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Obesity in children and adolescents with chronic pain: Associations with pain and activity limitations

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Abstract

Objectives—Obesity is associated with functional disability in adults with chronic pain, but less is known about obesity among youth with chronic pain. The purpose of this study was to 1) identify the prevalence of overweight and obesity in children and adolescents receiving treatment for chronic pain, and 2) examine associations between Body Mass Index (BMI), pain intensity, and activity limitations in this population.

Methods—Data was obtained from records of 118 patients, ages 8 to 18, seen in a multidisciplinary pediatric pain clinic. Information about age, gender, pain problem, duration and severity, medical diagnoses, medications, height and weight were collected from medical records and intake questionnaires. The CDC's pediatric BMI calculator was used to obtain percentile and category (underweight, healthy weight, overweight, obese). Children and parents completed the Child Activity Limitations Interview-21 (CALI-21), a self-report measure of activity limitations.

Results—A significantly higher rate of overweight and obesity was observed among youth with chronic pain compared to a normative sample. BMI percentile was predictive of concurrent limitations in vigorous activities, according to parent report.

Discussion—BMI percentile and weight status may contribute to activity limitations among children and adolescents with chronic pain. Weight status is an important factor to consider in the context of treatment of chronic pain and disability in children and adolescents.

Keywords

obesity; Body Mass Index (BMI); activity; pediatric; chronic pain

Introduction

Obesity is associated with disability in adults with chronic pain,¹ such that individuals in overweight and obese weight categories report more inactivity, higher levels of depression, lower physical health-related quality of life, and are more likely to be completely disabled than those in a normal weight category. Obesity has been identified as a contributor to poor health outcomes and reduced quality of life in a number of pediatric populations, including orthopedic and general pediatric samples.^{2–4} Much less is known about the prevalence and impact of obesity among youth with chronic pain, although there is some evidence that obesity adds to further reductions in health-related quality of life outcomes in this population.⁵

Children and adolescents with chronic pain may be at increased risk for obesity due to changes in their ability to participate in vigorous activities. Participation in physical activity is often limited among children and adolescents with chronic pain. It has been estimated that up to 75% of children and adolescents with chronic pain withdraw from sports participation, and these children and adolescents experience reductions in other physical and leisure activities, including gym class, playing, running, and walking.^{6, 7}

Conversely, pre-existing overweight or obese weight status may place children at greater risk for experiencing pain. Obesity among children has been linked to increased incidence of certain types of pain, specifically musculoskeletal pains and headache. Compared to children in the normal weight category, children in the overweight category have higher incidence of fractures and are more likely to report musculoskeletal pain or discomfort, most commonly knee pain.⁸ Children above the 95th percentile for BMI are more likely to have low back pain and pain in at least one joint than children below the 80th percentile.⁹ Among overweight children, increasing BMI is associated with knee and foot pain.¹⁰ The presence of musculoskeletal pain can decrease the likelihood that children will participate in physical activities and this inactivity can contribute to additional weight gain.⁸ Additionally, obese and overweight children are at increased risk for headache,^{11, 12} which may be more true for females.¹³ Research on other types of pain problems among overweight children is very limited.

Reduced physical activity contributes to weight gain and obesity. Less time spent in vigorous and moderate physical activity have been positively associated with body fat and BMI in 8–10 year olds.¹⁴ Similar findings have been shown longitudinally in adolescent girls, whose percent body fat increases more over the course of adolescence with inactivity.¹⁵ In a study of pediatric orthopedic patients, obesity was associated with limitations in sports, higher levels of pain, and lower levels of global functioning.¹⁶ Thus, when children and adolescents with chronic pain withdraw from activity participation, they may be at increased risk for weight gain and BMI increases, particularly if limitations persist over long periods of time. Weight gain may make additional contributions to withdrawal from activities and declines in functioning.^{8, 12}

While the incidence of pain is higher among children with overweight or obese weight status, the prevalence of obesity in pediatric clinical pain populations is largely unknown, as is the potential impact of weight status on other areas of functioning. Overall, the previous research in this area has focused on pain characteristics among children with overweight or obese weight status, while few studies have examined weight status in samples of youth with chronic pain.^{5, 12} The current study will contribute to our knowledge of the prevalence of overweight and obesity among children and adolescents with chronic pain, and will increase our understanding of the potential role that weight status might play in activity limitations in this population.

