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Musculoskeletal pain in obese adolescents

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Abstract

Objective: To determine the prevalence of pain, musculoskeletal syndromes, orthopedic disorders and using computers and playing videogames among obese adolescents.

Methods: This was a cross-sectional study that investigated 100 consecutive obese adolescents and 100 healthy-weight controls using a confidential, self-report questionnaire covering demographic data, sports participation, painful musculoskeletal system symptoms and using computers and playing videogames. The questionnaire's test-retest reliability was tested. Physical examination covered six musculoskeletal syndromes and seven orthopedic disorders.

Results: The kappa index for test-retest was 0.724. Pain and musculoskeletal syndromes were equally prevalent in both groups (44 vs. 56%, p = 0.09; 12 vs. 16%, p = 0.541; respectively). Notwithstanding, orthopedic disorders (98 vs. 76%, p = 0.0001), tight quadriceps (89 vs. 44%, p = 0.0001) and *genu valgum* (87 vs. 24%, p = 0.0001) were significantly more prevalent in obese adolescents than in controls. Median time spent using a computer the day before, on Saturdays and on Sundays were all lower among the obese subjects (30 vs. 60 minutes, p = 0.0001; 1 vs. 60 minutes, p = 0.001; and 0 vs. 30 minutes, p = 0.02; respectively). Obese adolescents were less likely to play handheld videogames (2 vs. 11%, p = 0.003) and there was no difference in the two groups' use of full-sized videogames (p > 0.05). Comparing obese adolescents with pain to those free from pain revealed that pain was more frequent among females (59 vs. 39%, p = 0.048) and was associated with greater median time spent playing on Sundays [0 (0-720) vs. 0 (0-240) minutes, p = 0.028].

Conclusions: Obesity can cause osteoarticular system damage at the start of adolescence, particularly to the lower limbs. Programs developed specifically for obese female adolescents with musculoskeletal pain are needed.

J Pediatr (Rio J). 2011;87(4):329-335: Adolescent, obesity, pain, musculoskeletal syndrome, computers, videogames, handheld videogames.

Introduction

Adolescent obesity and overweight are undeniably global public health problems[1,2] and Brazil is no exception. Wang et al.[3] investigated the prevalence of overweight over recent decades in four countries (Brazil, Russia, China and the United States) and observed that in Brazil the rate had increased by 240%.

Adolescent obesity is a multifactorial chronic disease that is related to genetic factors, changing dietary habits, reduced physical activity and increased use of computers and videogames, among other factors.[2] Obese adolescents suffer from a higher prevalence of comorbidities and complications, such as arterial hypertension, dyslipidemia, glucose intolerance,[1] cancer and pulmonary and dermatological diseases,[1] in addition to gastrointestinal,[4] genitourinary and neuropsychiatric disorders, among others.[1]

Some studies have found that obese adolescents suffer from a greater prevalence of localized musculoskeletal pain,[5-10] particularly in the lower limbs[5,9,10] and lumbar region,[8,9-11] and also from increased prevalence of localized orthopedic disorders,[12,13] such as: *genu valgum*,

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genu varum,[10,12] *genu recurvatum* and tight quadriceps.[8] Musculoskeletal syndromes that cause chronic and diffuse musculoskeletal pain, such as juvenile fibromyalgia, have been studied very little in obese adolescents.[8]

Some studies have also found evidence in adolescents and young people with healthy weight of associations between computer use and musculoskeletal pain[13] such as upper limb pain,[14] cervical pain[14-16] and feelings of musculoskeletal discomfort.[17,18] In contrast, others did not detect associations between a range of different types of pain and computer use in healthy-weight adolescents,[19,20] and there are no studies that have investigated these issues in obese adolescents.

There are also no studies that have compared pain, musculoskeletal syndromes, orthopedic disorders and computer and videogame use in obese and healthy-weight adolescents. Furthermore, no studies have systematically evaluated the prevalence rates of benign joint hypermobility syndrome (BJHS), myofascial syndrome, tendinitis, bursitis and epicondylitis in adolescents with this chronic disease.

The objectives of this study were to evaluate the prevalence of pain, musculoskeletal syndromes, orthopedic disorders, and using computers and playing videogames, in both obese and healthy-weight adolescents, in addition to assessing associations between demographic data, syndromes, orthopedic disorders, using computers and playing videogames and suffering musculoskeletal pain or being free from pain in obese adolescents.

