Joint hypermobility, growing pains and obesity are mutually exclusive as causes of musculoskeletal pain in schoolchildren

F. Sperotto, M. Balzarin, M. Parolin, N. Monteforte, F. Vittadello, F. Zulian

Department of Paediatrics, University of Padua, Padua, Italy.

Abstract

Objective

Chronic musculoskeletal pain (MSP) is common in children and can be due to several non-inflammatory conditions such as the benign joint hypermobility syndrome (BJHS), and growing pains (GP). We evaluated frequency, risk factors and causes of MSP in a large cohort of healthy schoolchildren.

Methods

We conducted a cross sectional study in a cohort of healthy schoolchildren, aged 8–13 years, by collecting information and performing a physical examination. The anamnesis was focused on family history for MSP, presence and sites of MSP interfering with the regular daily activities during the previous 6 months and presence of GP. Physical examination included body mass index, pubertal stage and musculoskeletal examination focused on the presence of hypermobility according to the Beighton criteria.

Results

Two hundred and eighty-nine schoolchildren, 143 females and 146 males, participated in the study. Chronic MSP occurred in 30.4% of subjects, BJHS occurred in 13.2%. GJH was more frequent in symptomatic subjects than in asymptomatic ones (p=0.054). Symptomatic subjects were more frequently pre-pubertal than pubertal (p=0.006). In general, GP, BJHS and obesity (OB) were mutually exclusive as causes of MSP as, among 88 symptomatic subjects, 52.3% had GP, 40.9% presented BJHS, 4.5% were OB and only two (2.3%) presented both BJHS and OB. After puberty, GP persisted in 66.7%, BJHS in 26.7% and in association with OB in 6.7%.

Conclusion

Approximately one third of schoolchildren suffer from MSP. BJHS, GP and OB are mutually exclusive as causes of MSP in schoolchildren. Pubertal stage plays an important role in the physiopathology of this condition.

Key words

musculoskeletal pain, joint instability, obesity, puberty

Francesca Sperotto, Student
Marta Balzarin, MD
Mattia Parolin, MD
Nadia Monteforte
Fabio Vittadello, MSc,
Francesco Zulian, MD

Please address correspondence and reprint requests to:
Francesco Zulian, MD,
Dipartimento di Pediatria,
Università di Padova,
Via Giustiniani 3,
35128 Padova, Italy.
E-mail: zulian@pediatria.unipd.it

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Introduction

Musculoskeletal pain (MSP) is quite common in children and can be due to several non-inflammatory conditions such as growing pains (GP) or generalised joint hypermobility (GJH) (1-3).
GP is a benign condition characterised by cramping limb pain, typically occurring in the evening or at night-time, lasting less than 72 hours with normal physical examination and whose physiopathology is still unknown (2, 4, 5).
GJH is defined as a generalised increased joint range of motion and can be identified with the Beighton criteria (6). When GJH is associated with MSP, the condition is called "benign joint hypermobility syndrome" (BJHS) (7), where the term "benign" wants to differentiate this from other more severe and disabling conditions such as Elhers-Danlos syndrome, Marfan syndrome and osteogenesis imperfecta, having joint laxity and hypermobility as common denominator (8-10). Certainly an overlap exists, so that some authors identify BJHS as Elhers-Danlos syndrome, of the hypermobility type (11).
BJHS should be therefore considered part of GJH, which is mostly asymptomatic and more common. Hypermobility is, in fact, a physiological feature of many children during the early infancy and may be related to the progressive collagen maturation process (8, 9). For this reason, BJHS can be correctly diagnosed only after 8 years of age (6, 7).
Aim of the present study was to evaluate prevalence and clinical features of chronic non-inflammatory MSP in schoolchildren and to analyse causes and possible risk factors associated with this condition.

