Original article

Prevalence and associated factors of musculoskeletal pain among hypermobile school-going children in Moodbidri, South India

Prevalência e fatores associados à dor musculoesquelética entre crianças hipermóveis em idade escolar em Moodbidri, Sul da Índia

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ABSTRACT | BACKGROUND: Hypermobility is often under-recognised in children, leading to significant delay in diagnosing the cause of musculoskeletal pain and other physical impairments. Due to multifaceted factors, pain in hypermobile children is indeed challenging to treat. The mechanism underlying the development of musculoskeletal pain in hypermobile children is unknown. **OBJECTIVE:** To identify the prevalence and factors associated with musculoskeletal pain in hypermobile children in Moodbidri, South India. **METHODS:** This cross-sectional study was conducted according to STROBE guidelines. Using the Beighton score, schoolchildren in Moodbidri were screened for hypermobility. Through multi-stage cluster sampling, 177 (65 boys and 112 girls) hypermobile children were enrolled in this study with parents' consent. The Nordic pain questionnaire is used to measure the prevalence of musculoskeletal pain. A structured questionnaire was designed to measure factors associated with musculoskeletal pain in hypermobile children. Demographic variables, characteristics of transport and school bags, characteristics of the school, participation in extracurricular activities, and screen time were the data collected. Descriptive data were analyzed using the chi-square test. Uni and multivariate logistic regression were performed for independent variables. **RESULT:** The overall prevalence for musculoskeletal pain in hypermobile children was 19.77% (6.77% in males and 12.99% in females). Spinal pain is more prevalent in both sexes. Musculoskeletal pain in hypermobile children is significantly associated with the type of school, classroom distance from school entrance, and increased sitting hours. The interaction of private school education and classrooms located on the 1st and 2nd floors increases the odds for occurrence of musculoskeletal pain in hypermobile children. **CONCLUSION:** The study result suggests that the prevalence (19.77%) of musculoskeletal pain in hypermobile children from Moodbidri, South India, is slightly higher than the prevalence reported from other regions of India. Hypermobile students studying in private institutions and their classrooms located on the 1st and 2nd floors are at risk for musculoskeletal pain.

KEYWORDS: Musculoskeletal Pain. Joint Instability. Students.

RESUMO | CONTEXTO: A hipermobilidade é frequentemente subdiagnosticada em crianças, levando a um atraso significativo no diagnóstico da causa da dor musculoesquelética e de outras deficiências físicas. Devido a fatores multifacetados, a dor em crianças hipermóveis é de fato desafiadora de tratar. O mecanismo subjacente ao desenvolvimento da dor musculoesquelética em crianças hipermóveis é desconhecido. **OBJETIVO:** Identificar a prevalência e os fatores associados à dor musculoesquelética em crianças hipermóveis em Moodbidri, sul da Índia. **MÉTODOS:** Este estudo transversal foi conduzido de acordo com as diretrizes STROBE. Usando o escore de Beighton, crianças em idade escolar em Moodbidri foram rastreadas para hipermobilidade. Por meio de amostragem por conglomerados em múltiplos estágios, 177 (65 meninos e 112 meninas) crianças hipermóveis foram incluídas neste estudo com o consentimento dos pais. O questionário nórdico de dor é usado para medir a prevalência de dor musculoesquelética. Um questionário estruturado foi elaborado para medir os fatores associados à dor musculoesquelética em crianças hipermóveis. Variáveis demográficas, características do transporte e mochilas escolares, características da escola, participação em atividades extracurriculares e tempo de tela foram os dados coletados. Dados descritivos foram analisados usando o teste qui-quadrado. Regressão logística uni e multivariada foram realizadas para variáveis independentes. **RESULTADO:** A prevalência geral de dor musculoesquelética em crianças hipermóveis foi de 19,77% (6,77% em homens e 12,99% em mulheres). A dor na coluna é mais prevalente em ambos os sexos. A dor musculoesquelética em crianças hipermóveis está significativamente associada ao tipo de escola, à distância da sala de aula da entrada da escola e ao aumento das horas sentadas. A interação entre educação em escolas particulares e salas de aula localizadas no 1º e 2º andares aumenta as chances de ocorrência de dor musculoesquelética em crianças hipermóveis. **CONCLUSÃO:** O resultado do estudo sugere que a prevalência (19,77%) de dor musculoesquelética em crianças hipermóveis de Moodbidri, sul da Índia, é ligeiramente maior do que a prevalência relatada em outras regiões da Índia. Alunos hipermóveis que estudam em instituições particulares e suas salas de aula localizadas no 1º e 2º andares correm risco de dor musculoesquelética.