Methods

The study period was from January 2008 to December 2010. A total of 200 adolescents were recruited consecutively during this period, 100 obese and 100 healthy-weight, from a population of 133 obese and 201 healthy-weight adolescents seen at a clinic for adolescents at the Hospital Regional Hans Dieter Schmidt (HRHDS) in Joinville, SC, Brazil. The study was approved by Research Ethics Committees at the institutions involved: the HRHDS and the Universidade de São Paulo Hospital das Clínicas (HC-FMUSP). All of the obese and healthy-weight adolescents and their parents signed free and informed consent forms.

Inclusion criteria for both groups were age from 10 years to 19 years and 11 months and the nutritional classification for the obese group was a body mass index (BMI) greater than or equal to the 95th percentile for their age and sex on the 2000 National Control Health System (NCHS) curves, while the criteria for the healthy-weight controls was a BMI less than or equal to the 85th percentile and greater than the 5th percentile for their age and sex on the NCHS curve.[21] Patients were excluded if they had musculoskeletal pain or injuries caused by one of the following conditions: connective tissue disorders, infectious diseases, oncological hematological conditions, genetic diseases, endocrine disorders (such as thyroid diseases and diabetes mellitus) or recent traumas. Additionally, patients on medication such as glucocorticoids, anticonvulsants and antipsychotics and those who did not complete the questionnaire adequately were also excluded.

This was a cross-sectional study that included administration of a questionnaire,[22,23] a general physical examination and a physical examination specific to the musculoskeletal system by a trained professional. Socioeconomic categories were assigned using the classification published by the Brazilian Association of Market Research Institutions (ABIPEME - Associação Brasileira dos Institutos de Pesquisa de Mercados).[24]

The questionnaire underwent a pilot study with 30 consecutive adolescents (15 obese and 15 healthy-weight) who were tested and then retested 10 days later during August and September of 2008, in order to evaluate response reliability.

The questionnaire was developed for an earlier study conducted by the same research team with adolescents at a private school in the city of São Paulo and has been published and validated.[20,22,23] The questionnaire is self-administrated and covers the following details: demographic data, participation in sports, painful musculoskeletal symptoms during the previous 3 months and time spent using computers and playing videogames.[22,23] The questionnaire contains 70 questions plus a diagram of a body on which respondents are asked to indicate the location of their musculoskeletal pain if they had answered "yes" to the question asking about pain in any location during the previous 3 months. Respondents were also explicitly asked whether they suffered from any of the following specific types of musculoskeletal pain: cervical pain, pain in upper limbs, chest pain, pain in trapezoid muscles, lumbar pain or lower limb pain.[22] With regard to computer usage, the respondents were asked about their computer usage, the availability of a computer at their home, whether they had their own computer and whether they had a portable computer (laptop). Additionally, they were asked what age they were when they started using a computer (in years), how long they spent using a computer on weekdays, on Saturdays and Sundays and on the day before answering the questionnaire. The same data were collected for use of videogames and handheld videogames (Game Boy, etc.).[20]

The general physical examination included calculating BMI (weight in kilos divided by the square of height, kg/m^2) and measuring waist circumference (in centimeters). Systolic (SBP) and diastolic (DBP) blood pressure were measured. Systemic arterial hypertension was defined as SBP and/or DPB greater than or equal to the 95th percentile for the subject's sex, age and height.[25]

The following syndromes were diagnosed or ruled out during the musculoskeletal examination: juvenile fibromyalgia, BJHS, myofascial syndrome, tendinitis, bursitis and epicondylitis. An orthopedic examination of the spine and lower limbs was also conducted in order to diagnose or rule out: scoliosis, *genu valgum*, *genu varum*, *genu recurvatum*, tight quadriceps, tight ischiotibials and *hallux valgus*.[26]

Juvenile fibromyalgia was diagnosed according to the American College of Rheumatology criteria.[27] Joint hypermobility (JH) was diagnosed according to the criteria proposed by Beighton.[22] Benign joint hypermobility syndrome was defined as JH plus musculoskeletal pain and five of the nine criteria. Myofascial syndrome was diagnosed on the basis of active trigger points, which in turn are defined as painful points in taut bands of muscle fibers. If pressured, these points induce reported pain that is reproducible and that affects specific places for each muscle.[22]

