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(RESEARCH ARTICLE)

The Influence of Parental Education on the Utilization and Quality of Life Outcomes (QoL) of Solid Ankle-Foot Orthoses in Children with Cerebral Palsy: A Comparative Study in Bangladesh

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Abstract

Background: Solid ankle-foot orthoses (SAFOs) are commonly prescribed to improve lower-limb alignment, stability, gait performance, and functional mobility in children with cerebral palsy (CP). However, the effectiveness of SAFOs may depend on caregiver-related factors, including parental education, which can influence adherence to orthotic use and rehabilitation recommendations. This study investigated the relationship between parental education, SAFO utilization, and quality of life among children with CP in Bangladesh.

Methods: A quantitative cross-sectional study was conducted among 100 children with CP who used SAFOs and their parents or primary caregivers at the Centre for the Rehabilitation of the Paralysed (CRP), Savar and Mirpur, Dhaka, Bangladesh, between October and November 2025. Data were collected through face-to-face interviews using a structured questionnaire. SAFO utilization was assessed using a Likert-type utilization scale, while quality of life was evaluated using cerebral palsy-specific quality-of-life domains. Descriptive statistics were used to summarize participant characteristics. The Shapiro–Wilk test assessed data normality, and non-parametric analyses, including the Kruskal–Wallis test and Spearman's rank correlation, were performed to examine associations between study variables.

Results: The majority of children were younger than 7 years (73%), male (69%), diagnosed with spastic diplegic CP (76%), and classified as Gross Motor Function Classification System (GMFCS) Level II (91%). No statistically significant association was found between parental education level and either SAFO utilization or quality-of-life scores ($p > 0.05$). However, SAFO utilization demonstrated a moderate positive correlation with quality of life ($\rho = 0.449$, $p < 0.001$), indicating that greater orthosis use was associated with better perceived well-being and functional outcomes.

Conclusions: Parental education was not significantly associated with SAFO utilization or quality of life among children with CP. Nevertheless, regular and effective use of SAFOs was positively associated with improved quality of life. These findings highlight the importance of consistent orthotic follow-up, caregiver education and training, affordability of assistive devices, and family-centered rehabilitation approaches to optimize outcomes for children with CP.

Keywords: Cerebral palsy; Solid ankle-foot orthosis; SAFO utilization; Quality of life; Parental education; Rehabilitation; Bangladesh

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1. Introduction

Cerebral palsy (CP) is a permanent neurodevelopmental condition that affects movement, posture, and motor function, often characterized by spasticity, weakness, impaired balance, abnormal gait, and limitations in activities of daily living (1). It is widely recognized as one of the most common causes of physical disability in childhood, with consequences extending beyond motor impairment to participation, education, family functioning, and quality of life (1).

In Bangladesh, the burden of CP is clinically significant, as access to early diagnosis, rehabilitation services, assistive technology, and community-based follow-up remains uneven, particularly for rural and low-income populations (2,3). The Bangladesh Cerebral Palsy Register has reported substantial gaps in rehabilitation service utilization and highlighted the influence of contextual and family-related factors on care access (3).

Children with CP frequently present with lower-limb biomechanical impairments such as equinus deformity, crouch gait, reduced foot clearance, ankle instability, and inefficient gait patterns. These limitations often restrict safe ambulation and reduce participation in school, play, and community life. Orthotic management is therefore a key component of pediatric rehabilitation. Solid ankle-foot orthoses (SAFOs) are commonly prescribed to improve ankle alignment, control excessive plantarflexion, enhance standing balance, and support gait training (4,5).

Systematic reviews have demonstrated that ankle-foot orthoses can improve gait parameters, balance, and functional mobility in children with CP when appropriately prescribed, fitted, and used consistently (4,6). However, the effectiveness of SAFOs depends not only on biomechanical design but also on adherence to use. Even optimally designed orthoses may fail to produce functional benefits if they are not worn regularly due to discomfort, skin irritation, difficulty in application, or lack of follow-up support.

Caregivers play a central role in orthotic adherence, particularly in young children who depend on parents for donning and doffing, adherence to wearing schedules, skin monitoring, and follow-up attendance. Previous studies have shown that caregiver perceptions, including comfort, perceived benefit, professional guidance, affordability, and family routine, significantly influence orthotic use (7,8).

Parental education is often considered a determinant of health behavior and rehabilitation adherence. Higher educational attainment may enhance health literacy, understanding of therapeutic instructions, and communication with professionals. Conversely, lower educational levels may limit awareness of orthotic benefits, maintenance procedures, and follow-up needs. However, education alone does not operate in isolation; broader social determinants such as income, accessibility, cultural beliefs, distance to services, and availability of trained professionals also strongly influence rehabilitation outcomes (9,10).

