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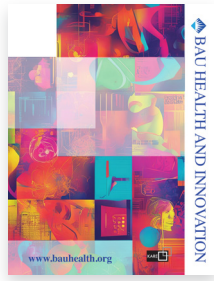

Original Article

Exploring the Impact of Caregiving on Musculoskeletal Health: Insights from Caregivers of Children with Cerebral Palsy

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Abstract

Objectives: This study aimed to evaluate the frequency, severity, and regional distribution of musculoskeletal pain in primary caregivers of children with cerebral palsy (CP) and to investigate its associations with caregiving-related factors, including the child's motor impairment level and demographic variables.

Methods: A cross-sectional observational study was conducted with 84 caregivers of children with CP. Musculoskeletal complaints were assessed using the Extended Nordic Musculoskeletal Questionnaire, and pain severity was measured by the Visual Analog Scale (VAS). The Gross Motor Function Classification System (GMFCS) was used to assess the motor impairment level of the children. Associations between caregiver pain and clinical variables were analyzed using appropriate statistical tests.

Results: The most frequently reported pain regions were the lower back (69.0%), neck (59.5%), and shoulders (58.3%). Pain in these areas significantly interfered with daily activities. Statistically significant associations were found between higher GMFCS levels and increased shoulder, wrist/hand, upper back, and lower back pain. Older child age and caregiver age were also associated with greater musculoskeletal burden. VAS scores showed a positive correlation with both GMFCS level and caregiver age ($P < 0.05$).

Conclusion: Musculoskeletal pain is common among caregivers of children with CP and is influenced by the severity of the child's motor disability and caregiver demographics. Preventive strategies, such as ergonomic education, regular screening, and multidisciplinary support should be integrated into pediatric rehabilitation services to protect caregiver health and ensure sustainable care.

Keywords: Caregiver burden, cerebral palsy, ergonomic risk, musculoskeletal pain.

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Cerebral palsy (CP) is a group of permanent, non-progressive motor disorders caused by disturbances in the developing fetal or infant brain, characterized primarily by impairments in movement and posture due to abnormalities in muscle tone, reflexes, motor control, and coordination.[1] CP is not a uniform condition; rather, it comprises a spectrum of clinical manifestations that may also involve sensory, perceptual, cognitive, communicative, and behavioral impairments, as well as epilepsy and secondary musculoskeletal problems.[2,3] With an estimated prevalence of 4.4/1000 live births in Turkey, CP constitutes one of the most common causes of childhood physical disability and places a significant burden on both families and healthcare systems.[4]

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Children with CP often experience limitations in gross and fine motor functions, which lead to difficulties in performing daily activities independently. As a result, they require continuous and intensive care, often provided by a primary caregiver, who is typically a family member. Caregiving responsibilities include a range of physical tasks, such as lifting and transferring the child, assisting with personal hygiene, supporting therapeutic exercises, and facilitating mobility, particularly in non-ambulatory cases.[5,6] These tasks frequently require sustained physical effort and are often performed in ergonomically unfavorable positions, especially when the child grows older or gains weight, significantly increasing the physical workload on the caregiver.[7]

Over time, this physical strain may lead to a variety of musculoskeletal complaints among caregivers. Previous studies have reported high rates of musculoskeletal symptoms – particularly in the neck, back, shoulders, and lower limbs – among caregivers of individuals with disabilities or chronic conditions.[8,9] These symptoms can negatively impact caregivers' physical health, psychological well-being, and quality of life, potentially compromising the continuity and quality of care they provide.[10] Furthermore, the cumulative burden on caregivers may contribute to increased healthcare utilization and indirect societal costs, highlighting the importance of early identification and prevention strategies.[11]

Despite the considerable physical demands involved in caregiving for children with CP, limited research has specifically investigated the musculoskeletal health of their caregivers. Most available studies focus on caregiver stress or psychological burden, with relatively few addressing the prevalence, distribution, and severity of musculoskeletal symptoms in this population, as well as their relationship with caregiving demands.[12] Moreover, the identification of risk factors, such as duration of caregiving, age of the child, gross motor function level, or caregiving posture may provide critical insight into targeted interventions for caregiver support.[13]