In addition to these investigations, during the musculoskeletal examination, patients were observed in the supine position with their hips at 90º and diagnosed with tight ischiotibials if knee extension was less than 15º. Quadriceps flexibility was tested with the knee fully extended and the anterior surface of the thigh against the contact surface. Quadriceps were classed as tight if the calves did not reach the gluteus.[26]

For statistical analysis, continuous variables were converted to medians and ranges and categorical variables into frequencies and percentages. GraphPad StatMate 1.01 was used to calculate the sample size needed to detect differences greater than or equal to 20% in the prevalence of musculoskeletal pain. The test-retest reliability of the questionnaire was verified using the kappa index. Medians were compared using the Mann-Whitney test to detect differences between obese and healthy-weight adolescents and between obese adolescents with pain and obese adolescents free from pain. Fisher's exact test and the chi-square test were used for categorical variables and results where p was ≤ 0.05 were considered statistically significant.

Results

The kappa index for test-retest was 0.724, demonstrating excellent reliability for the adolescents' responses.

The prevalence of at least one type of musculoskeletal pain and at least one musculoskeletal syndrome were similar for obese and healthy-weight subjects. Chest pain and epicondylitis were significantly less frequent among obese than controls. At least one orthopedic condition, tight quadriceps and *genu valgum* were significantly more prevalent among obese adolescents than controls (Table 1). Twenty-six percent of the obese adolescents and 27% of the controls took part in sport more than twice a week (p = 1.0).

The results for use of computers, videogames and handheld videogames for obese vs. healthy-weight adolescents are given in Table 2. Availability of a computer at home and computer use on the previous day were both significantly less frequent among the obese adolescents. Furthermore, median age when first used computers, the time spent using computers on the previous day, on Saturdays and on Sundays were all significantly lower for the obese subjects. There were no differences between the two groups in terms of playing with videogames or handhelds (Table 2).

As would be expected, median BMI and waist circumference were significantly greater among obese adolescents (29.45 [23.7-45.4] vs. 18.8 [14.8-24.1] kg/m^2, p = 0.0001; and 95 [69.5-123] vs. 69 [55-83] cm, p = 0.0001; respectively). Furthermore, median systolic and diastolic blood pressures were significantly higher among obese adolescents than healthy-weight subjects (110 [80-140] vs. 100 [70-130] mmHg, p = 0.0001; and 70 [50-90] vs. 60 [40-80] mmHg, p = 0.0001; respectively). Arterial hypertension was observed in 21% of obese vs. 3% of healthy-weight subjects (p = 0.0004).

With regard to the comparisons made between obese adolescents who reported pain and those who did not, female obese adolescents were more likely to suffer pain than male obese adolescents (59 vs. 39%, p = 0.048). While musculoskeletal syndromes were more common among the obese adolescents with pain, there was no difference between them and the obese adolescents who were free from pain. Four obese adolescents had tendinitis/epicondylitis, but did not report pain on their questionnaires. Rates of orthopedic disorders were similar for obese adolescents with and without pain (Table 3). There were no statistical differences between these two groups for BMI, waist circumference, blood pressure or sporting activities (p > 0.05).

There were no significant differences between obese adolescents with and without pain in terms of use of computers, videogames or handhelds (Table 4).

Discussion

This is the first study to have conducted an extensive investigation of pain, locomotor system disorders and using computers and playing videogames in obese and healthy-weight adolescents.

One of the strong points of this study is the use of a self-report questionnaire containing objective questions in combination with a diagram of the body for respondents to indicate the location of the pain they were reporting.[20,22,23] In order to reduce the effects of memory bias, respondents were asked to report on musculoskeletal symptoms suffered during the previous 3 months, unlike other authors, who chose to use a 1-year recall period.[13] Another relevant

Table 1 - Demographic data, musculoskeletal syndromes and pain and orthopedic disorders in obese and healthy-weight adolescents

