

ORIGINAL ARTICLES

Prevalence, characteristics, and impact of spinal and lower limb recurrent pain at age 13

Rodrigues E¹, Moura Bessa I¹, Brochado G², Carvalho P³, Talih M⁴, Pires C⁴, Lucas R⁴**ABSTRACT**

Objectives: To compare spinal and lower limb pain in adolescents regarding prevalence, characteristics, causes, and impact.

Methods: A descriptive cross-sectional study was conducted in 13-year-old adolescents (female n=2210; male n=2353) from the Portuguese Generation XXI birth cohort. Data were collected between 2018 and 2020 through personal interviews by applying the Luebeck Pain Questionnaire. The pain features examined in each anatomical location (back and lower limb) were recurrence, duration, frequency, intensity, perceived causes, and impact on school and leisure activities. Frequencies and the Chi-square test were used.

Results: Questionnaires from 4563 adolescents were analysed, 57.9% had pain in the last three months (main pain in the spine: 11.6%; main pain in the lower limb: 29.0%). Of those, 69.4% and 62.4% reported recurrent pain in the spine and lower limb, respectively. Recurrent pain was more frequent in girls than in boys (spine: 80.0%; 57.0%; lower limb: 70.4%; 58.1% respectively). Pain lasted more than three months in most adolescents (spine: about 60%; lower limb: above 50%); frequency was similarly high in both regions and both sexes (girls: 47.0%; boys: 45.7% in the spine; girls: 45.7%; boys: 40.3% in the lower limb); intensity was rated as high by girls (spine: 45.5%; lower limb: 47.3%) and moderate by boys (spine: 42.0%; lower limb: 41.0%). The leading causes of pain were daily living activities, both for the spine (girls: 65.9%; boys: 76.5%) and the lower limb (girls: 62.2%; boys: 72.1%). Psychosocial causes were the second most common cause of spinal pain (girls: 25.0%; boys: 21.0%). Other causes of lower limb pain were traumatic (girls: 25.5%; boys: 16.6%) and physical factors (girls: 20.7%; boys: 23.8%). Absences from school (girls: 11.7%; boys: 4.8%) and restrictions of leisure activities (girls: 20.7%; boys: 25.2%) were more related to pain in the lower limb.

Conclusion: More than half of the adolescents reported spinal or lower limb recurrent pain, which presents a higher frequency, higher intensity, and longer duration in the spine. However, lower limb pain led to more concurrent limitations.

Keywords: Chronic musculoskeletal pain; Cohort study; Adolescence; Back pain; Lower limb pain.

INTRODUCTION

Pain in children and adolescents has been identified as a significant public health issue due to its concurrent and future implications¹⁻³. In children and adolescents, pain is usually associated with a higher risk of depression and anxiety, school absenteeism⁴, social isolation⁵ and reduced quality of life^{2,6,7}. It is also accepted that back pain

tends to persist from adolescence into adulthood⁸, suggesting that pain patterns can be established early in life⁹.

Back pain in youth can coexist with pain in the upper limbs and lower limbs², affecting important regular activities such as schoolwork and participation in physical activities¹⁰⁻¹³. Evidence suggests that most neck and back pain in children is of non-specific origin^{14,15}, a diagnosis by exclusion that includes heterogeneous presentation and symptoms not attributable to a specific organic lesion and has an unfavourable prognosis¹⁶. On the other hand, pain in the lower limb more commonly has an identifiable cause (e.g., accidental injuries, joint hypermobility, viral infections, and reactive arthritis)¹⁷ and generally has a favourable prognosis. The prevalence of non-specific back pain in children is uncertain, and it is more common in girls, but according to the Global Burden of Disease Study, musculoskeletal disorders ranked 10th on the list of causes of years lived

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with disability among children aged 5 to 14 worldwide in 2017¹⁸. Back pain in adolescents has been well described^{10, 19}, but little attention has been paid to complaints in the lower limbs, perhaps due to their association with mild trauma resulting from typical physical activity in children. According to the literature²⁰, girls report greater pain intensity, while lower limb pain appears to be more common in boys.