This study had several aims, including to 1) examine the prevalence of obesity in a sample of children and adolescents seeking treatment for chronic pain and compare prevalence rates to those in the general population; 2) describe differences in BMI by age, gender, type of prescribed medication, and pain location in this sample; and 3) examine pain intensity and BMI as predictors of concurrent activity limitations. We hypothesized that children and adolescents seeking treatment for chronic pain would be more likely to be overweight or obese than children and adolescents in the general population, and that similar to the general population, adolescents (13–18 years) would have higher BMI percentile than children (8–12 years).¹⁷ Antidepressant medications, including selective serotonin reuptake inhibitors (SSRI) and tricyclic antidepressants (TCA) are sometimes associated with weight gain. It is also possible that patient weight status impacts the types of medications that are prescribed for chronic pain. Thus, we examined associations between medication type and BMI, hypothesizing that SSRI and TCA medications would be associated with higher BMI in this population. We also

hypothesized that similar to cross-sectional research in adults, BMI would be predictive of activity limitations in this sample of youth with chronic pain.

Materials and Methods

The sample consisted of 118 children and adolescents (ages 8–18 years) with chronic pain conditions and their parents who were seeking pain treatment. This sample was selected from 224 consecutive new patients being seen for evaluation in a pediatric pain management clinic between January 2005 and June 2008. This multidisciplinary clinic is a tertiary care specialty outpatient clinic that incorporates pain medicine, physical therapy, and psychology assessment and treatment services. The majority of patients are referred from other specialty clinics, including gastroenterology, orthopedics, and neurology. Data were obtained from retrospective record review of medical records and intake questionnaires collected at the patients' initial consultation visit to the clinic. IRB approval was obtained for conducting the chart review. Children and their parents completed pain clinic questionnaires which included measures of pain, demographics, and activity limitations (the CALI-21).¹⁸ The parent- and child-report questionnaires were mailed to participants approximately 3 weeks prior to their appointment, completed at home and brought to the child's clinic appointment.

Children were included in the sample if they were: between 8–18 years, had a chronic painful condition present for ≥ 3 months that was not due to an identified serious disease, had completed the CALI-21, and had height and weight available in medical records. Serious disease conditions that were excluded included cancers, arthritis, Crohn's disease, and spina bifida, among others. Of the 224 potential participants, 104 were excluded for one or more of the following reasons: 13 did not meet age criteria, 19 did not complete the CALI-21, 58 did not have height and weight data available for BMI calculation, 48 had a serious disease diagnosis identified as the source of their pain, and 1 had a developmental disability. Children who were not included in the sample due to not having height and weight or CALI-21 data available were not significantly different from children who had this data available on usual pain intensity or on pain duration. The final sample included 118 children who were 8–18 years old ($M = 14.48$, $SD = 2.38$), 72.9% Caucasian, and 64.4% female. Primary pain diagnoses assigned by the pain management physician included headache ($n = 39$), abdominal pain ($n = 28$), back pain ($n = 21$), lower extremity musculoskeletal pain ($n = 15$), and other musculoskeletal pain ($n = 15$). Two of the children with other musculoskeletal pain had widespread body pain. Two or more pain diagnoses were present for 17% of the sample ($n = 20$). Mean duration of pain was 2.13 years. See Table 1 for sample characteristics.

Measures

Demographics—Parents completed demographic information including child age, gender, ethnicity, and racial background via questions included in an intake assessment packet.

Pain location, pain duration and comorbid chronic disease—Information about primary pain location, chronic pain duration and chronic disease were obtained through medical records review.