In this context, the present study aims to evaluate the frequency and severity of musculoskeletal symptoms among primary caregivers of children diagnosed with CP, to examine the association between these symptoms and the caregiving process, and to identify potential risk factors contributing to musculoskeletal burden. To achieve this, we utilized the Extended Nordic Musculoskeletal Questionnaire (NMQ-E), a validated and widely used instrument for assessing musculoskeletal complaints, and incorporated data from the Gross Motor Function Measure-88 (GMFM-88) to account for the motor severity of the children under care.

Materials and Methods

Study Design and Setting

This cross-sectional observational study was conducted at the Physical Therapy and Rehabilitation Clinic of Beykent University Faculty of Medicine. The study aimed to assess the frequency and severity of musculoskeletal symptoms among primary caregivers of children diagnosed with CP, and to examine the relationship between these symptoms and caregiving-related physical burden. The study was approved by the Istanbul Beykent University Non-Interventional Clinical Research Ethics Committee (approval number: 2025/5; date: 26.06.2025), and all participants provided informed consent in accordance with the Declaration of Helsinki.

Participants

A total of 84 primary caregivers of children diagnosed with CP who were receiving routine physical therapy at our clinic were included in the study. Inclusion criteria were: (1) Being the primary caregiver of a child aged 4–18 years with a confirmed diagnosis of CP; (2) Providing direct physical care to the child (e.g., lifting, transferring, assisting with daily living activities); and (3) Voluntary consent to participate. Caregivers with known musculoskeletal disorders unrelated to caregiving, recent trauma or surgery, or those with systemic diseases that could affect musculoskeletal symptoms were excluded.

Data Collection and Measures

The gross motor function levels of the children were obtained retrospectively from medical records using the GMFM-88. The GMFM-88 is a standardized observational tool designed to evaluate changes in gross motor function over time in children with CP. It consists of 88 items divided into five dimensions: (1) Lying and rolling (17 items), (2) Sitting (20 items), (3) Crawling and kneeling (14 items), (4) Standing (13 items), and (5) Walking, running, and jumping (24 items). Each item is scored using a 4-point Likert scale (0 = Does not initiate, 1 = Initiates, 2 = Partially completes, 3 = Completes independently).[14,15] This scale has been shown to have high reliability and validity for assessing gross motor function in children with CP.[16]

Musculoskeletal complaints of caregivers were assessed using the NMQ-E. This validated instrument evaluates the presence of musculoskeletal symptoms in nine anatomical regions (neck, shoulders, upper back, elbows, wrists/hands, lower back, hips/thighs, knees, and ankles/feet) over three time frames: (1) During the past 12 months, (2) During the past 7 days, and (3) Whether the pain prevented the individual from performing normal activities.[17] Responses were binary (yes/

Table 1. Frequency of musculoskeletal pain, pain-related activity limitation, and recent pain experience in caregivers according to body region

Body region	Pain in the past 12 months				Interfered with daily activities				Pain in the past 7 days			
	No		Yes		No		Yes		No		Yes	
	n	%	n	%	n	%	n	%	n	%	n	%
Neck	34	40.5	50	59.5	67	79.8	17	20.2	72	85.7	12	14.3
Shoulder	35	41.7	49	58.3	80	95.2	4	4.8	74	88.1	10	11.9
Elbow	68	81.0	16	19.0	84	100.0	0	0	80	95.2	4	4.8
Wrist/hand	54	64.3	30	35.7	80	95.2	4	4.8	78	92.9	6	7.1
Upper back	40	47.6	44	52.4	80	95.2	4	4.8	73	86.9	11	13.1
Lower back	26	31.0	58	69.0	72	85.7	12	14.3	67	79.8	17	20.2
Hip/thigh	66	78.6	18	21.4	82	97.6	2	2.4	80	95.2	4	4.8
Knee	63	75.0	21	25.0	82	97.6	2	2.4	80	95.2	4	4.8
Ankle/foot	61	72.6	23	27.4	79	94.0	5	6.0	78	92.9	6	7.1

no), and although the questionnaire allows for region-specific symptom mapping, it does not produce a total score. The Turkish version of the NMQ-E has been previously validated and widely used in occupational and clinical populations.[18,19]