Little is known about whether adolescents report specific and non-specific pains similarly in terms of symptom attributes, perceived triggers, and consequences. This may be relevant to identify predictors of chronic pain development. Therefore, we aimed to estimate the three-month prevalence of recurrent pain in the back and the lower limb in 13-year-old adolescents from a population-based cohort and to compare those pains according to duration, frequency, and intensity, as well as the adolescents' perceptions of their causes and effects on daily activities.

METHODS

Study design and participants

A cross-sectional study was conducted in Porto, Portugal, on adolescents of both sexes, aged 13 years, belonging to the Generation XXI cohort^{21, 22}. Participants were recruited at birth in 2005/06 from the five public-level III maternities in the metropolitan area of Porto, Portugal. Families were followed up regularly at ages 4, 7, 10 (through parents' reports), and 13 years (through adolescents' self-reports). For the present work, data from the cohort were collected between August 2018 and March 2020 using a Portuguese version of the Lübeck pain screening questionnaire, which was applied to adolescents by trained interviewers as part of the face-to-face assessment at age 13. This evaluation wave was suspended early in March 2020 due to the COVID-19 pandemic, after 53% of participants were assessed, whose evaluations were scheduled based on their date of birth. All adolescents who completed the questionnaire were considered eligible. We have previously conducted an analysis of families who did not participate in the 13-years evaluation wave and found that the slight differences found in socioeconomic background did not affect our results on pain related variables²².

This study was conducted according to the Helsinki Declaration and approved by the Ethics Committee of the Institute of Public Health of the University of Porto (CE19132). Carers signed written informed consent forms, and children provided their oral assent. The analysis was performed on a pseudonymised dataset.

Sample characteristics

The variables studied included the demographic char-

acteristics of age and sex assigned at birth. Participants underwent a physical examination conducted by trained health professionals that included an anthropometric assessment obtained while the adolescent stood barefoot in light indoor clothing. Weight was measured to the nearest 0.1 kg using digital scales (TANITA® model TBF 300), and height was measured to the nearest 0.1 cm using a wall stadiometer (SECA®). The body mass index was calculated as the ratio of weight in kg to squared height in m.

Pain history

To assess pain history, a Portuguese adaptation of the Lübeck Pain-Screening Questionnaire²³ (LPQ) for adolescents was used. The LPQ emulates a clinical interview and was designed to be analysed at face value, item by item. Therefore, we also analysed each item separately, after professional translation from the original German version to Portuguese. Although, as for all evaluation instruments, we assessed the questionnaire's face validity in five Generation XXI children and mothers pairs, we are not aware of any further validation of the Luebeck pain screening questionnaire in Portugal. The Portuguese version of the questionnaire can be downloaded from the cohort's website (<https://www.geracao21.com/pt/projeto/#avaliacoes> in tab 13 years).

The LPQ is a cross-cultural multidimensional questionnaire that assesses the occurrence of pain in the last three months, its attributes, perceived causes/triggers, and impact on daily life. The first item of the questionnaire focused on whether the adolescent had had pain in the previous three months. Adolescents who gave a negative answer did not complete the remaining questionnaire. In the case of a positive answer, the adolescent was asked to select all painful anatomical sites (among a list comprising head, back, ears, stomach (abdominal), lower abdomen (pelvic), arms, legs, chest (thoracic), throat, teeth, and other sites) and, from these, identify the site that he or she considered to be his or her main pain. In this study, we selected the spine (back and neck/shoulder - since the neck/shoulder location was not on the list, this was determined by recoding the content of the "other" field) and the lower limbs as the sites of interest. Pain in the spine or lower limbs was considered present when that site was mentioned as the main pain, and, by questionnaire design, the remaining attributes were collected only when the main pain site was recurrent.