PALAVRAS-CHAVE: Dor Musculoesquelética. Hipermobilidade Articular. Alunos.

Submitted April 4th, 2025, Accepted August 21st, 2025, Published Sept. 25th, 2025
J. Physiother. Res., Salvador, 2025;15:e6203
https://doi.org/10.17267/2238-2704rpf.2025.e6203 | ISSN: 2238-2704
Assigned editors: Ana Lúcia Goes, Bruno Goes

How to cite this article: Shetty KS, Ravichandran H, Janakiraman B. Prevalence and associated factors of musculoskeletal pain among hypermobile school-going children in Moodbidri, South India. J Physiother Res. 2025;15:e6203. https://doi.org/10.17267/2238-2704rpf.2025.e6203

1. Introduction

Hypermobile joints are common in childhood and usually disappear in adolescence. Collagen in the connective tissues around the joint is less mature and more elastic in children, permitting greater flexibility in joint range. Genetically inherited Hypermobile joints result in loosening or weakening the connective tissues[1].

Globally, the prevalence of hypermobility ranges from 8% to 39%[2] depending on the criteria used to define hypermobility and the population studied. Hypermobility can be associated with conditions like Ehlers-Danlos syndrome and Marfan syndrome, but it can also occur as a benign condition, generalised joint hypermobility, in many children[3]. Studies[3-5] in the literature suggest that generalised hypermobility is more common in certain ethnic groups, such as those of African, Asian, or Middle Eastern descent, compared to White populations.

In India, studies[6,7] show a wide range in prevalence, from 44.4% to 58.8% for hypermobility in childhood. The prevalence of musculoskeletal pain in children is high, and hypermobility may be a contributing factor, but it is not the sole cause. Musculoskeletal pain is a frequent reason for children to seek medical attention[8] and joint hypermobility could be associated with musculoskeletal pain in children[9]. While the physical manifestation of hypermobility may not be outwardly visible, the condition can significantly impact daily life, leading to chronic pain, fatigue, and other related issues[10]. The association between generalised joint hypermobility and musculoskeletal pain in children is complex and includes socio-demographic, biomechanical, lifestyle practice, behavioural, and psychosocial factors[11]. The interplay between these factors leads to pain in hypermobile children.

Many children with generalized joint hypermobility are asymptomatic, but the instability can still affect their physical development and daily life[12]. Hypermobility, even without immediate pain, can lead to various issues over time, including increased risk of injuries, diminished balance, postural deviations, joint impairments, and lower quality of life[13]. Studies on the prevalence of musculoskeletal pain in hypermobile Indian children are still limited. Identifying the prevalence and factors associated with musculoskeletal pain in hypermobile children helps in the early recognition and implementation of effective treatment strategies. In this study, the primary objective is to identify the prevalence of musculoskeletal pain, and the secondary objective is to assess the association of factors with musculoskeletal pain in hypermobile children in Moodbidri, a town in South India.

2. Methods

2.1 Ethical approval and protocol

The institutional ethical approval for this cross-sectional study was obtained from the Alva's College of Physiotherapy and Research Centre, Moodbidri, Dakshina Kannada, Karnataka. The study protocol is designed in accordance with STROBE guidelines for observational studies. The study is registered in Clinical Trial Registry (CTRI/2024/07/070333).