Patients and methods

The study was conducted from April to June 2009. The study population consisted of healthy schoolchildren, aged 8–13 years, attending four schools (three primary schools and one middle school) in the district of Padua, Italy.
After the approval by the Ethics Committee of the Padua District Health Authority and by the schools directors, a consent form, describing purposes and procedures of the study, was distributed to the schoolchildren's parents. Once both parents gave informed written consent and children assented to research, the subjects entered the study. On the basis of preliminary parent's information, children with past or present signs of any neurologic, skeletal, metabolic or autoimmune diseases were excluded.
The past medical history from all participants was collected and the physical examination was carried out by a team of three pediatricians, well trained in joint assessment helped by a specialised nurse. All physicians followed the same protocol, examined children with the help of a goniometer to investigate GJH and filled a standardised form to collect information on symptoms and risk factors.
The clinical assessment consisted of collection of information on: positive family history for MSP conditions or complaints, in order to investigate possible familial predisposition for GP or BJHS; presence and sites of child's chronic MSP, defined as continuous or recurrent pain lasting more than 3 months, according to the International Association for the Study of Pain (12), during the previous 6 months, with an intensity so high to interfere with the regular activities of daily living; type of sport activities, age and gender. Sport activities with articular overloading are, for example, volleyball, basketball, football, rugby, tennis etc., those without articular overloading are essentially swimming and cycling. History of GP, defined as cramping bilateral limb pain typically occurring in the evening or at night and associated with a normal physical examination (2, 4, 5) was also explored.
General physical examination was focused on weight, height, body mass index (BMI) and pubertal stage evaluation. OB was defined as a BMI greater than 95th percentile for age, while overweight was defined as a BMI between the 85th and the 95th percentile for age, plotted on the Italian version of NCHS (National Centre for Health Statistics) curves (13). The pubertal stage was assessed by the presence of secondary signs of pubertal development. For females, puberty was defined by the stage of breast development (Tanner stage

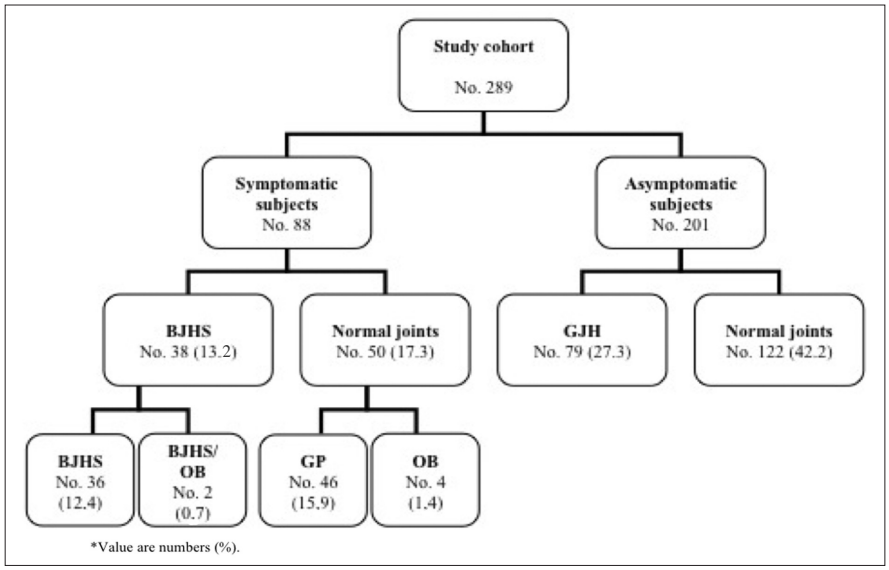

Fig. 1. Prevalence of musculoskeletal complaints in children with or without generalised joint hypermobility.

Table I. Clinical features and risk factors for musculoskeletal pain in schoolchildren.

	Symptomatic (n=88)	Asymptomatic (n=201)	*p*-value
Sex (F:M)	0.7	1.1	0.054
Age (years)	10.4	10.8	0.088
Pre-pubertal	73 (83.0)	135 (67.2)	0.006
Pubertal	15 (17.0)	66 (32.8)	
Normal BMI	59 (67.0)	151 (75.1)	0.156
Overweight/obesity	29 (33.0)	50 (24.9)	
Joint hypermobility	38 (43.2)	79 (39.3)	0.054
Sport with articular overloading	66 (75.0)	153 (76.1)	0.979
Sport w/o articular overloading	10 (11.4)	22 (10.9)	
No sport	12 (13.6)	26 (12.9)	

*Values are the number or mean (%).