The adolescents were also asked if the pain had occurred more than once in the last 3 months, regardless of the cause. Those who answered affirmatively were asked to classify the duration, frequency, and intensity of the main pain. Duration was divided into short (≤ 3 months), medium (3 to 12 months), and long (> 12 months), considering that pain that persists for 3

months or more is classified as chronic²⁴; frequency was divided as low (up to once a month), medium (2 to 3 times a month to once a week), and high (more than once a week); intensity was assessed using a visual analogue scale²⁵ with a score ranging from 0 to 100mm, where 0 means no pain and 100 means maximum pain (“the strongest you can imagine”), being classified as low (< 30 mm), moderate (30 to 59 mm), and high (\geq 60 mm)^{26, 27}. These cut-off points are often used in clinical practice to help define or modify interventions. Furthermore, adolescents were asked to identify the causes of the pain, with the possibility of selecting more than one option, which were classified as: psychosocial causes, which included interpersonal (e.g. quarrels, irritability, family problems, and loneliness), psychological (e.g. new and unfamiliar situations, agitation and nervousness, loneliness, and sadness), family-related (household or interpersonal family problems), and school-related (problems with socialising at school or schoolwork); physical causes (acute or chronic diseases or dysfunctions, treatments, and constitutional or growth-related factors); traumatic causes (e.g. falls); causes related to daily living activities (little sleep, physical effort/sports, watching TV, using computer); and environmental causes (weather and noise); unclassified/undefined causes. Participants were also asked about the impact of the pain on their regular activities, specifically whether it prevented them from attending school or participating in leisure activities.

Analytical approach

Out of the 8647 participants recruited at birth, 4584 were evaluated in person at age 13. Of these, we excluded adolescents who did not complete the pain questionnaire ($n = 21$), resulting in an analytical sample of 4563 (female = 2207; male = 2353). Results are presented stratified by sex in absolute (n) and relative (%) frequencies for categorical variables and as mean and standard deviation for continuous variables. Chi-square was calculated looking for the association between two categorical variables: sex and i) pain in the lower limb, ii) recurrent pain in the lower limb, iii) pain in the spine, and iv) recurrent pain in the spine, and between pain characteristics, perceived causes, and its impact on daily activities and recurrent pain sites (spine vs. lower limb).

RESULTS

Prevalence and sex-based distribution of spinal and lower limb pain

Prevalence estimates were obtained for pain at any anatomical site based on the total number of adolescents,

for main pain in the spine or lower limb based on the total number of adolescents with pain, and for recurrent pain in these two regions based on the total number of adolescents with main pain at each site.

Of the total sample, 2640 (57.9%) adolescents reported pain at any site in the previous three months. Of these, 1073 (40.6%) considered spinal or lower limb pain as their main pain, with the lower limb being more frequent (lower limb: 29.0%; spine: 11.6%).

When spinal pain was reported as the main pain, it was defined as recurrent by 69.4% of the adolescents, and 62.4% of adolescents whose main pain was in the lower limb considered that to be recurrent.

In relation to sex distribution, there were significant differences ($p < 0.001$) in the proportions of boys (38.3%) and girls (20.0%) who reported pain in the lower limb, with boys reporting almost twice as much pain in this region as girls.

Both sexes mentioned spinal pain as their main pain in a similar way. Of the adolescents with the main pain in the spine, 80% of girls and 57% of boys reported recurrence. Regarding recurrent pain in the lower limb, there were also significant differences ($p < 0.001$) in the proportion of boys (58.1%) and girls (70.4%) who reported it, but in this case, it was more frequent in girls.

Characteristics, perceived causes, and impact of spinal and lower limb recurrent pain

Table I presents the anthropometric characteristics of adolescents with recurrent pain in the spine or lower limbs and of adolescents without pain, showing that height, weight, and body mass index were similar across groups.

Table II shows spinal and lower limb recurrent pain characteristics, perceived causes, and impact by sex. The percentages presented are calculated as a proportion of the total number of participants with recurrent pain at each site.

Most adolescents with recurrent pain reported that pain lasted longer than three months, both when the main pain was in the spine (58.6%) and in the lower limb (51.9%). Pain duration in the spine was reported as medium or long (\geq 3 months) by similar proportions in both sexes (girls: 59.1%; boys: 58.1%). In the lower limb, pain lasted longer than three months for most adolescents in both sexes, with a slightly higher percentage in boys (52.8%) than in girls (50.5%).

Recurrent pain frequency was commonly classified as high in both regions (spine: 46.5%; lower limb: 42.5%). High-frequency pain was similar by sex in the spine (girls: 47.0%; boys: 45.7%) and slightly more mentioned by girls (45.7%) than by boys (40.3%) in the lower limb.