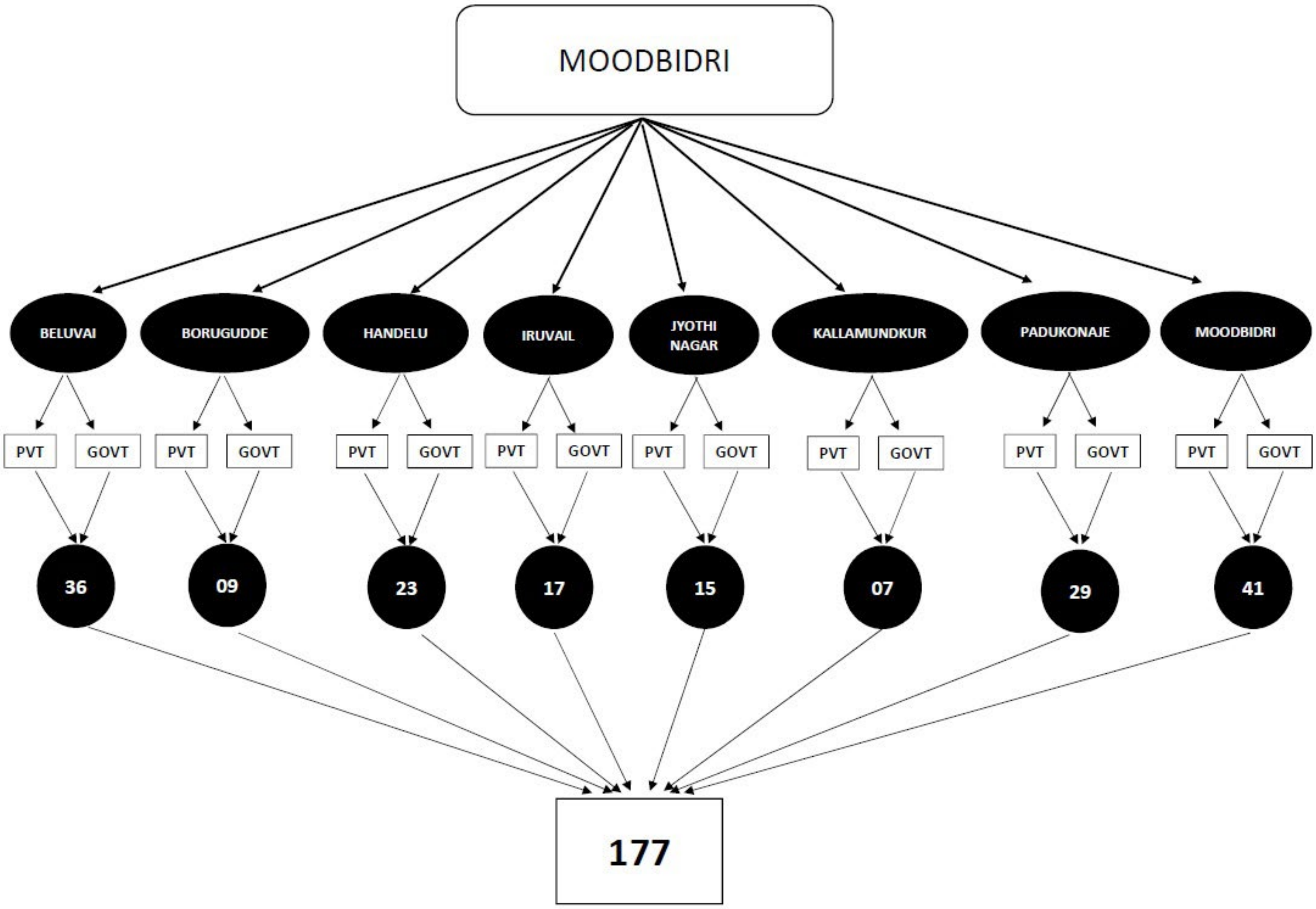
2.2 Sample size estimation

The following assumptions were used in G*power statistical software to determine the sample size: expected proportion of musculoskeletal pain prevalence in hypermobile children 10%, a 95% confidence level, power (80%), and constant proportion of 0.5. Based on these parameters, the sample size required for the present study is 158.

2.3 Study setting and sampling method

Moodbidri block in the Dakshina Kannada district of Karnataka has 8 school clusters. Both government and private schools of the Moodbidri block are included in these 8 different clusters. Through multi-stage cluster sampling method, hypermobile children from all possible clusters were enrolled for the study. In the initial phase, 8 clusters of schools located in Moodbidri were identified. In the second phase, private and government schools from each cluster were categorized. Finally, through convenient sampling, the hypermobile children were recruited (Figure 1).

Figure 1. Convenient sampling for recruiting hypermobile children from various school clusters in Moodbidri, South India



Source: the authors (2025).

https://doi.org/10.17267/2238-2704rpf.2025.e6203 | ISSN: 2238-2704

2.4 Selection criteria

Children with generalized joint hypermobility aged 6 to 12 years, both males and females, were included. Congenital deformities, musculoskeletal injuries or acquired dysfunctions, known systemic illness, neurological conditions, vision/hearing/speech deficits, poor cognition, and parents' consent not obtained are the criteria considered to exclude from participation.

2.5 Consent

The study protocol was explained, and informed consent was obtained from parents/guardians of the participating children.

2.6 Data collection procedures

The main investigator performed the Beighton score procedure for all the participants in the camp, and an orthopedic physician screened for generalized joint hypermobility to exclude hypermobile Ehlers-Danlos syndrome and other conditions. Data collectors (post-graduate Physical Therapy students) included were explained the objectives and procedures of the study. Three-day intensive training was given to seven data collectors by the principal investigator. Training includes methods to simplify the questions, accompany parents or guardians during data collection, and give clear explanations whenever questions arise to ensure completeness and accuracy of collected data. Initially, 198 children with hypermobility were identified, and 21 parents denied their consent to collect data from their children. Hence, the final sample size included in this study was 177 children.