≥3) and menarche. For males, puberty was defined in presence of a testicles volume ≥12 ml and presence of pubic and underarm hair (14, 15).

The rheumatologic examination was mainly focused on the presence and degree of joint laxity, according to the Beighton's score, using the 4/9 cut-off to define a condition of GJH (6). Presence of enthesopathy, arthritis or fibromyalgia was carefully searched according to the current criteria.

Statistical analysis

Descriptive statistics were performed to analyse the data. We calculated the prevalence of children with MSP in our sample and the Clopper-Pearson method was used to calculate the 95% confidence interval (CI). The statistical significance of differences between the two groups of symptomatic and asymptomatic patients was assessed by the Pearson's chi-square test (or Fischer's exact test) for categorical variables. Continuous variables were compared by the Student's *t*-test for independent samples or by the Mann-Whitney rank-sum test, as appropriate.

The risk factors possibly associated with the presence of MSP were sex, age, pubertal stage, BMI, GJH and type of sport activity. Those who resulted significant at the univariate analysis were included in a logistic regression model (16), in order to identify possible prognostic factors. For each analysis, the statistical significance was defined with a p-value <0.05 (2-tailed test). All data were processed using the statistical software SPSS 14.0.

Sample size needed for estimating the prevalence of children with MSP (primary endpoint) was computed by using single proportion sample size calculation formula, assuming 95% confidence level, 5% margin of error, and 25% expected prevalence of MSP. Accordingly, a sample size of 290 children was computed and therefore included in the study.

Results

Two hundred and eighty-nine schoolchildren, 143 females and 146 males, with F:M=1:1, entered the study. The mean age was 10.6 years (range 8–13), 285 (98.6%) were Caucasian, 4 (1.4%) non-Caucasian. Two hundred and eight (72%) were in pre-pubertal stage, 81 (28%) were pubertal.

MSP was referred by 88 subjects (30.4%, 95%CI 25.2%–36.1%) and in 38 (13.1%, 95%CI 9.5%–17.6%) it was associated with GJH. This means that 43.2% of the subjects with MSP had concomitant GHJ and were, by definition, affected by BJHS (Fig. 1, Table I). Fifty subjects (17.3%), with either GP or were obese, had normal joint examination. No patient presented enthesopathy, arthritis or fibromyalgia.

There was no significant difference between the mean age of symptomatic and non-symptomatic children. The most common involved sites (90.9% of subjects) were the lower limbs (85.2%) and the spine (11.4%). The highest frequency of MSP was reported by 9 years old females and by 10 years old males.

Subjects with symptoms were more frequently pre-pubertal than pubertal (83.0% *vs*. 17.0%, p=0.006) and males were more frequently affected than females (59.1% *vs*. 40.9%) (Table I). In pre-pubertal age, male had an higher incidence of MSP (42.6% *vs*. 27.0%, p=0.02), while after puberty female were more affected, although not significantly.

Symptomatic children showed a higher frequency of GJH than the asymptomatic ones, and this difference was close to

statistical significance (p=0.054). Overweight or OB was found in 29 (33%) symptomatic subjects and, in particular, pre-pubertal males had a significantly higher BMI than pre-pubertal females (p=0.003) (Fig. 2). OB was found in 6 (6.8%) symptomatic subjects and was unrelated with sex or pubertal stage.

Sport activities, with or without articular overloading, did not represent a significant risk factor for the occurrence of MSP (Table I).

GP, BJHS and OB were mutually exclusive as causes of MSP as, among the 88 symptomatic children, 46 (52.3%) had GP, 36 (40.9%) presented BJHS, 4 (4.5%) were OB and only 2 (2.3%) presented both BJHS and obesity (Fig. 1).

