	13.1	11.9		0.378

* Group sample size differs as a result of missing data of variable; confidence intervals (CI) of mean data. Groups were compared with chi square tests (female/male and Tanner Stage) and Mann-Whitney U tests (BMI-Z score, PedsQL-Physical Function score, PedsQL-Psychosocial Health score, and PACER score); BMI = body mass index; PedsQL = Pediatric Quality of Life Inventory 4.0 Generic Core; PACER = Progressive Aerobic Cardiovascular Endurance Run test.

Table 4. Association of BMI Z-score with PedsQL and PACER scores

Score	BMI Z-score
Peds QL	$\rho = -0.222$
Physical Function	$p = 0.007$
Peds QL	$\rho = -0.226$
Psychosocial Function	$p = 0.006$
PACER score	$\rho = -0.427$
	$p < 0.001$

BMI = body mass index; PedsQL = Pediatric Quality of Life Inventory 4.0 Generic Core; PACER = Progressive Aerobic Cardiovascular Endurance Run test.

There are several limitations to our study. First, the retrospective study design required data extraction from medical charts. Incomplete or missing information in the medical chart did not allow for a complete data set for the PedsQL and PACER variables in our analysis. PedsQL scores and PACER scores were available in 83% and 82%, respectively, of our total sample (n = 175). Given the large sample sizes that remained for analyses related to the PedsQL and PACER variables (n = 145 and n = 146, respectively), we do not believe these missing data impacted

our findings. Second, the cross-sectional analyses in this study limit any interpretation of causality between analyzed variables. We cannot establish cause and effect, specifically whether LE pain leads to reduced physical function, psychosocial health, or physical fitness. However, our findings do indicate that reports of LE pain are an important factor to consider in the physical function, psychosocial health, and physical fitness of obese children. Third, recall bias of the individuals completing the questionnaires may limit the accuracy of their responses. The descriptive data of our sample, including prevalence of LE pain reports, is similar to what has been reported in previous literature [13, 51, 53]. In our sample, 40% reported joint pain and of those individuals, LE pain was reported by a majority (73%). This is comparable to other studies with similar sample sizes and participant characteristics with ours who report prevalence of LE pain ranging from 30% to 65% [13, 51, 53]. Fourth, other confounding factors such as psychological health (eg, depression), socioeconomic status, family or school situation, LE malalignment, or time of participation in physical activity were not specifically collected in the clinic setting. Finally, generalization of our findings to the obese pediatric population may be difficult because the subjects studied were at a tertiary clinic setting and may have been sicker or

more motivated to join the comprehensive weight management program.

We found no differences in the BMI-Z scores of obese children reporting LE pain compared with the BMI-Z score of children who do not report LE pain. This finding indicates that factors beyond BMI may be associated with reports of LE pain in obese children. Lower extremity malalignment is frequently present in obese children [28–30, 52] and is associated with pain in other populations [45, 47, 48, 64]. Further investigation into factors such as LE alignment that may differ between obese children with pain and those without pain is warranted.

We documented differences in physical function and psychosocial health scores between obese children with LE pain and those without LE pain. Although the two groups were comparable in terms of age, sex, pubertal stage, and BMI Z-score, those with LE pain reported clinically poorer physical function and psychosocial health as measured by the PedsQL-Physical Function and PedsQL-Psychosocial Health scores, respectively. The PedsQL is a common tool to evaluate function and health-related quality of life in children and previous work has shown lower PedsQL scores in obese children compared with healthy-weight peers [37, 46, 63]. The overall mean scores on the PedsQL-Physical Function and Psychosocial Health scores of our entire sample were 77.6 and 74.2, respectively. This is comparable to previous work (scores, 79.5 and 73.5, respectively) [63]. However, the LE+ group reported PedsQL-Physical Function scores that were on average 7.1 points lower than the LE– group, indicating a clinically meaningful difference (MCID of 6.7) [56]. We found similar results for the PedsQL-Psychosocial Health scores because the LE+ group scored 5.9 points lower, meeting the MCID of 5.3 [56].

We found no differences in the level of physical fitness as measured by the PACER between obese children with LE pain and those without LE pain. Previous studies report lower physical fitness levels, using the PACER, in obese children compared with nonobese peers; however, mean data were not reported [20]. In our overall sample, the mean PACER score was 13.4 laps, which is lower than the mean fitness level of 29.7 laps from a large school-based population [6]. The mean BMI of the sample in the study by Carrel et al. [6] was 21 kg/m² compared with the mean BMI of 36 kg/m² in our sample. Although the obese children in our sample appear to have lower physical fitness, the level of physical fitness was not different between those reporting LE pain and those not reporting LE pain. The PACER, a measure of physical fitness, may not be the appropriate tool to measure specific function of the LE, which may be of greater importance in children with LE pain. Future research may focus on other measures of LE function such as strength, stability, and performance in obese children to further elucidate this relationship.

Finally, we found an inverse association of BMI-Z score with physical function score, psychosocial health score, and physical fitness score in obese children. Increasing BMI-Z scores were associated with progressive declines in physical function, psychosocial health, and physical fitness scores. Our findings of small to moderate inverse associations between the BMI-Z scores and PedsQL scores are consistent with previous findings by Quaresma et al. [40] of small to moderate inverse associations of BMI and scores on the Impact of Weight on Quality of Life questionnaire (physical comfort: $r = -0.15$, $p = 0.002$; social life: $r = -0.18$, $p \leq 0.001$; total score [quality of life specific to obesity]: $r = -0.22$, $p \leq 0.001$) in 401 children. In the same study, Quaresma et al. [40] found no significant correlations between BMI and PedsQL scores [40]. The mean BMI in the study by Quaresma et al. [40] was 21 kg/m² compared with the mean BMI of 36 kg/m² in our sample, which may account for our different findings. Obesity in children is associated with reduced levels of physical activity and sports participation [21, 49]. Our finding of a moderate association between BMI-Z scores and PACER scores such that increasing BMI-Z scores are associated with decreasing physical fitness score is consistent with the lower levels of activity in this population [39].

Overall, our findings indicate that obese children with LE pain do have worse physical function and poorer psychosocial health compared with obese children without LE pain. We found that increasing BMI-Z scores are associated with reduced physical function, reduced psychosocial health, and reduced physical fitness. Our findings warrant consideration of LE pain in the evaluation and management of obesity in children. Further investigation of the role of LE pain, if any, in the compliance of weight management programs, exercise regimes, or physical activity recommendations is necessary. Future work should also consider if weight loss results in changes in reported pain along with physical function, psychosocial health, or physical fitness. Physical function and psychosocial health may be adversely impacted by LE pain in obese children who are not physically fit; and practitioners should take into account the child's limitations and consider targeted recommendations for physical activity regimens that account for and address LE pain. In the long term, whether LE pain or diminished function is an indicator of poorer joint health, or the potential for degenerative joint disease over time, should be addressed in large, prospective longitudinal studies that focus on objective parameters related to LE joint integrity, physical functioning, and quality of life.

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