2.7 Screening for hypermobility

Beighton score is used to screen for joint hypermobility by assessing the range of motion in specific joints, including the elbows, knees, fingers, wrists, and lower back. A Beighton score of 6 or more is considered the cut-off threshold for identifying generalized joint hypermobility in children[3].

2.8 Generalized joint hypermobility criterion

The International Consortium on Ehlers-Danlos syndrome recognised skin hyperextensibility with atrophic scarring as one of the two major criteria for hypermobile Ehlers-Danlos syndrome. Hence, children with skin hyperextensibility were excluded from the study. Children with known genetic predisposition or other diagnoses related to their hypermobility were also excluded from data collection.

2.9 Musculoskeletal pain

Musculoskeletal pain experienced in different body parts was collected using a Nordic musculoskeletal questionnaire.

2.10 Structured questionnaire

A questionnaire was designed to collect data about independent factors associated with hypermobility and musculoskeletal pain in children with generalized joint hypermobility. The independent variables included in the questionnaire were categorised into 5 sections, including demographic data, mode of commuting and school bag weight, school characteristics, extracurricular activity, and screen time spent (Appendix A).

2.11 Data analysis

Data were checked for completeness, coded, and entered into the IBM statistical software package for Social Sciences (SPSS) version 26 for Windows for statistical analysis. Descriptive statistics for independent categorical variables were presented as frequencies and percentages, and a chi-square statistical test was performed to associate those independent variables with dependent variable musculoskeletal pain in hypermobile children. Specific documentation for the prevalence and location of pain in males and females was performed. Unadjusted and adjusted odds ratio was executed to examine the association of independent variables with the dependent variable. The interaction effect of the independent variable with the dependent variable is analyzed using the uni and multivariate logistic regression analysis method with a power of 80% and significance set at 5%.

3. Results

3.1 Demographic variables

A total of 2,297 children were screened from private and government schools in each cluster, out of which 177 children had hypermobile joints demonstrated through the Beighton score. Informed consent was sought from the parents to collect data regarding pain and other factors associated with their children's hypermobile joints. A significant proportion, 55.36% of the children, were aged between 10 and 12 years; female children were more, 63.27% (n = 112) compared to male children. In stature, 63.84% were above 132 cm, and in body mass, 93.22% were above the 28.5 kg category. BMI percentile showed that the majority, 68.92% of the children had a healthy weight BMI, 5% - 85% percentile category. Overall, 10.73% of children had postural deviation in limbs, and 22.59% of them had deviations in the spine. Moderate acute malnutrition was evident in 16.94% of the children. About school transportation, 53.10% of children were commuting passively, and 66.66% of them carried their school bags by themselves irrespective of the type of commuting. Nearly 47.45% of children had their school bag weighing more than 10% of their body weight. Among the children, 62.71% of them are studying in private schools, and in all the schools, the proportionate percentage of classroom location is equal on the ground floor, 1st floor, and 2nd floor. Around 53.67% of children spent 7 to 9 hours per day sitting in classrooms, and 46.89% attended private educational training after school hours. The physical education facility in the school was unavailable for 33.89% (n = 60) of the children. In addition to school, 46.89% (n = 83) of children attended private educational training after the school sessions. It is identified that 56.49% of children had no extracurricular activities at home, 18.64% participated in music/singing/dance, and 24.85% participated in sporting activities. Among the samples, 38.41% occasionally, and 31.07% spent almost all their time at home on digital gadgets for education. For entertainment, 36.15% occasionally and 28.24% spent most of their time on digital screens purposes at home. The demographic data indicates that hypermobility is significantly associated with age (10 – 12 years), stature (> 132cm), type of school (Private), classroom location (2nd floor), hours spent in sitting (7 – 9 hours) and screen time spent for studies (Table 1).

Table 1. Socio-demographic factors of hypermobile children with and without musculoskeletal pain