In Bangladesh, children with CP face multiple barriers to rehabilitation access, including limited service availability, financial constraints, and geographical challenges (3). Although parental education has been suggested as a contributing factor in service utilization, there is limited empirical evidence examining its specific association with SAFO use and quality of life in the Bangladeshi context. This represents a critical evidence gap for family-centered rehabilitation planning.

Therefore, this study aimed to examine the influence of parental education on SAFO utilization and quality of life among children with cerebral palsy in Bangladesh. The study also investigated the association between SAFO use and quality of life.

2. Material and Methods

2.1. Study Design and Setting

A quantitative cross-sectional study was conducted at the Centre for the Rehabilitation of the Paralysed (CRP), Savar and Mirpur, Dhaka, Bangladesh, between October and November 2025.

2.2. Participants

The study included children diagnosed with cerebral palsy (CP) who were using solid ankle-foot orthoses (SAFOs) and their parents or primary caregivers. Eligible participants were children aged 4–18 years who had used a SAFO for at least three months and were accompanied by a parent or caregiver willing to provide informed consent. Children who

were not using SAFOs, those with severe cognitive impairment that precluded reliable caregiver reporting, those with severe comorbid medical conditions, and individuals unwilling to participate were excluded.

2.3. Sample Size and Sampling

A purposive sampling technique was employed. Although the estimated sample size was 384 participants, a total of 100 children with CP and their caregivers were recruited because of time, resource, and accessibility constraints during the study period.

2.4. Data Collection

Data were collected through face-to-face interviews using a structured questionnaire comprising three sections: (1) sociodemographic and clinical characteristics, (2) SAFO utilization, and (3) quality of life assessment.

2.5. Measures

2.5.1. SAFO Utilization

SAFO utilization was assessed using a researcher-developed Likert-type scale that evaluated multiple aspects of orthosis use, including regularity of wear, comfort, confidence during walking, use during school and daily activities, ease of donning and doffing, affordability, professional support, understanding of orthotic purpose, skin-related concerns, child acceptance, stair negotiation, follow-up difficulties, and caregiver understanding of recommended wearing duration. The scale demonstrated good internal consistency (Cronbach's $\alpha = 0.805$). Content validity was established through expert review by rehabilitation professionals.

2.5.2. Quality of Life

Quality of life was assessed using domains derived from the Cerebral Palsy Quality of Life Questionnaire (CPQOL), including family acceptance, peer acceptance, play opportunities, school participation, recreation, community participation, general health, mobility, independence in activities of daily living, child happiness, parental happiness, pain and discomfort, and confidence about the future.

2.5.3. Statistical Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics were used to summarize participant characteristics and study variables, including frequencies, percentages, means, and standard deviations.

The Shapiro–Wilk test was performed to assess the normality of continuous variables. Because SAFO utilization scores were not normally distributed, non-parametric statistical methods were applied. Kruskal–Wallis tests were used to compare SAFO utilization and CPQOL scores across categories of parental education. Spearman's rank-order correlation was used to examine the association between SAFO utilization and quality-of-life scores. Statistical significance was set at $p < 0.05$.

2.5.4. Ethical Considerations

Ethical approval was obtained from the Institutional Review Board of the Bangladesh Health Professions Institute (BHPI), Centre for the Rehabilitation of the Paralysed (Reference No. CRP-BHPI/IRB/07/2025). Written informed consent was obtained from all participating parents or caregivers prior to data collection. Confidentiality and anonymity were maintained throughout the study, and participation was entirely voluntary.

3. Results

A total of 100 children with CP and their caregivers participated in this study. Most children were younger than 7 years (73%), with a mean age of 5.96 +/- 2.70 years. Boys accounted for 69% of the sample. Diplegic CP was the most common type (76%), followed by quadriplegic CP (14%) and hemiplegic CP (10%). Most children were classified as Gross Motor Function Classification System (GMFCS) level II (91%), while 9% were level III. All children used SAFOs. The mean daily wearing time was 4.53 +/- 2.29 hours, and the mean duration of SAFO use was 1.88 +/- 1.58 years.

Parental education levels varied. College or university education was reported for 51% of fathers and 52% of mothers. Secondary education was reported for 30% of fathers and 35% of mothers. Most fathers were engaged in service or job-related work (63%), whereas most mothers were housewives (93%). Most families reported a monthly income between

20,001 and 40,000 Bangladeshi taka (75%). Residence was almost equally distributed between city (50%) and village (46%), with a small proportion from small towns (4%). Key sociodemographic and clinical findings are presented in Table 1.