Based on previous studies that examined the relationship between caregiving burden or musculoskeletal pain and factors, such as Gross Motor Function Classification System (GMFCS) level or caregiving duration (e.g., Gokcin Eminel et al., 2021; Sharan et al., 2018),[20,21] an expected effect size of r=0.30 was assumed. This value represents a medium effect size according to Cohen's classification and is consistent with reported associations in similar caregiver populations. Using G*Power 3.1.9.7 for a two-tailed Pearson correlation, with α=0.05 and statistical power of 0.80, the minimum sample size required was calculated to be 84 participants.

Data Analysis

Statistical analyses were performed using the IBM Statistical Package for the Social Sciences Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize sociodemographic and clinical characteristics. For normally distributed continuous variables, mean and standard deviation values were reported; for non-normally distributed variables, medians along with minimum and maximum values were presented. The Kolmogorov-Smirnov test was used to evaluate the normality of continuous variables. Depending on the distribution, either the paired samples t-test (for normally distributed data) or the Wilcoxon signed-rank test (for non-normally distributed data) was applied to assess within-group differences. Categorical variables were compared using the Chi-square test or Fisher's exact test, where appropriate. For correlation analyses, Pearson or Spearman correlation coefficients were calculated based on data distribution. If multiple comparisons were performed, P-values were adjusted using the Bonferroni correction method to control for the risk of Type I error. A $p<0.05$ was considered statistically significant.

Results

A total of 84 children with CP and their primary caregivers were included in this study. The mean level of the children on the GMFCS was 2.37±0.74, ranging from level 1 to level 4. The mean age of the children was 8.37±3.80 years, with a range of 4–17 years. The mean age of the caregivers was 35.13±5.55 years, ranging from 29 to 53 years. The caregivers' pain levels were assessed using the Visual Analog Scale (VAS), and the mean score was 5.30±1.34, with scores ranging from 2 to 8. Regarding the gender distribution of the children, 60.7% were female (n=51) and 39.3% were male (n=33). As for the occupational status of the caregivers, 94.0% (n=79) were housewives, while 6.0% (n=5) were employed.

Based on the Nordic Musculoskeletal Questionnaire, the most commonly reported pain regions over the past 12 months were the lower back (69.0%), neck (59.5%), and shoulders (58.3%). Pain in these regions also caused the greatest interference with daily activities, particularly in the neck (20.2%) and lower back (14.3%).In the past 7 days, the most frequent complaints were again in the lower back (20.2%), neck (14.3%), and upper back (13.1%). These findings highlight the physical burden of caregiving, especially on spinal and upper body regions (Table 1).

When musculoskeletal pain in caregivers was evaluated over the past 12 months, several statistically significant associations were identified. Shoulder pain was significantly associated with higher GMFCS levels (p=0.013) and older child age (p=0.004). Elbow pain was linked to higher GMFCS levels (p=0.033) and significantly younger caregiver age

Table 2. Distribution of musculoskeletal pain by body region and its associations with GMFCS level, child age, and caregiver age