Variables	Category	Sample total	Hypermobile children without pain	Hypermobile children with pain	Chi square
		N (%)	N (%)	N (%)	
Age	6 – 9 years	79 (44.63%)	71 (40.11%)	8 (4.51%)	0.003*
	10 – 12 years	98 (55.36%)	71 (40.11%)	27 (15.25%)	
Gender	Male	65 (36.72%)	53 (29.94%)	12 (6.77%)	0.449
	Female	112 (63.27%)	89 (50.28%)	23 (12.99%)	
Weight in Kg	< 28.5	12 (6.77%)	11 (6.21%)	1 (0.56%)	0.271
	> 28.5	165 (93.22%)	131 (74.01%)	34 (19.20%)	
Height in cm	< 132 cm	64 (36.15%)	56 (31.63)	8 (4.51%)	0.049*
	> 132 cm	113 (63.84%)	86 (48.58%)	27 (15.25%)	
BMI	Healthy weight 5% - 85%	122 (68.92%)	95 (53.67%)	27 (15.25%)	0.201
	Overweight 85% - 95%	11 (6.21%)	11 (6.21%)	0	
	Obese > 95%	0	0	0	
	Underweight < 5%	44 (24.85%)	36 (20.33%)	8 (4.51%)	
Postural deviation	None	118 (66.66%)	95 (53.67%)	23 (12.99%)	0.987
	Axial	40 (22.59%)	32 (18.07%)	8 (4.51%)	
	Appendicular	19 (10.73%)	15 (8.47%)	4 (2.25%)	
Malnutrition by MUAC	None	147 (83.05%)	118 (66.66%)	29 (16.38%)	0.973
	Moderate acute malnutrition	30 (16.94%)	29 (16.38%)	6 (3.38%)	
Mode of commuting	Active commuting	83 (46.89%)	63 (35.59%)	20 (11.29%)	0.174
	Passive commuting	94 (53.10%)	79 (44.63%)	15 (8.47%)	
School bag weight	< 10% of body weight	93 (52.54%)	79 (44.63%)	14 (7.90%)	0.097
	> 10% of body weight	84 (47.45%)	63 (35.59%)	21 (11.86%)	
School bag carried by	Parent/caretaker	59 (33.33%)	47 (26.55%)	12 (6.77%)	0.894
	Self	118 (66.66%)	95 (53.67%)	23 (12.99%)	
Type of school	Government	66 (37.28%)	45 (25.42%)	21 (11.86%)	0.002*
	Private	111 (62.71%)	97 (54.80%)	14 (7.90%)	
Classroom location	Ground floor	57 (32.20%)	51 (28.81%)	6 (3.38%)	0.006*
	1st floor	59 (33.33%)	50 (28.24%)	9 (5.08%)	
	2nd floor	61 (34.46%)	41 (23.16%)	20 (11.29%)	
Hours spent in sitting	5 – 7 hours	82 (46.32%)	71 (40.11%)	11 (6.21%)	0.048*
	7 – 9 hours	95 (53.67%)	71 (40.11%)	24 (13.55%)	
Physical education hour in school	Yes	117 (66.10%)	90 (50.84%)	27 (15.25%)	0.123
	No	60 (33.89%)	52 (29.37%)	8 (4.51%)	
Private Educational training after school hours	No	94 (53.10%)	81 (45.76%)	13 (7.34%)	0.035*
	Yes	83 (46.89%)	61 (34.46%)	22 (12.42%)	
Extra-curricular activities	None	100 (56.49%)	76 (42.93%)	24 (13.55%)	0.270
	Music/singing/dance	33 (18.64%)	28 (15.81%)	5 (2.82%)	
	Physical sport	44 (24.85%)	38 (21.46%)	6 (3.38%)	
Screen time spent for studies	Never	54 (30.50%)	46 (25.98%)	8 (4.51%)	0.044*
	Occasional	68 (38.41%)	58 (32.76%)	10 (5.64%)	
	Always	55 (31.07%)	38 (21.46%)	17 (9.60%)	
Screen time spent for extracurricular activities	Never	63 (35.59%)	54 (30.50%)	9 (5.08%)	0.108
	Occasional	64 (36.15%)	46 (25.98%)	18 (10.16%)	
	Always	50 (28.24%)	42 (23.72%)	8 (4.51%)	

Source: the authors (2025).
* Significance if P < 0.05.

3.2 Prevalence of pain in hypermobile children

Of 177 children, 19.77% (n = 35) had musculoskeletal pain in the past 1 year. The reported prevalence of musculoskeletal pain was higher in the female children, 12.99% (n = 23) than the male children 6.77% (n = 12). In female children, 9.61% (n = 17) reported musculoskeletal pain in more than 1 joint, while 3.38% (n = 6) had pain in only one joint. Among males, the reported prevalence of pain in single joints (3.95%) and multiple joints (2.82%) was nearly equal. The most frequently reported musculoskeletal pain was in the axial skeleton (cervical, thoracic, and lumbar), and the least reported musculoskeletal pain was in the wrist for females and knee, shoulder, and elbow for male children (Table 2).