Pain Intensity—Average or usual pain intensity was assessed using an 11-point numerical rating scale (NRS), with anchors from 0, 'no pain' to 10, 'worst pain ever'. Children were asked to rate their usual pain intensity in the past four weeks. The NRS is recommended for assessment of pain intensity due to its excellent reliability and validity.¹⁹

Body Mass Index (BMI)—Children's height and weight were taken and recorded by nursing staff at the time of the child's clinic visit. Weight was taken to the nearest .10 kg and height

was taken to the nearest .10 cm using a medical scale and height rod. Prior to 2006, these data were recorded in the patient's paper chart and subsequently scanned into an electronic medical record. Beginning in 2006, height and weight data was entered directly into the patient's electronic medical records as part of a routine nursing check-in. All data used in this study were obtained from electronic medical records. Height, weight, gender, full birth date, and visit date were entered in the CDC's online pediatric BMI calculator, which was used to obtain BMI, BMI percentile, and BMI category (available at: <http://apps.nccd.cdc.gov/dnpabmi/Calculator.aspx>). BMI percentiles are based on nationally established norms for the child's gender and chronological age. BMI categories are based on the following percentile ranges, as established by the American Academy of Pediatrics:²⁰ underweight = $\leq 5\%$; healthy weight = >5 to $<85\%$; overweight = ≥ 85 to 94% ; and obese = $\geq 95\%$. BMI percentile was utilized as the primary measure of weight status in this study, which has been used in previous studies with pediatric pain samples.¹²

Medications—Information about children's current prescribed medications at the time of intake was obtained from medical records. Medications were classified into the following five categories: Non-steroidal anti-inflammatory drugs (NSAID), anti-seizure medications, anti-depressant medications (SSRI and TCA), opioids, and other prescription drugs.

Activity Limitations—As part of the intake process, children and their parents completed the Children's Activity Limitations Interview – 21 (CALI-21),¹⁸ a new questionnaire version of the original CALI.21 This measure is designed to assess pain-related activity limitations in children and adolescents (ages 8–18) via parent and child written report. The measure asks participants to report on pain-related limitations in 21 activities in a variety of domains over the previous 4 weeks, rating the difficulty participating in each activity on a 5-point rating scale, ranging from 0 'not difficult' to 4 'extremely difficult' because of pain. Two subscales describe two different domains of activity limitations. The Active domain subscale includes vigorous physical activities such as gym, sports, and running, while the Routine domain subscale includes activities such as attending school and doing things with friends. Higher scores indicate greater activity limitations or more impairment. In the current sample, reliability of the parent-report Active and Routine subscales was high ($\alpha = .93$ and $.89$, respectively). Reliability of the child-report Active and Routine subscales was moderate to high ($\alpha = .94$ and $.75$, respectively). In the current study, Active and Routine subscale scores were utilized. Child and parent reports were correlated significantly on both subscale scores in this sample (Active, $r = .71$, $p < .001$; Routine, $r = .72$, $p < .001$).

Statistical Analyses

Descriptive statistics were used to describe overweight and obesity prevalence, and Chi-squared tests were used to compare prevalence in this sample to a geographically similar normative sample. Chi-squared and t-tests were used to compare pain and BMI variables in school-age children (ages 8–12) and adolescents (ages 13–18) in this sample. Bivariate correlations were used to examine associations between BMI percentile and other study variables. One-way ANOVA was used to examine differences in BMI percentile and other variables by primary pain diagnosis, and contrasts were examined with Bonferroni procedures. Multiple linear regressions were used to test a model in which pain intensity and BMI were examined as predictors of activity limitations after controlling for child age and gender. All analyses were conducted using SPSS v15.