Variables	Obese (n = 100)	Healthy-weight (n = 100)	p
Demographic data			
Current age, years	12.6 (10-18.2)	13 (10-19)	0.051
Female	48 (48)	60 (60)	0.089
Socioeconomic classes C and D	71 (71)	62 (62)	0.231
Musculoskeletal pain	44 (44)	56 (56)	0.09
Cervical pain	6 (6)	10 (10)	0.435
Upper limb pain	3 (3)	10 (10)	0.082
Chest pain	2 (2)	13 (13)	0.005
Trapezoid pain	16 (16)	17 (17)	1.0
Lumbar pain	0 (0)	4 (4)	0.121
Lower limb pain	23 (23)	22 (22)	1.0
Musculoskeletal syndromes	12 (12)	16 (16)	0.541
Juvenile fibromyalgia	0 (0)	1 (1)	1.0
BJHS	0 (0)	2 (2)	0.497
Myofascial syndrome	0 (0)	1 (1)	1.0
Tendinitis	9 (9)	3 (3)	0.134
Epicondylitis	3 (3)	11 (11)	0.027
Bursitis	0 (0)	0 (0)	1.0
Orthopedic conditions	98 (98)	76 (76)	0.0001
Scoliosis	30 (30)	33 (33)	0.761
Tight quadriceps	89 (89)	44 (44)	0.0001
Genu valgum	87 (87)	24 (24)	0.0001
Genu varum	1 (1)	8 (8)	0.0349
Genu recurvatum	1 (1)	0 (0)	1.0
Tight ischiotibials	6 (6)	1 (1)	0.054
Hallux valgus	1 (1)	0 (0)	1.0

Results are shown as n (%) or median (range).
BJHS = benign joint hypermobility syndrome.

Table 2 - Results for computer use, and playing videogames and handheld videogames in obese vs. healthy-weight adolescents

Variables	Obese (n = 100)	Healthy-weight (n = 100)	p
Computer			
Computer use	69 (69)	79 (79)	0.107
Computer at home	54 (54)	68 (68)	0.042
Uses own computer	24 (24)	36 (36)	0.064
Uses own laptop	8 (8)	14 (14)	0.233
Used computer on previous day	32 (32)	48 (48)	0.015
Age when started using a computer*	10 (5-15)	11 (5-16)	0.01
Time used previous day†	30 (0-360)	60 (0-720)	0.0001
Time used on Saturdays†	1 (0-720)	60 (0-600)	0.001
Time used on Sundays†	0 (0-720)	30 (0-720)	0.02
Use on weekdays‡	2 (0-7)	3 (0-7)	0.077
Videogames			
Plays videogames	39 (39)	43 (43)	0.605
Has videogame at home	32 (32)	35 (35)	0.617
Played videogame previous day	12 (12)	12 (12)	1.0
Handheld videogames			
Plays handheld videogames	2 (2)	11 (11)	0.003
Played handheld game on previous day	2 (2)	3 (3)	1.0

Results are n (%) or median (range).
* In years.
† In minutes.
‡ In days.

feature is the high kappa index for the pilot study test-retest,[28] which indicates excellent response reliability for this group.[28]

This study detected a high prevalence of reported musculoskeletal pain among both obese and healthy-weight adolescents, particularly lower limb and trapezoid pain. Another study conducted by our research team found a 40% prevalence of musculoskeletal pain among healthy-weight adolescents.[22] In the United States, 61% of 135 obese children and adolescents reported at least one musculoskeletal pain, but that study did not include a healthy control group.[9]

The pain reported by obese and healthy-weight adolescents was more likely to be acute, transitory and localized and may also have been overestimated. The physical examination conducted to diagnose musculoskeletal

Table 3 - Demographic data, musculoskeletal syndromes and orthopedic disorders for obese adolescents with pain vs. obese adolescents free from pain

Variables	Obese, in pain (n = 44)	Obese, free from pain (n = 56)	p
Demographic data			
Current age, years	12.5 (10-19)	12.7 (10.2-17.2)	0.692
Female	26 (59)	22 (39)	0.048
Socioeconomic classes, C and D	32 (73)	39 (70)	0.829
Musculoskeletal syndromes	8 (18)	4 (7)	0.124
Juvenile fibromyalgia	0 (0)	0 (0)	1.0
BJHS	0 (0)	0 (0)	1.0
Myofascial syndrome	0 (0)	0 (0)	1.0
Tendinitis	6 (14)	3 (5)	0.176
Epicondylitis	2 (4)	1 (2)	0.581
Orthopedic conditions	44 (100)	54 (96)	0.502
Scoliosis	11 (25)	19 (34)	0.384
Tight quadriceps	39 (89)	50 (89)	1.0
Genu valgum	41 (93)	46 (82)	0.1380
Genu varum	1 (2)	0 (0)	0.44
Genu recurvatum	1 (2)	0 (0)	0.44
Tight ischiotibials	1 (2)	5 (9)	0.225
Hallux valgus	1 (2)	0 (0)	0.44

Results are shown as n (%) or median (range).
BJHS = benign joint hypermobility syndrome.