Table 2. Prevalence of pain in hypermobile children

Prevalence of pain in hypermobile children,	Gender, n (%)	Pain in number of joints		Sites of pain								
		Pain in 1 joint, n (%)	Pain in > 1 joint, n (%)	Cervical	Thoracic	Lumbar	Shoulder	Elbow	Wrist	Hip	Knee	Ankle
35 (19.77%)	Male Child, 12 (6.77%)	7 (3.95%)	5 (2.82%)	9	7	8	1	1	3	2	1	2
	Female child, 23 (12.99%)	6 (3.38%)	17 (9.61%)	19	15	15	3	4	0	2	3	1

Source: the authors (2025).

3.3 Associated factors of musculoskeletal pain in hypermobile children

In univariate analysis, the unadjusted odds ratio for independent variables such as age (10 – 12 years), classroom location on the 2nd floor, private school, and 7 – 9 hours of sitting time in the classroom were significantly associated with musculoskeletal pain in the hypermobile children. In adjusted odds ratio analysis, no statistical significance was found to be associated with those variables (Table 3). Hence, multivariate regression analysis was performed. The multivariate regression model revealed that studying in private schools increases the risk for developing musculoskeletal pain in hypermobile children by 6.1 times. Classrooms located on the 1st or 2nd floor have a 1% and 5% chance, respectively, of contributing to musculoskeletal pain. The other possible interactions presented in table 4 reported insignificant association with musculoskeletal pain among hypermobile children.

Table 3. Univariate logistic regression for independent variables

Variables	Category	COR	95%CI	P	AOR	95%CI	P
Age	6 – 9 years		1 (reference)			1 (reference)	
	10 – 12 years	3.375	1.436 – 7.934	0.005*	0.220	0.033 – 1.463	0.117
Gender	Male		1 (reference)			1 (reference)	
	Female	1.141	0.525 – 2.481	0.738	0.898	0.332 – 2.432	0.833
BMI	Healthy weight 5% - 85%		1 (reference)			1 (reference)	
	Overweight 85% - 95%	0.000	0.000	0.999	0.000	0.000	0.999
	Underweight < 5%	0.782	0.325 – 1.880	0.583	0.596	0.184 – 1.928	0.387
Postural mal-alignment	None		1 (reference)			1 (reference)	
	Axial	0.908	0.275 – 2.994	0.874	1.691	0.515 – 5.552	0.386
	Appendicular	0.938	0.244 – 3.609	0.925	1.472	0.346 – 6.250	0.601
Malnutrition by MUAC	None		1 (reference)			1 (reference)	
	Moderate malnutrition	1.017	0.381 – 2.717	0.973	2.127	0.587 – 7.707	0.250
School bag weight	< 10% of body weight		1 (reference)			1 (reference)	
	> 10% of body weight	1.881	0.886 – 3.994	0.100	1.055	0.400 – 2.780	0.914
School bag carried by	Others		1 (reference)			1 (reference)	
	Self	0.948	0.434 – 2.070	0.894	1.041	0.387 – 2.797	0.937
Mode of commuting	Passive		1 (reference)			1 (reference)	
	Active	1.672	0.792 – 3.528	0.177	1.101	0.415 – 2.920	0.847
Classroom location	Ground floor		1 (reference)			1 (reference)	
	1st floor	1.530	0.507 – 4.616	0.450	1.319	0.269 – 6.474	0.733
	2nd floor	4.146	1.524 – 11.278	0.005*	5.064	0.958 – 26.764	0.05*
School type	Government		1 (reference)			1 (reference)	
	Private	0.309	0.144 – 0.663	0.003*	0.390	0.099 – 1.541	0.179
Hours spent sitting in school	5 – 7 hours		1 (reference)			1 (reference)	
	7 – 9 hours	2.182	0.994 – 4.787	0.05*	0.931	0.170 – 5.113	0.935
Physical education hour	Yes		1 (reference)			1 (reference)	
	No	0.513	0.217 – 1.211	0.128	0.292	0.057 – 1.505	0.141
Attends tuition	No		1 (reference)			1 (reference)	
	Yes	2.247	1.049 – 4.814	0.037	1.412	0.529 – 3.768	0.491
Extra-curricular activity	None		1 (reference)			1 (reference)	
	Music/singing/ dance	0.565	0.197 – 1.626	0.290	1.045	0.300 – 3.648	0.945
	Physical sport	0.500	0.188 – 1.326	0.164	0.320	0.085 – 1.202	0.091
Screen time spent for studies	Never		1 (reference)			1 (reference)	
	Occasional	0.991	0.362 – 2.714	0.987	1.855	0.553 – 6.226	0.317
	Always	2.572	1.001 – 6.610	0.050*	1.022	0.285 – 3.665	0.973
Screen time spent for entertainment	Never		1 (reference)			1 (reference)	
	Occasional	2.348	0.963 – 5.726	0.06	1.249	0.372 – 4.193	0.718
	Always	1.143	0.406 – 3.215	0.80	0.786	0.204 – 3.028	0.726

Source: the authors (2025).
* Significance if P < 0.05.