Results

BMI Descriptives and Overweight Prevalence

In this sample of children and adolescents with chronic pain, BMI ranged from 14.61 to 54.02, with the mean BMI being 24.02 ($SD = 7.34$, Median = 22.12). BMI percentiles ranged from 1 to 99 ($M = 65.40$, $SD = 31.27$, Median = 76.50), with 3 children (2.5%) being classified as underweight, 70 children (59.3%) being classified as healthy weight, 12 children (10.0%) being classified as overweight, and 33 children (28.0%) being classified as obese. The rate of combined overweight and obese weight status in the current sample was 38.2%. In geographically similar samples of children who live in Oregon, overweight and obese prevalence estimates have been slightly lower than national rates historically, and have ranged from 26.5% to 31.6% in health surveys conducted between 1999 and 2006.^{17, 22, 23} We compared our chronic pain sample to the most recent National Survey of Children's Health of 10–17 year olds in Oregon, in which 14.7% were classified as overweight and 9.6% were classified as obese (24.3% overweight or obese).²⁴ The rate of obese weight status was significantly higher in the current chronic pain sample (28.0%) compared to the Oregon estimate (9.6%), $\chi^2(1) = 29.26$, $p < .001$.

Prescribed Medications and BMI percentile

The majority of the children in the sample were taking one or more medications as part of their pain treatment. The most commonly prescribed medications in the sample were as follows: anti-seizure medications, $n = 48$, 40.7%; NSAID, $n = 46$, 39.0%; anti-depressant medications: SSRI, $n = 21$, 17.8%, TCA, $n = 17$, 14.4%; other prescription medications, $n = 36$, 30.5%; opioid medications, $n = 25$, 21.2%. The majority of children were prescribed one or more medications, with 8.5% of the sample prescribed no medications, 39.8% prescribed one medication, 32.2% prescribed two medications, 18.6% prescribed three medications, and 1% prescribed four medications for their pain. Two-tailed t-tests were used to compare BMI percentile between the two groups: children taking a medication and children not taking a medication from each of the five medication classes. Contrary to hypotheses, results indicated no significant difference in BMI percentile based on any medication class.

BMI percentile by age, gender, and pain location

Older and younger children had differences in BMI percentile, such that children ages 8–12 had significantly lower BMI percentile than children ages 13–18 (see Table 1). Twenty-two percent of children ages 8–12 were in the overweight or obese weight categories, compared to 43% of 13–18 year olds. These age differences were in the expected direction, similar to differences observed in large normative samples of children and adolescents.¹⁷ BMI percentile did not differ by gender, $t(117) = .24$, $p = .81$.

BMI was also examined across primary pain location in the entire sample of both children and adolescents. Children and adolescents with back pain had significantly higher BMI and BMI percentiles compared to children and adolescents with headache, who had the lowest BMI and the lowest BMI percentiles. These effect sizes were small. Table 2 presents comparisons of mean pain intensity and BMI variables by pain location. Figure 1 illustrates obesity rates in the full sample and by pain location, and the obesity rate in the normative Oregon comparison sample.

Associations among BMI percentile, pain variables, and activity limitations

In bivariate correlations, BMI percentile had a small but significant association with usual pain intensity, such that youth with higher BMI percentile reported higher usual pain intensity ($r = .17$, $p < .05$). BMI percentile was not correlated with pain duration, and was not correlated

with parent or child report of Active or Routine activity limitations in the sample. Post hoc bivariate correlation analyses were conducted with school-age children (ages 8–12) and adolescents (ages 13–18), which showed that the correlation between BMI percentile and pain intensity was significant for adolescents ($r = .24, p < .05; n = 91$) but not for school-age children ($r = .00, p = .99; n = 27$). BMI was also not correlated with pain duration or activity limitations when examined separately in school-age children and adolescents.

In regression analyses, child age and gender did not contribute significantly to activity limitations. After controlling for age and gender, regression analyses examined the predictive contribution of pain intensity and BMI percentile to parent and child report of activity limitations. Usual pain intensity made a significant contribution to parent report of activity limitations in the Active domain ($\beta = .24, p < .05$), but not the Routine domain. BMI percentile accounted for a significant portion of the variance in parent report of the Active domain of activity limitations ($\beta = .25, p < .05$) after controlling for child sex and age in step one, and usual pain intensity in step two. Child report of Active domain limitations was predicted by pain intensity ($\beta = .39, p < .01$), and BMI percentile did not contribute significantly above pain intensity. Overall, the proportion of variance explained by the models predicting Active domain limitations was small but significant ($R^2 = .15$ for parent report on Active domain, $R^2 = .22$ for child report on Active domain). None of the variables examined accounted for a significant portion of the variance in Routine activity limitations.