TABLE I. SAMPLE CHARACTERISTICS: MEAN AND STANDARD DEVIATION VALUES FOR AGE, HEIGHT, WEIGHT AND BODY MASS INDEX IN ADOLESCENTS WITH RECURRENT PAIN IN THE SPINE, LOWER LIMBS AND WITHOUT PAIN

	Main recurrent pain - Spinal			Main recurrent pain - Lower limb			Without pain		
	Total n = 213	Female n = 132	Male n = 81	Total n = 478	Female n = 188	Male n = 290	Total n = 1923	Female n = 873	Male n = 1050
Age (years)	13.7 (0.3)	13.7 (0.3)	13.7 (0.3)	13.7 (0.3)	13.7 (0.3)	13.7 (0.3)	13.7 (0.3)	13.7 (0.3)	13.7 (0.3)
Height (cm)	160.8 (7.2)	158.9 (5.7)	162.9 (8.0)	160.7 (8.0)	158.7 (6.3)	161.7 (8.6)	159.8 (7.7)	158.3 (6.3)	161.1 (8.5)
Weight (kg)	54.8 (11.3)	54.2 (10.4)	55.5 (12.2)	53.5 (11.5)	53.7 (11.0)	53.3 (11.7)	52.9 (11.9)	53.2 (11.6)	52.8 (12.2)
Body Mass Index (kg/m ²)	21.1 (3.7)	21.4 (3.7)	20.7 (3.6)	20.6 (3.6)	21.3 (3.8)	20.3 (3.5)	20.6 (3.8)	21.1 (4.0)	20.2 (3.7)

Data are expressed as Mean (Standard Deviation)

TABLE II. DISTRIBUTION N (%) OF DURATION, FREQUENCY, INTENSITY OF RECURRING PAIN AND PERCEPTION OF CAUSE AND IMPACT ON THE SPINE AND LOWER LIMBS BY SEX

	Main recurrent pain - Spinal			Main recurrent pain - Lower limb		
	Total	Female	Male	Total	Female	Male
Duration – n (%)						
Short (≤ 3 months)	88 (41.3)	54 (40.9)	34 (42.0)	230 (48.1)	93 (49.5)	137 (47.2)
Medium (3 < months ≤12)	64 (30.0)	45 (34.1)	19 (23.5)	125 (26.2)	50 (26.6)	75 (25.9)
Long (> 12 months)	61 (28.6)	33 (25.0)	28 (34.6)	123 (25.7)	45 (23.9)	78 (26.9)
Frequency – n (%)						
Low (up to once a month)	41 (19.2)	22 (16.7)	19 (23.5)	106 (22.2)	37 (19.7)	69 (23.8)
Medium (2-3 times a month to once a week)	73 (34.3)	48 (36.4)	25 (30.9)	169 (35.4)	65 (34.6)	104 (35.9)
High (more than once a week)	99 (46.5)	62 (47.0)	37 (45.7)	203 (42.5)	86 (45.7)	117 (40.3)
Intensity – n (%)						
Low (VAS < 30mm)	32 (15.0)	16 (12.1)	16 (19.8)	86 (18.0)	25 (13.3)	61 (21.0)
Medium (VAS 30 a 59mm)	90 (42.3)	56 (42.4)	34 (42.0)	193 (40.4)	74 (39.4)	119 (41.0)
High (VAS ≥ 60mm)	91 (42.7)	60 (45.5)	31 (38.3)	199 (41.6)	89 (47.3)	110 (37.9)
Perception of cause (each variable binary, multiple options possible) – n (%)						
Psychosocial	50 (23.5)	33 (25.0)	17 (21.0)	37 (7.7)*	16 (8.5)	21 (7.2)
Physical	36 (16.9)	28 (21.2)	8 (9.9)	108 (22.6)	39 (20.7)	69 (23.8)
Trauma	18 (8.5)	7 (5.3)	11 (13.6)	96 (20.1)*	48 (25.5)	48 (16.6)
Daily living activities	149 (70.0)	87 (65.9)	62 (76.5)	326 (68.2)	117 (62.2)	209 (72.1)
Physical environment	11 (5.2)	7 (5.3)	4 (4.9)	17 (3.6)	13 (6.9)	4 (1.4)
Unknown / Undefined	24 (11.3)	18 (13.6)	6 (7.4)	29 (6.1)*	16 (8.5)	13 (4.5)
Impact on daily activities (each variable binary, multiple options possible) – n (%)						
Absence from school	15 (7.0)	10 (7.6)	5 (6.2)	36 (7.5)	22 (11.7)	14 (4.8)
Restriction of leisure-time activities	35 (16.4)	21 (15.9)	14 (17.3)	112 (23.4)*	39 (20.7)	73 (25.2)