Table 4. Univariate and multivariate analysis for interaction effects in independent variables

	Hypermobile children with pain				Likelihood ratio χ²	Pseudo R- Square
Predictor	B	Standard Error	P	Odds (95% CI)		
Age	0.58	0.83	0.48	1.8 (0.34 to 9.28)		
Classroom location						
First floor	1.04	0.53	0.01	0.1 (0.03 to 0.70)		
Second floor	1.84	0.75	0.05	0.3 (0.12 to 1.01)		
Private school	1.82	0.52	0.01	6.1 (2.21 to 17.21)	20.40*	0.15
7 to 9 Hours spent in sitting posture per day	0.07	0.77	0.91	0.9 (0.20 to 4.24)		
Screen time spent for studies						
Occasional	0.23	0.56	0.67	0.7 (0.26 to2.39)		
Always	0.02	0.56	0.96	0.9 (0.32 to 2.93)		

Source: the authors (2025).
* Significance if P < 0.05.

4. Discussion

The present study is designed to identify the prevalence and associated factors for musculoskeletal pain in hypermobile school-going children in Moodbidri. The study results demonstrated that the overall prevalence of musculoskeletal pain experienced in hypermobile children was 19.77%, and the main factors positively associated with musculoskeletal pain in hypermobile children were school bags weighing >10% of body weight and the floor location of the classroom. The prevalence identified in the result is higher than 11.8% reported by Abujam and Aggarwal (2014)[6] in school children with hypermobility from Lucknow, India. The prevalence of musculoskeletal pain in hypermobile children has not been exhaustively investigated due to overlapping genetic conditions and the lack of a clear diagnostic framework. In the literature, the prevalence of musculoskeletal pain regardless of hypermobility in schoolchildren ranges from 16.2% (New Delhi, India) to 52.4% (Gondar, Ethiopia)[14-20]. Hypermobility is often ignored or overlooked by healthcare professionals who treat children with musculoskeletal pain in primary care. This might lead to chronic pain and instability in joints.

Contradicting our findings, Leone et al.[21] and Nicolajsen et al.[22] found no association between hypermobility and musculoskeletal pain in schoolchildren. Increased range in hypermobile joints enhances flexibility to participate in sporting and other high-impact activities. The imbalance in internal and external factors contributing to joint stability in hypermobile individuals determines the onset of fatigue, pain, and other musculoskeletal pain. Hypermobility is a common physical trait. Factors influencing joint stability in hypermobile children determine the musculoskeletal dysfunctions in schoolchildren.

In this study, the estimated prevalence of musculoskeletal pain is two times higher in female children with hypermobility than in males. This is comparable to the synthesis of results reported from a recent systematic review[23] which reported that girls had a prevalence of 43.1% for musculoskeletal pain, twice higher than that of boys, 26.8%. The higher prevalence of musculoskeletal pain in female children could be due to pre-pubertal fluctuations in hormones and associated rapid skeletal growth[18,24], female children's contribution to household chores, and lower pain thresholds in female children[20,25]. The laxity of soft tissues and pre-pubertal development in girls contribute to increased joint mobility[5,26,27].

Children with hypermobility experienced more pain in the axial skeleton (cervical, thoracic, and lumbar spine) than compared to the appendicular skeleton in this study. Hypermobility-associated impairments in passive (vertebral body, intervertebral disc, ligaments, tendons)[28], active (muscles)[29,30], and neural subsystems[31] might contribute to a higher prevalence of spinal pain in children. More than 66% of hypermobile children in this study had a healthy body mass index without postural deviations and malnutrition. Thus, positive indicators of physical fitness could protect hypermobile children against the odds of developing musculoskeletal pain.

Active commuters (11.29%) experienced pain, slightly higher than passive commuters (8.47%). Contrastingly, Kimura et al. (2022) reported that decreased walking and increased sitting duration are associated with a higher prevalence of musculoskeletal pain[32]. Both external and internal factors such as long school commutes, time constraints, school bag weight, unfavourable weather, body composition (lean body mass, fat percentage), psychosocial factors (lack of motivation, perceived effort), repetitive movements around joints and lack of joint stability might be attributed to increased musculoskeletal pain in actively commuting hypermobile children.