Body region	Pain lasts 12 months	n	%	GMFCS (Mean±SD)	p	Patient age (Mean±SD)	p	Caregiver age (Mean±SD)	p
Neck	No	36	40.9	2.25±2.25	0.310	8.11±3.89	0.608	34.64±5.10	0.621
	Yes	52	59.1	2.40±2.40		8.44±3.81		35.50±5.94	
Shoulder	No	38	43.2	2.13±2.13	0.013	7.00±3.26	0.004	34.45±4.82	0.417
	Yes	50	56.8	2.50±2.50		9.30±3.95		35.68±6.12	
Elbow	No	72	81.8	2.28±2.28	0.033	8.60±4.12	0.427	35.87±5.91	0.013
	Yes	16	18.2	2.63±2.63		7.00±1.55		31.88±1.67	
Wrist/hand	No	58	65.9	2.19±2.19	0.004	7.86±3.96	0.031	34.36±5.26	0.039
	Yes	30	34.1	2.63±2.63		9.17±3.46		36.67±6.00	
Upper back	No	43	48.9	2.16±2.16	0.021	8.23±3.97	0.737	35.98±5.87	0.177
	Yes	45	51.1	2.52±2.52		8.39±3.72		34.32±5.25	
Lower back	No	27	30.7	2.11±2.11	0.040	7.04±3.12	0.032	34.48±3.67	0.960
	Yes	61	69.3	2.44±2.44		8.87±3.99		35.44±6.27	
Hip/thigh	No	70	79.5	2.29±2.29	0.134	8.46±3.84	0.441	35.09±5.67	0.739
	Yes	18	20.5	2.56±2.56		7.72±3.82		35.39±5.45	
Knee	No	65	73.9	2.34±2.34	0.844	7.83±3.60	0.069	35.11±5.11	0.603
	Yes	23	26.1	2.35±2.35		9.65±4.18		35.26±6.94	
Ankle/foot	No	64	72.7	2.30±2.20	0.259	8.03±3.88	0.155	34.73±5.10	0.429
	Yes	24	27.3	2.61±2.71		9.04±3.67		36.25±6.75	

GMFCS: Gross motor function classification system, SD: Standard deviation

(p=0.013). Wrist/hand pain was related to higher GMFCS levels (p=0.004), older child age (p=0.031), and older caregiver age (p=0.039). Upper back pain was significantly associated with higher GMFCS levels (p=0.021). Lower back pain was associated with higher GMFCS levels (p=0.040) and older child age (p=0.032). No statistically significant associations were found between pain presence and study variables in the hip, knee, or ankle/foot regions (Table 2).

These findings suggest that musculoskeletal pain in caregivers, particularly in the shoulder, wrist, and lower back regions, is influenced by both the child's level of motor impairment and age, and in some areas, by the caregiver's age.

A correlation analysis was conducted to examine the relationship between pain severity (VAS scores) and clinical variables. VAS scores were found to be significantly and positively correlated with GMFCS level (r=0.248, p=0.020) and caregiver age (r=0.215, p=0.044). The correlation between VAS scores and child age did not reach statistical significance (r=0.206, p=0.054), although it approached the threshold. These findings suggest that caregivers of children with higher functional limitations and older caregivers tend to report higher levels of pain.

Discussion

This study revealed a high prevalence of musculoskeletal complaints among caregivers of children with CP, with the lower back, neck, and shoulders being the most frequently affected regions. These findings are consistent with previous research highlighting the physical burden and ergonomic challenges associated with caregiving tasks, particularly in non-ambulatory or severely impaired children.[22–24]

Our results demonstrated significant associations between musculoskeletal pain and both child- and caregiver-related factors. Specifically, higher GMFCS levels and older child age were consistently associated with pain in the shoulder, wrist/hand, and lower back regions. These findings are plausible considering that children with more severe motor limitations require full physical assistance with activities of daily living, including transfers, hygiene, and mobility support, which frequently involve repetitive lifting, pushing, and awkward postures. This mechanical overload is particularly concentrated in the upper body and spine. Our findings are in line with those of Gökcin Eminel et al.,[20] who reported that lower levels of gross motor function in children with CP are significantly correlated with increased physical workload and pain complaints in caregivers, particularly in the back and upper extremities. Similarly, Sharan et al.[25] emphasized that repetitive bending, twisting, and lifting without proper ergonomics were primary risk factors for the development of musculoskeletal disorders in caregivers of children with disabilities.