Data are expressed in absolute (n) and relative (%) frequencies; VAS, Visual Analogue Scale; * significantly different from main recurrent pain in the spine p<0,05

Recurrent pain intensity was classified as moderate to high by around 40% of adolescents in both regions, with similar proportions between sexes for moderate

intensity. High intensity was more frequent in girls (spine: 45.5%; lower limb: 47.3%) than in boys (spine: 38.3%; lower limb: 37.9%).

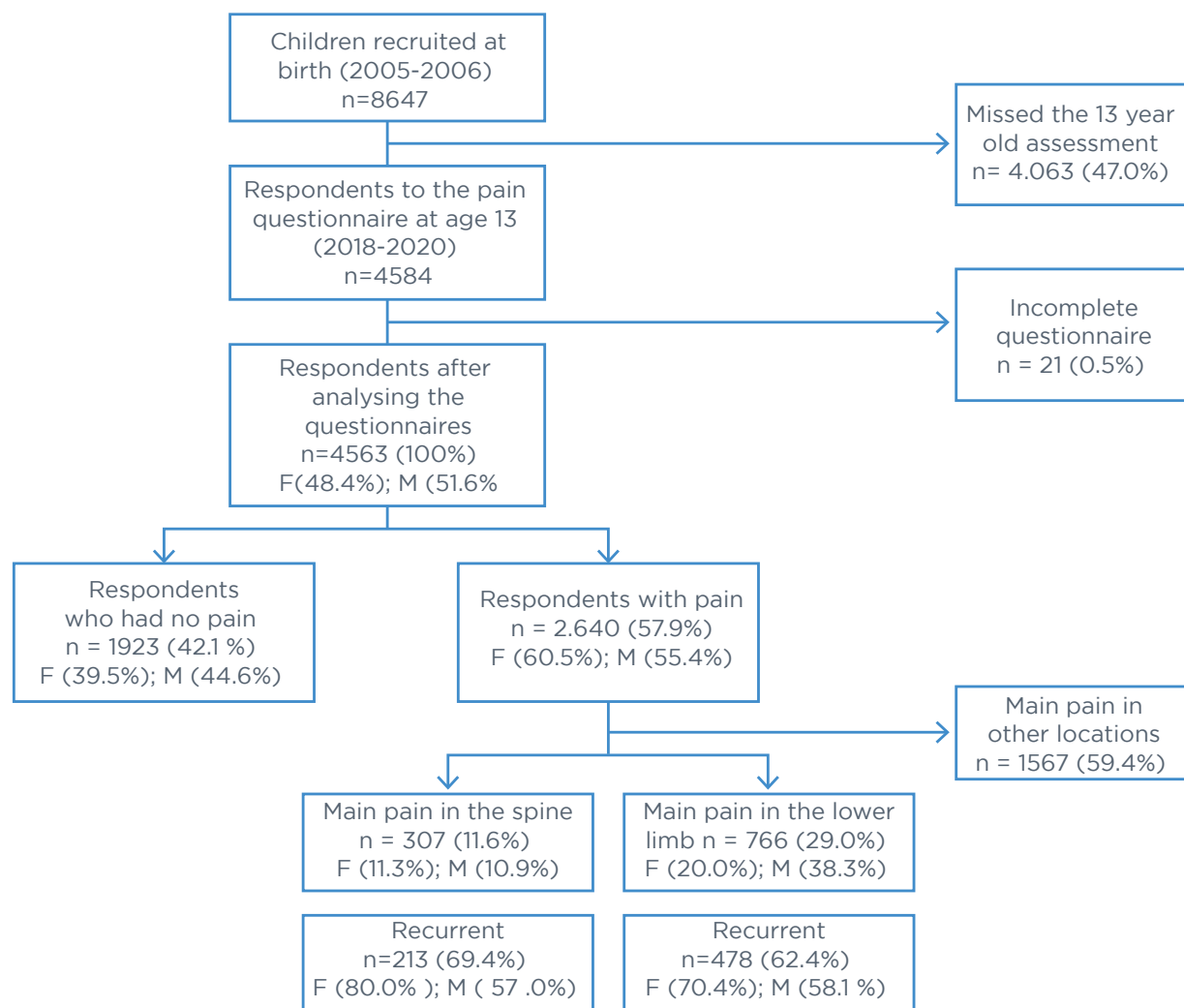


Figure 1. Sample selection flowchart. F: Female (%); M: Male (%).