Musculoskeletal pain is higher in hypermobile children who carry school bags weighing more than 10% of their body weight, walk long distances from the school entrance to their classroom, spend several hours in sitting posture, attend coaching sessions after school, lack extra-curricular activities, and have increased exposure to screen time. This is also evident from the multiple regression analysis results that hypermobile children studying in private schools with classrooms far from the school entrance are 10 times at risk for developing musculoskeletal pain. Unusually, children attending government schools and participating in physical education sessions had experienced more pain. Regardless of schoolbag weight, the fatigue experienced and chronic repetitive stress in active commuters might probably increase pain among them.

The present study findings highlight that schoolbag weight, mode of commuting, level of physical activity, and sustained posture are not directly associated, but their impact on the musculoskeletal system varied accordingly with changes in other independent variables.

Clinically, pain management in hypermobile children requires a multi-disciplinary, individualized, and preventative approach. Physical therapy forms the core and addresses joint stability, proprioception, and muscle-strengthening issues, trains parents and teachers about joint protection techniques for hypermobile students and also provides postural endurance through low-impact activities. The occupational therapist assists in evaluating school ergonomics, training activity pacing, and energy conservation. Organization policies include ergonomic seating facilities in school, frequent breaks from static postures, and structured physical education programs.

The present study has a few limitations. Firstly, analyzing the association of body composition, muscle strength, and endurance with pain among hypermobile children might provide more insights. Secondly, the status of static and dynamic joint stability of the participants was not known. Lastly, evaluation of the neuromuscular control on hypermobile joints (proprioception and kinesthesia) is not performed.

5. Conclusion

The prevalence of musculoskeletal pain among hypermobile school children in Moodbidri is 19.77%. Hypermobile students in private schools have a six times higher risk of musculoskeletal pain. Though a healthy Body Mass Index, optimal posture, and proper nourishment could potentially protect against the odds of developing musculoskeletal pain, the impact of positive indicators of physical fitness on each independent variable need to be validated in future research.

Acknowledgments

The authors express their gratitude to Chairman Dr. Mohan Alva and Management Trustee Mr. Vivek Alva of Alva's Education Foundation, Moodbidri, Dakshina Kannada, Karnataka, India for their unwavering support throughout this research endeavour.

Authors' contributions

The authors declared that they have made substantial contributions to the work in terms of the conception or design of the research; the acquisition, analysis or interpretation of data for the work; and the writing or critical review for relevant intellectual content. All authors approved the final version to be published and agreed to take public responsibility for all aspects of the study.

Competing interests

No financial, legal, or political conflicts involving third parties (government, private companies, and foundations, etc.) were declared for any aspect of the submitted work (including but not limited to grants and funding, advisory board participation, study design, manuscript preparation, statistical analysis, etc.).

Indexers

The Journal of Physiotherapy Research is indexed by DOAJ, EBSCO, LILACS and Scopus.

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Appendix A. Structured questionnaire

SECTION A – Demographic data			
S.no	**Information**	**Response**	**Code**
1	Child ID code		
2	Assessors ID code		
3	Date of screening		
4	School details		
5	Date and time of enrolment		
6	Gender	Male Female	A1 A2
7	Chronological age		
8	Height in cm		
9	Weight in Kg		
10	BMI children adjusted percentiles	Underweight < 5% Healthy weight 5 – 85% Overweight 85 – 95% Obese > 95%	B1 B2 B3 B4
11	Socio-economic status	Upper class Upper middle class Middle class Lower middle class Lower class	C1 C2 C3 C4 C5
12	Postural deviation	None Axial Appendicular	D1 D2 D3
13	Malnutrition by MUAC	Yes No	E1 E2
SECTION B – Characteristics of transport and school bag			
14	Mode of travel to school	Walk Vehicle	F1 F2
15	School bag weight	< 10% body weight >10% body weight Carried by parent/guardian	G1 G2 G3
SECTION C – Characteristics of the School			
16	Type of school	Government Private	H1 H2
17	Classroom location	Ground floor 1st floor 2nd floor	I1 I2 I3
18	Hours spent sitting in classroom	5 – 7 hours 7 – 9 hours	J1 J2
19	Physical education hour	Yes No	K1 K2
SECTION D – Participation in Extracurricular Activities			
20	Attends Tuition after school	Yes No	L1 L2
21	Hours spent in skills	Dance Singing Musical instruments Indoor games (swimming, badminton etc) Chess Outdoor games/Martial arts None	M1 M2 M3 M4 M5 M6 M7

SECTION E – Screen time			
22	Screen time spent for studies	Occasional Always Never	N1 N2 N3
23	Screen time spent for entertainment	Occasional Always Never	O1 O2 O3

Source: the authors (2025).