In addition to child-related characteristics, caregiver-related factors – especially age – also played a significant role in pain development. Our study revealed that older caregivers

reported higher levels of pain severity (VAS) and greater frequency of regional pain, particularly in the elbow and wrist/hand. This aligns with the findings of Ramezani et al.,[26] who demonstrated that advanced age, increased body weight (body mass index), and the accumulation of physically demanding caregiving tasks were significant predictors of chronic low back pain among mothers of children with CP. It is likely that age-related musculoskeletal vulnerability, combined with long-term repetitive strain, reduces tissue resilience and heightens pain sensitivity over time. These data suggest that both the intensity and duration of caregiving are critical in shaping the physical health profile of caregivers.

Interestingly, while neck pain was one of the most frequently reported symptoms, its statistical associations with measured clinical variables were weaker than for other body regions. This may reflect the contribution of unmeasured ergonomic factors, such as prolonged static postures, unsupported head/neck positioning during caregiving (e.g., feeding, dressing), or visual tracking while attending to the child's needs. These actions may not involve overt lifting or resistance, but they contribute to sustained muscle tension, particularly in the trapezius and cervical paraspinal regions. The accumulation of such micro-strain over time may explain the high prevalence yet weak statistical link to gross motor metrics.

Beyond anatomical localization and mechanical causes, emerging literature highlights the importance of pain mechanisms in understanding caregiver burden. In this context, Saraçoğlu et al.[23] examined pain phenotypes in caregivers of children with CP and identified the presence of not only nociceptive pain due to mechanical strain but also nociplastic and neuropathic pain components, which may reflect central sensitization and chronicity-related changes in pain processing. Notably, caregivers with nociplastic or neuropathic pain phenotypes reported higher pain severity scores and poorer quality of life, even in the absence of corresponding increases in physical load. This suggests that long-term caregiving may trigger complex pain mechanisms, involving alterations in the central nervous system's response to pain stimuli.

These findings underscore the importance of adopting a biopsychosocial model when addressing caregiver pain. Interventions should not only target mechanical load reduction through ergonomic training, assistive devices, or physical therapy, but also include psychoeducation, stress management, and, where necessary, treatment for central sensitization syndromes. Regular screening for early pain symptoms, psychological distress, and functional limitations among caregivers should be integrated into pediatric rehabilitation follow-up protocols. Ultimately, optimizing caregiver health is essential not only for their own well-being but also for ensuring the continuity and quality of care delivered to children with CP.

The emotional and psychological dimensions of caregiver burden, although not directly assessed in this study, should not be overlooked. Studies have shown that depression, stress, and perceived stigma significantly influence musculoskeletal symptoms and overall caregiver health.[24-27] Therefore, any intervention strategy should be holistic and family-centered.

The cross-sectional nature of our study limits causal inference, and the self-reported nature of musculoskeletal complaints may be subject to recall bias. Pain severity was assessed only through VAS and not confirmed through clinical or imaging methods. Other important variables, such as body mass index, physical fitness, or psychosocial factors, were not included. In addition, the sample consisted primarily of female caregivers, which may limit the generalizability of the findings to broader caregiver populations.

Conclusion

Caregivers of children with CP face a high risk of musculoskeletal pain, particularly in the lower back, neck, and shoulders. These symptoms are significantly influenced by caregiving burden, especially in cases involving children with more severe motor impairments and older age. Preventive strategies, such as ergonomic training, physical therapy, and routine musculoskeletal screening should be integrated into pediatric rehabilitation programs. Supporting caregiver well-being is essential not only for their health but also for the sustainability and quality of care provided to children with CP.

Disclosures

Ethics Committee Approval: The study was approved by the Istanbul Beykent University Non-interventional Clinical Research Ethics Committee (no: 2025/5, date: 26/06/2025).

Informed Consent: Informed consent was obtained from all participants.

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