Discussion

Our results indicate that children and adolescents being seen in a specialty pain clinic were more likely to be obese than children and adolescents in the general population of Oregon state where the clinic is located. Children and adolescents with back pain in this sample had the highest BMI and BMI percentile, significantly higher than children and adolescents with headache. While the highest percentage of children with back pain had obese weight status (57.1%), it is notable that in all other pain locations, rates were higher than the general population of 10–17 year olds in Oregon. The obesity rate observed in the current sample (28.0%) was somewhat higher than previous studies that have examined weight status in children and adolescents with chronic pain. For instance, in a sample of 3–18 year olds with migraine, 17.5% were classified in the obese weight status category,¹² and in a sample of 8–18 year olds with headache, abdominal pain, or orthopedic pain, 17.5% were classified as obese. The combined rate of overweight and obese weight status was also slightly lower in these previous studies than in the current sample.

Compared to children ages 8–12, adolescents ages 13–18 had significantly higher BMI percentile. While this is similar to patterns of BMI increases seen across age in children and adolescents,¹⁷ the findings indicate that adolescents seeking treatment for pain problems may be at higher risk for being overweight or obese. This finding is not explained by longer pain duration in adolescents in this sample; children and adolescents had been experiencing pain for similar lengths of time, and pain duration was not significantly correlated with BMI percentile. BMI percentile was related to usual pain intensity, though the correlation was small, and post hoc analyses demonstrated that this association was stronger for adolescents. This finding suggests that as BMI percentile increases children are more likely to report higher levels of pain intensity, particularly older children and teenagers. However, BMI may contribute to pain intensity for some children regardless of age. Additionally, this study showed that among children and adolescents with chronic pain, BMI percentile is predictive of concurrent activity limitations, particularly limitations in vigorous activities such as running and sports, as reported by parents. This association was relatively small, but BMI percentile was a significant predictor of parent report of Active domain limitations on the CALI-21 after controlling for usual pain intensity. The finding that BMI percentile was not associated with child reports of activity

limitations is not surprising given the strong association between child report of pain intensity and child report of Active domain limitations. This suggests that for children, perception of their own pain may have the greatest impact on their perceived difficulty with Active or vigorous activities, whereas parent reports of Active activity limitations may be more strongly related to child weight status. BMI percentile was not related to limitations in the Routine domain, suggesting that the negative impact of being overweight may be restricted to limitations in more vigorous physical activities.

Our results are similar to one previous pediatric study by Hainsworth et al.⁵ that demonstrated associations between weight status and health-related quality of life, which is a broadly defined outcome focusing on an individual's perception of overall health and satisfaction with their ability to participate in life activities.²⁵ However, in the current study we have extended these findings to show associations between BMI percentile and pain-specific activity limitations, as measured by the CALI-21, which assesses an individual's perceptions of difficulty participating in age-appropriate activities because of pain.²⁵ We have also considered pain intensity as a predictor of activity limitations, and demonstrated that BMI percentile contributes to vigorous activity limitations above the effect of pain intensity alone. Thus, there is growing evidence from two similar but distinct correlational studies that weight status plays an important role in predicting pediatric chronic pain outcomes, including general health-related quality of life and pain-specific activity limitations. Next steps in this area of research will be to examine multiple outcome domains in prospective studies of children and adolescents with chronic pain.