When we stratified the analysis according to the pubertal stage, we did not observe significant changes in the relative frequency of these three conditions in the 73 pre-pubertal subjects. After puberty 10 out of 15 subjects (66.7%) presented GP, 4 (26.7%) had BJHS and only 1 (6.7%) had BJHS and OB. Indeed, these conditions were equally distributed in both gender except for GP that in pre-puberty was more frequent in males (75.0% *vs*. 25.0%) and BJHS that, after puberty, affected only females.

Logistic regression analysis (backward stepwise), including all variables which resulted significantly associates to BJHS in the univariate analysis, confirmed that the pre-pubertal status was predictive factor for BJHS (OR 2.34, 95%CI 1.25–4.41; p=0.008).

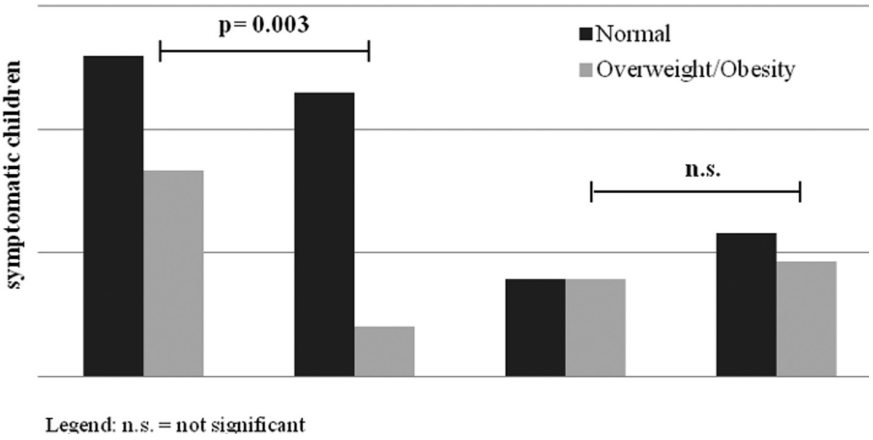

Fig. 2. Distribution of symptomatic subjects according to the body mass index, pubertal stage and sex.

Discussion

Chronic MSP, in its continuous or recurrent form, is quite common in childhood, but its origin is often difficult to establish because of the confusing terminology and sometimes the variety of health professionals involved in its management (2, 3, 17). The analysis of the existing studies on prevalence of MSP in children and adolescents shows heterogeneous results (17, 18). Chronic pain lasting more than 6 months was reported in one study in 30.8% of schoolchildren (19). More recently, a survey among teenagers has reported that as many as 83% of females and 68% of males experienced at least one episode of limb or spine pain during the preceding 6 months (20). This heterogeneity is due to the different definition of chronic MSP, different instruments adopted to collect data (children *vs*. parental filled questionnaire, survey *versus* clinical examination), referral bias (community-based *versus* hospital-based studies) and variability in the estimation of pain levels.

To properly increase the reliability of our study, we combined the collection of information on the past medical history with the clinical examination of each subject performed by a team of specialists. The rationale of this choice is the evidence that both observational and self-report measures are essential in pain assessment (21). In this way, we could confirm that one third of schoolchildren suffers from chronic MSP, mostly affecting lower limbs and spine, as previously reported for Caucasian children (3, 22, 23). Despite in the literature the incidence of chronic MSP increases with age (24-26), and peaks at 12–14 years (27), our study showed the highest frequency in 9–10 years old subjects. Considering these peak ages, MSP is probably correlated with the skeletal structural modifications preceding the growth spurt. Moreover, a significant reduction of the symptoms was found in post-pubertal subjects and was more significant in males than in females. This probably supports the role of the sex hormones in the stabilisation of the joint structure (28).

It is well known that MSP is not a homogeneous condition but represents the result of several different factors. In our study, GP was found to be responsible of MSP in 52.3% of symptomatic subjects and GJH in 43.2%. Unexpectedly, OB was found to be another condition associated with MSP, although at a less extent (4.5%).

In the developed countries, GP affects approximately 21% of 9–13 years aged children (29), although they may occur up to age of 19 (2, 30). In our population, GP occurred in 15.9% of the subjects and this was similar to what reported in other studies (29, 31, 32). Moreover, a significant persistence of GP after puberty was found in 1 out of 8 subjects.