Table 1 Sociodemographic and clinical characteristics of participants (n=100)

Variable	Category	Frequency/value
Child age	<7 years	73 (73.0)
Child age	>=7 years	27 (27.0)
Child age	Mean +/- SD (range)	5.96 +/- 2.70 (1-14)
Child sex	Boy	69 (69.0)
Child sex	Girl	31 (31.0)
Type of CP	Hemiplegic	10 (10.0)
Type of CP	Diplegic	76 (76.0)
Type of CP	Quadriplegic	14 (14.0)
GMFCS level	Level II	91 (91.0)
GMFCS level	Level III	9 (9.0)
Daily SAFO wearing time	Mean +/- SD (range)	4.53 +/- 2.29 (1-12) hours
Duration of SAFO use	Mean +/- SD (range)	1.88 +/- 1.58 (1-10) years
Father's education	College/University	51 (51.0)
Mother's education	College/University	52 (52.0)
Family income	20,001-40,000 BDT	75 (75.0)
Residence	City/Village	50 (50.0) / 46 (46.0)

CP: cerebral palsy; GMFCS: Gross Motor Function Classification System; SAFO: solid ankle-foot orthosis; BDT: Bangladeshi taka.

Caregiver responses generally indicated positive perceptions of SAFO use. Most caregivers reported that their child wore the brace regularly (70%), clearly understood its purpose (74%), and had received sufficient advice and training from doctors or therapists (72%). However, affordability was a major concern: only 18% agreed that the family could afford the brace and related treatment, while 59% disagreed or strongly disagreed. Follow-up access was also a challenge, with 36% reporting that traveling to the clinic was difficult. Selected caregiver responses are presented in Table 2.

Table 2 Selected caregiver responses regarding SAFO utilization

Item	Agree n (%)	Neutral n (%)	Disagree/strongly disagree n (%)
Child wears the brace regularly	70 (70.0)	22 (22.0)	8 (8.0)
Brace is comfortable for the child	56 (56.0)	21 (21.0)	23 (23.0)
Child walks more confidently with brace	47 (47.0)	39 (39.0)	14 (14.0)
Brace is easy to put on and take off	55 (55.0)	37 (37.0)	8 (8.0)
Family can afford brace and treatment	18 (18.0)	23 (23.0)	59 (59.0)
Satisfied with support and services	56 (56.0)	33 (33.0)	11 (11.0)
Clearly understands purpose of brace	74 (74.0)	24 (24.0)	2 (2.0)
Received enough advice and training	72 (72.0)	27 (27.0)	1 (1.0)
Travel to clinic for follow-up is difficult	36 (36.0)	32 (32.0)	32 (32.0)
Understands daily wearing duration	49 (49.0)	43 (43.0)	8 (8.0)

SAFO: solid ankle-foot orthosis. Response categories were collapsed for concise presentation.

Quality-of-life responses showed relatively favorable scores for family acceptance, peer acceptance, play opportunities, general health, and future confidence. However, independence in daily activities was the weakest area: 50% of caregivers reported that the child was unhappy or very unhappy about their ability to eat, dress, or use the toilet independently. Selected CPQOL responses are shown in Table 3.

Table 3 Selected quality-of-life responses

Item	Happy/very happy n (%)	Neither n (%)	Unhappy/very unhappy n (%)
Accepted by family members	81 (81.0)	15 (15.0)	4 (4.0)
Accepted by other children	73 (73.0)	24 (24.0)	3 (3.0)
Opportunities to play with friends	71 (71.0)	24 (24.0)	5 (5.0)
Opportunities to participate in school	49 (49.0)	47 (47.0)	4 (4.0)
Opportunities for games, sports or recreation	66 (66.0)	30 (30.0)	4 (4.0)
General health	75 (75.0)	17 (17.0)	8 (8.0)
Mobility	61 (61.0)	24 (24.0)	15 (15.0)
Eating, dressing or toileting independently	38 (38.0)	12 (12.0)	50 (50.0)
Child happiness	58 (58.0)	29 (29.0)	13 (13.0)
Confidence about future	84 (84.0)	10 (10.0)	6 (6.0)

Quality-of-life responses were collapsed into positive, neutral, and negative categories for concise presentation.