It is likely, particularly in children with back pain, that the relationship between BMI and pain is bi-directional, and partially mediated by physical activity levels. Being overweight places additional strain on musculoskeletal structure, increasing risk of injury and pain. The experience of pain, particularly back pain, is likely to limit whole body movement, increase inactivity, and may lead to additional weight gain. Weight gain may perpetuate the cycle of inactivity, both because of decreased tolerance caused by the added weight,²⁶ and because of pain and discomfort associated with reconditioning.²⁷ Inactivity and additional weight gain then contribute to additional deconditioning and increased pain.^{8, 28}

Taken together, these findings have a number of clinical implications. First and foremost, providers of health care services for children and adolescents with chronic pain should routinely assess BMI and weight status as part of chronic pain treatment, as is recommended for adult chronic pain patients,¹ and has been recommended by one previous pediatric study.⁵ Weight status category may be the most relevant indicator to use in clinical practice, as clinicians are familiar with evaluating BMI within these guidelines. Adolescents with chronic pain in particular are more likely to fall in the obese weight category, and this sub-population might be identified as candidates for future targeted interventions. Additionally, BMI percentile may be associated with higher pain intensity and may be predictive of more limitations in vigorous activities, at least in parent report outcomes in these cross-sectional data. It should be noted that the higher prevalence of obesity in this sample may not be representative of other clinical pediatric chronic pain samples and requires further study, especially among children and adolescents with different pain diagnoses and among more ethnically diverse samples of children and adolescents. Our results indicate that BMI assessment might be particularly important in teenagers, and among children and adolescents with back pain or lower extremity pain.

Second, interventions related to weight status might be important to incorporate into chronic pain treatment. Currently, it is unknown whether weight status impacts the course of pain treatment, the types of treatments recommended by providers, or treatment outcome. While this deserves additional research, there are a range of interventions related to weight

management that might be incorporated into chronic pain treatment. Less intense interventions could be as simple as providing feedback about BMI and weight status. Slightly more intense interventions might include counseling about weight loss, nutrition, and physical activity. Moderately intense intervention might include psychological treatments supporting behavior change, such as diet and exercise improvements, and reduction of sedentary time. Studies show that sedentary time, such as screen time, is related to BMI in children, and thus reducing screen time might be a good target for intervention.^{14, 29} Simple reward systems for activity participation²⁹ may be fairly feasible to integrate into multidisciplinary pain management programs. Finally, some patients will need more intense treatment. Comprehensive cognitive behavioral therapy treatment programs for obesity that involve parents have been shown to be effective for weight loss and for improving psychological well-being.³⁰ Referring patients to obesity treatment programs that involve parents may be important for children and adolescents who require more intense intervention related to weight. Many of the goals of chronic pain treatment, including the rehabilitation model of helping children return to normal activities, are commensurate with weight loss programs. For some children, normal participation in pain treatment may serve to facilitate weight loss and additional specialized interventions may not be needed.

There are a number of limitations to the current study. First, we compared the rate of obesity to a geographically similar normative sample of Oregon children, but the age range of the comparison sample (10–17) was not identically matched to our 8–18 year old sample, and we were not able to match on other sociodemographic variables. It is possible that a more precisely matched comparison sample might have yielded different results. Our sample size was relatively small, and thus the rate of obese weight status observed in the sample should only be interpreted as an estimate of the rate in the population. Our sample was also relatively homogenous in ethnic background, and additional studies need to be conducted with more diverse samples. We were also limited in our ability to assess the dosage and length of time that patients were taking prescribed medications, and relatively small numbers of children were prescribed medications in each medication class that was examined. Thus, our findings of no associations between medication and BMI percentile may have been due to inadequate assessment of medication usage and there may be true effects of medications on weight gain or of weight status on prescribing patterns that we were not able to detect. Study data are cross-sectional, and as such conclusions cannot be drawn about the direction of effects between weight status and pain or activity limitations, or the effects of pain characteristics and activity limitations on weight gain over time. Additionally, information about other health risk factors, such as smoking, alcohol and drug use, and caffeine intake, was not available. These behaviors might make additional contributions to activity limitations and weight status in this population.

Future research in this area should include information about other health risk factors. In addition, this study provides some support for weight status impacting functional outcomes, but the observed associations were relatively small. Additionally, these are cross-sectional data so it is also possible that restriction of activity due to chronic pain increases weight in children over time. Longitudinal designs will be necessary to examine the complex associations between pain, BMI, and activity limitations in larger more diverse samples. Depression is related to lower levels of physical activity in children,³¹ and the role of depressed mood in BMI and weight gain might be examined in future studies of children and adolescents with chronic pain.