The most frequently reported causes of pain in both regions were daily living activities (spine: 70.0%; lower limb: 68.2%), followed in the spine by psychosocial (23.5%), physical (16.9%), unknown/undefined (11.3%), and trauma (8.5%). The remaining causes of lower limb pain were physical (22.6%), trauma (22.1%), psychosocial (7.7%), and unknown/undefined (6.1%). Regarding psychosocial causes and trauma, there were significant differences ($p < 0.001$) in the proportions reported in the spine and in the lower limb by the adolescents. Significant differences ($p = 0.018$) were also found in the proportion of unknown/undefined causes reported in the spine and in the lower limb by the adolescents.

Although both boys and girls reported daily living activities as the primary cause of recurrent pain in the two regions, boys mentioned it more than girls, both in the spine (boys: 76.5%; girls: 65.9%) and the lower limbs (boys: 72.1%; girls: 62.2%). Psychosocial factors

were identified as the second cause of recurrent spinal pain by 23.5% of the girls and 21.0% of the boys. As for other causes of recurrent lower limb pain, boys pointed to physical (23.8%) and trauma (16.6%), and girls reported the same causes but in reverse order (trauma: 25.5%; physical: 20.7%).

Adolescents reported an impact on leisure activities more frequently when recurrent pain was in the lower limb (23.4%) than in the spine (16.4%), with significant differences in its proportions ($p = 0.038$), but school absence was similarly reported (lower limb: 7.5%; spine: 7.0%). The impact of recurrent spinal pain was slightly higher among girls in terms of school absence (girls: 7.6%; boys: 6.2%) and among boys in terms of restricting participation in leisure activities (boys: 17.3%; girls: 15.9%). Recurrent pain in the lower limb was reflected in greater school absence among girls (11.7%) compared to boys (4.8%) and restricted

participation in leisure activities among boys (25.2%) compared to girls (20.7%).

DISCUSSION

Pain in adolescence is a serious public health problem, not only because of the immediate damage it causes to quality of life (school and social), but essentially because of the risk of persistence towards adulthood and the high health costs it entails. In this study, adolescents described recurrent spinal pain as having a higher frequency, longer duration, and more frequent psychosocial causes than lower limb pain. However, lower limb pain led to more concurrent limitations, which shows that the impact measured in adolescence may not be as important in predicting long-term prognosis. Intensity was not particularly important to differentiate pain in these regions, as seen in previous studies in this cohort²².

In this cohort, more than half of the adolescents considered their main pain to be recurrent (more than once in the last three months), with a higher frequency in the spine and occurring in girls with a higher frequency in both regions; for the majority of adolescents with a recurrent pain in the spine or lower limb, that pain lasted longer than three months, its frequency was high (more than once a week), and intensity was moderate to high, with girls tending to report higher intensity pain. The values obtained are worrisome given that this is a study of young adolescents, and evidence suggests that episodes of pain in early adolescence may contribute to their continuity into adulthood^{8, 9, 28-30}, emphasising the need for early preventive interventions. The finding that girls present higher intensity pain may be a result of complex mechanisms that include biological factors related to growth and pubertal development, as well as psychological factors such as the perception and valuation of pain²⁸, or because it is socially more acceptable for girls to report symptoms^{29, 30}. Previous studies have obtained results similar to ours²³.