Table 4 - Results for computer use, and playing videogames and handheld videogames in obese adolescents with pain vs. obese adolescents

Variables	Obese, in pain (n = 44)	Obese, free from pain (n = 56)	p
Computer			
Computer use	30 (68)	39 (70)	1.0
Computer at home	24 (54)	30 (54)	1.0
Uses own computer	12 (27)	12 (21)	0.638
Uses own laptop	6 (14)	2 (4)	0.133
Used computer on previous day	12 (27)	20 (36)	0.396
Age when started using a computer*	10 (5-10.8)	10 (3-15)	0.734
Time used previous day†	20 (0-360)	30 (0-300)	0.558
Time used on Saturdays†	1 (0-720)	45 (0-720)	0.14
Time used on Sundays†	1 (0-720)	30 (0-720)	0.646
Videogames			
Plays videogames	17 (39)	22 (39)	1.0
Has videogame at home	16 (36)	16 (29)	0.518
Plays own videogame	9 (21)	12 (21)	1.0
Played videogame previous day	5 (11)	7 (13)	1.0
Handheld videogames			
Plays handheld videogames	1 (2)	1 (2)	1.0
Played handheld on previous day	1 (2)	1 (2)	1.0

Results are n (%) or median (range).
* In years.
† In minutes.

syndromes (which habitually include painful chronic diseases) only detected abnormalities in 18% of the obese adolescents who reported pain. Only one subject, a healthy-weight adolescent with juvenile fibromyalgia, complained of chronic pain, here defined as pain lasting longer than 3 months.

Another interesting feature was that localized orthopedic disorders, particularly tight quadriceps and *genu valgum*, were observed among the obese adolescents, as reported by other studies.[10-12] Many of these adolescents described musculoskeletal pains which are likely to intensify if obesity is maintained, leading to biomechanical damage to the locomotor system.[6] If obesity is maintained into adulthood, the effort needed for support is increased and osteoarthritis may set in, with erosion of knees and hips,[7,11] in addition to increased risk of fractures, epiphysiolysis[10] and *genu varum*.[7] As these orthopedic disorders increase the tendency towards physical inactivity, they contribute to perpetuating these patients' abnormal weight gain.[5]

Exposure of young people to electronic devices is a phenomenon that is increasing globally,[20] as demonstrated in this study. Interestingly, obese subjects used computers and handheld videogames *less* than healthy-weight adolescents and only greater time spent playing videogames on Sundays was associated with pain among these patients.

The only factor associated with musculoskeletal pain among obese adolescents was female sex, in agreement with other studies.[15,19,22] The medical literature indicates that females have different perception of pain from males, and differ in the manner in which they relate to pain, possibly resulting in increased reporting of pain. Furthermore, females have a lower pain threshold, a lower pain tolerance[22] and a greater prevalence of pain in all age groups.[15,19,22]

This study suffers from certain limitations, including the lack of a psychological assessment. Emotional disorders can cause pain[19] and are also factors associated with adolescent obesity.[7]

The obese patients in this study also had arterial hypertension and large waist circumference measurements, as widely reported in the literature.[1,23] The excessive weight does not appear to have contributed to complaints of musculoskeletal pain, but this does not negate its cardiovascular implications.

Supervised or group physical activity programs can improve pain, encourage the development of muscle strength and improve self-esteem and quality of life, as has been shown with other chronic pediatric diseases.[29,30] Ergonomics and muscle relaxation should also be taught at school.[23]

In conclusion, obesity can damage the osteoarticular system at the start of adolescence, particularly the lower limbs. Obese female adolescents reported more musculoskeletal pain, suggesting that programs should be developed specifically for females. Longitudinal studies that evaluate the impact of obesity on adolescents' musculoskeletal biomechanics are needed.

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