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Figure 1.
Rate of obese weight status by pain location and sample

Table 1

Demographic Characteristics of the Sample and Age Comparisons

	Total Pain Clinic Sample <i>n</i> = 118		Children, ages 8–12 <i>n</i> = 27	Adolescents, ages 13–18 <i>n</i> = 91
Characteristic	Range	<i>n</i> (%) / <i>M</i>(<i>SD</i>)	<i>n</i> (%) / <i>M</i>(<i>SD</i>)	<i>n</i> (%) / <i>M</i>(<i>SD</i>)
Age (years)	8.17–18.67	14.48 (2.38)		
Gender				
Male		42 (35.6%)	15 (55.6%)	27 (29.7%)
Female		76 (64.4%)	12 (44.4%)	64 (70.3%) ^a
Ethnicity				
American Indian/Alaska Native		5 (4.2%)	1 (3.7%)	4 (4.4%)
Asian American		3 (2.5%)	0 (0.0%)	3 (3.3%)
Caucasian		86 (72.9%)	21 (77.8%)	65 (71.4%)
Hispanic		9 (7.6%)	2 (7.4%)	7 (7.7%)
Other or Mixed Ethnicity		6 (5.1%)	1 (3.7%)	5 (5.5%)
Missing		9 (7.6%)	2 (7.4%)	7 (7.7%)
Usual Pain Intensity (NRS 0–10)		5.43 (2.13)	5.46 (2.69)	5.43 (1.97)
Pain Duration in years		2.13 (3.02)	2.33 (3.66)	2.06 (2.82)
BMI	14.61–54.02	24.02 (7.34)	18.53 (3.50)	25.65 (7.41) ^b
BMI Percentile	1–99	65.40 (31.27)	51.44 (31.28)	69.55 (30.21) ^c
BMI Category:				
Underweight (<5%-ile)		3 (2.5%)	1 (3.7%)	2 (2.2%)
Healthy Weight (>5 to <85%-ile)		70 (59.3%)	20 (74.1%)	50 (54.9%)
Overweight (≥85 to <95%-ile)		12 (10.2%)	5 (18.5%)	7 (7.7%)
Obese (≥95%-ile)		33 (28.0%)	1 (3.7%)	32 (35.2%)

^a Proportion of female adolescents greater than proportion of female children: $\chi^2(1) = 6.09, p < .01$

^b Higher BMI in adolescents than children: $t(116) = -4.82, p < .001$

^c Higher BMI percentile in adolescents than children: $t(116) = -2.71, p < .01$

Table 2

Differences in pain intensity and BMI variables by primary pain location

	Primary Pain Location					ANOVA Results		
	Headache <i>n</i> = 39 <i>M</i> (<i>SD</i>)	Abdominal <i>n</i> = 28 <i>M</i> (<i>SD</i>)	Back <i>n</i> = 21 <i>M</i> (<i>SD</i>)	Lower Extremity <i>n</i> = 15 <i>M</i> (<i>SD</i>)	Other Musculos. <i>n</i> = 15 <i>M</i> (<i>SD</i>)	<i>F</i> (3, 114)	<i>p</i>	partial eta-squared
Pain Intensity	5.04 (2.58)	5.76 (1.79)	6.05 (1.91)	5.76 (1.75)	4.67 (1.91)	1.48	.21	.05
BMI	21.67 (5.60) ^a	23.14 (7.31) ^b	27.96 (7.25) ^{a, b}	25.46 (7.60)	24.82 (9.31)	2.98	.02	.07
BMI %-ile	56.04 (34.30) ^c	64.36 (30.93)	81.13 (29.35) ^c	68.13 (28.70)	66.13 (7.58)	2.46	.05	.06
% Overweight	15.4	3.6	9.5	0	20.0			
% Obese	17.9	25.0	57.1	33.3	13.3			

^{a, b, c} Bonferroni contrast procedures indicated that children with back pain were significantly higher on BMI than children with headaches and abdominal pain, and were also significantly higher on BMI percentile than children with headaches.