Although the most frequently reported causes of recurrent spinal pain were daily activities (poor sleep, physical effort or sports, watching TV, using a computer), the ones that cause most concern are the psychosocial ones, since they are a predictor of chronic pain²⁸, greater disability, and a worse prognosis and have also been associated with pain in the back, shoulders, and neck³¹. Psychosocial causes were identified as the second most common cause of spinal pain in both sexes, followed by physical and unknown/undefined causes in girls and traumatic and physical causes in boys. These were also causes of lower limb pain in second and third place in girls and in reverse order in boys. Psychosocial causes were the fourth cause, also reported in both

sexes, suggesting that these causes are more associated with spinal pain and that the lower limb is more related to physical and traumatic causes, which is in line with the aetiology of typical traumatic pain in this region, i.e., a specific cause^{17, 32}. However, lower limb pain associated with stress should not be neglected, as some authors found similar levels of stress in groups of adolescents with extremity³³ and neck/shoulder pain³¹. Unknown/undefined causes were more frequent in the spine, which is in line with what is referred to in the literature as the most common cause of pain in this region (non-specific)^{14, 15}.

The results show that around 7% of adolescents reported skipping classes and having limitations in leisure activities because of recurrent spinal and lower limb pain. This may be justified by the high intensity of pain reported by some adolescents in this study since, according to some authors^{34, 35}, the intensity of pain is related to limitations in activities of daily living. It was also found that the impact is lower on school absence than on leisure-time activities, which can be justified by a perceived optional nature (by parents and/or adolescents) and the higher physical demand of the latter. This may have other implications due to the reduction of social experiences that are fundamental for healthy development²⁹. In fact, it is now known that there is an increased risk of back pain in adulthood if there is a history of these complaints in adolescence^{8, 9, 28-30}. Therefore, the high frequency of these complaints, and especially their recurrence, should be considered a warning sign for their implications in future life, with consequent more sedentary lifestyles, greater work absenteeism, a worse quality of life, and more health problems, with the associated economic implications¹¹.

The strengths of the study include our approach that compared pain characteristics and sex distribution from two regions where the aetiology differs: spinal pain is usually nonspecific in origin, and lower limb pain is typically specific. All regions of the spine were included instead of only the low back, as in most literature. Considering that only 13-year-old adolescents were included, another strength is the sample size and absence of confounding by birth year, which is likely to produce more valid estimates. The response rate of this study (53%) is related to the emergence of the COVID-19 pandemic, which forced the suspension of data collection in March 2020. While the reduced participation in the 13-years follow-up has decreased the precision of our estimates, we have no reason to believe that our estimates were biased due to this suspension, based on previous sensitivity analyses²².

Given the study design, it reflects the adolescents' perceptions through their responses to the Luebeck questionnaire, which, although not validated for the

Portuguese population, has demonstrated satisfactory reliability, and content, and face validity²².

There may have been a recall bias, although, by definition, pain is a subjective phenomenon, and therefore any measure that is not based on self-report is likely to produce even more inaccurate results³⁶. On the other hand, the estimates obtained in this study may be underestimated since small occurrences may be omitted as more severe pain episodes may have been more likely memorised and reported. The frequency estimates may also be underestimated, as not all adolescents with back or lower limb pain were included, but only those whose main pain was in one of these regions. Even so, the data obtained are in line with the literature, which gives plausibility to the findings.

Our findings are cross-sectional, and future research may focus on assessing and comparing the long-term predictive value of spinal pain vs. lower limb pain for chronic musculoskeletal pain in adulthood. It may also explore novel pain features that can accurately predict future maladaptive pain, in addition to classic attributes and concurrent limitations.

CONCLUSION

Out of the adolescents belonging to this population-based cohort who presented pain in the previous three months and whose main pain site was the spine or lower limb, more than half reported it as recurrent. Spinal recurrent pain was more frequent and lasted longer than lower limb pain, and psychosocial causes were more related to spinal pain than to lower limb pain. Daily activities were regarded as the primary cause of pain in both areas. The impact of pain on adolescents' lives is more pronounced in their leisure activities, particularly when it affects their lower limbs. This leads to more concurrent limitations, indicating that the extent of the impact observed during adolescence may not be as significant in determining long-term prognosis.

Although lower limb pain has a greater impact on daily activities during adolescence, the fact that it is known that back pain tends to persist into adulthood is where more attention should be paid due to the impact on quality of life in general, namely daily activities, interpersonal relationships, career choices, health costs, risks of comorbidities, and the need for lifestyle adaptations.

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