Among all known causes of chronic pain, GJH is often overlooked, particularly by general practitioners or other health professionals with poor training in rheumatology. GJH is defined as generalised increased joint range of motion and identified by the Beighton criteria (6). Although GJH does not seem to affect the functional ability and the physical and psychosocial weel being of children, this is not true when GJH is associated with MSP (33). In this case, as already mentioned, the condition is called BJHS, where the term “benign” wants to differentiate this from other more severe conditions such as Elhers-Danlos syndrome or Marfan syndrome. In our study, BJHS was found in 13.2% of schoolchildren while, in general, as many as 40.5% satisfied the Beighton criteria for GJH. Previously, the prevalence of BJHS in the general paediatric population has been reported with frequency ranging between 7.4% and 9% (25, 34). This variability is certainly due to the different age of the subjects cohorts, as the incidence decreases

with increasing of the age (6), and also to the different Beighton's score cut-off used to define GJH (25, 34). BJHS has often a negative impact on the physical and psychological well-being of young individuals and their families, therefore its early identification is essential to address the proper treatment, which consists of physical therapy, propioceptive enhancement and cognitive-behavioural therapy (1, 10, 35).

Our study also revealed that OB alone is responsible of MSP in 4.5% of the symptomatic patients and that an overweight status may represent a potential risk factor for MSP, especially for prepubertal males or once associated with GJH. OB is an emerging problem in western countries and a significant risk factor for the development of chronic degenerative diseases early in adulthood. Previous studies showed that OB in children may be associated with MSP, since it may cause misalignments of the skeletal bones due to the excessive weight and joint capsule stretching (36). Indeed, a positive relationship between BMI and musculoskeletal pain was reported (37).

The pubertal stage was found to be another important factor to be considered. In fact, while GP was responsible for almost half of MSP in pre-pubertal stage, it was found in as many as two thirds of symptomatic pubertal subjects. Conversely, BJHS also persists after puberty but causes MSP in only one third of the subjects.

The most interesting finding emerged from our study, is that GP, BJHS and OB resulted to be mutually exclusive conditions. This means that, in the majority of patients, MSP is related to only one of these aspects. This finding has an immediate implication in the daily clinical practice. Dealing with a child with MSP, we should first exclude GP by an accurate clinical history reporting bilateral lower limb pain with evening or nocturnal onset, inconstancy and frequent positive family history for GP. The physical examination of the joints, focused on joint laxity, allows for the identification of BJHS when the Beighton criteria are satisfied. In absence of hypermobility or GP, we should assess the BMI in order to define an overweight or OB state. BMI, however, should be assessed also in presence of hypermobility because, in the rare cases in which they are associated, they both contribute to cause pain.

This simple step-by-step approach allows to properly address the diagnosis and to choose the right treatment that, for BJHS or OB, includes life-style changes, focused on diet control, proper physical activity habits and specific physical rehabilitation programme. On the contrary, in case of GP, which is a benign condition with spontaneous resolution, reassurance of patients and their parents is essential in order to avoid useless laboratory and treatment procedures.

Of course, the present study has strengths and weaknesses. The relative small number of pubertal subjects in comparison to the pre-pubertal cohort may represent a limitation, since conditions such as fibromyalgia might have been found in a larger cohort of teenagers. Indeed, a proportion of patients who agreed to take part to the study might probably have had MSP and this may have represented a selection bias. One of the strengths was that, unlike previous reports (19, 20, 22), our study was not based on a survey through a questionnaire, but all patients were carefully evaluated by physicians with good paediatric rheumatology training. Indeed, we intend to follow this cohort of pre- and post-pubertal patients prospectively up to adulthood, in order to evaluate possible changes in their rheumatologic complaints.

Conclusion

In conclusion, approximately one third of schoolchildren suffers from MSP. These subjects should be carefully evaluated for the presence of GP, GJH and OB, which are mutually exclusive as causes of MSP. Pubertal stage plays an important role in the physiopathology of this condition.

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