As shown in Figure 1, quality-of-life outcomes were generally favorable across psychosocial domains. The highest positive ratings were observed for confidence about the future (84%), family acceptance (81%), general health (75%), and peer acceptance (73%). In contrast, independence in activities of daily living demonstrated the lowest positive rating (38%), indicating that many children continued to experience functional dependence in self-care activities despite orthotic use. This finding suggests that while SAFOs may support mobility and participation, additional rehabilitation interventions may be required to improve independence in daily occupations.

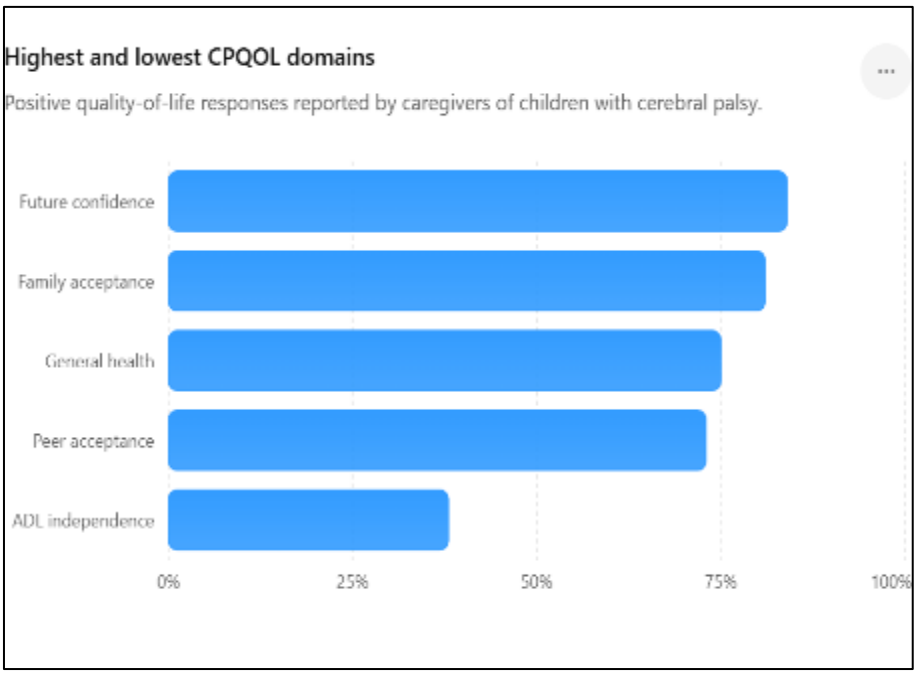

Figure 1 Highest and lowest quality-of-life domains among children with cerebral palsy

Kruskal–Wallis H tests showed no statistically significant differences in SAFO utilization or CPQOL scores across categories of father's or mother's education ($p > .05$). This suggests that parental education level was not associated with either orthosis utilization or quality-of-life outcomes in this sample (Table 4).

Table 4 Mean ranks of SAFO utilization and CPQOL scores by parental education level (Kruskal–Wallis test)

Parental education	Outcome variable	Category	n	Mean rank
Father's education	SAFO utilization	No schooling	4	43.13
		Primary	15	53.80
		Secondary	30	43.95
		College/University	51	53.96
Mother's education	SAFO utilization	No schooling	3	46.67
		Primary	10	44.90
		Secondary	35	46.96
		College/University	52	54.18
Father's education	CPQOL	No schooling	4	50.13
		Primary	15	58.23
		Secondary	30	45.15
		College/University	51	51.40
Mother's education	CPQOL	No schooling	3	49.83
		Primary	10	40.35
		Secondary	35	45.67
		College/University	52	55.74

SAFO = Solid Ankle–Foot Orthosis; CPQOL = Cerebral Palsy Quality of Life.

Spearman's rank-order correlation revealed a moderate positive association between SAFO utilization and CPQOL scores ($\rho = 0.449$, $p < .001$), indicating that higher orthosis use was associated with better quality-of-life outcomes (Table 5).

Table 5 Spearman correlation between SAFO utilization and CPQOL score

Variables	Spearman's rho	p-value	Interpretation
SAFO utilization score and CPQOL score	0.449	<0.001	Moderate positive correlation

CPQOL: cerebral palsy quality of life; SAFO: solid ankle-foot orthosis.

Figure 2. Major barriers to solid ankle-foot orthosis (SAFO) utilization among children with cerebral palsy. Horizontal bar chart showing the proportion of caregivers reporting negative perceptions regarding key barriers to SAFO use. Affordability was the most frequently reported barrier (59%), followed by difficulty attending follow-up appointments (36%), brace discomfort (23%), and dissatisfaction with support services (11%). These findings suggest that financial constraints and healthcare accessibility may have a greater influence on orthotic utilization than parental educational attainment.

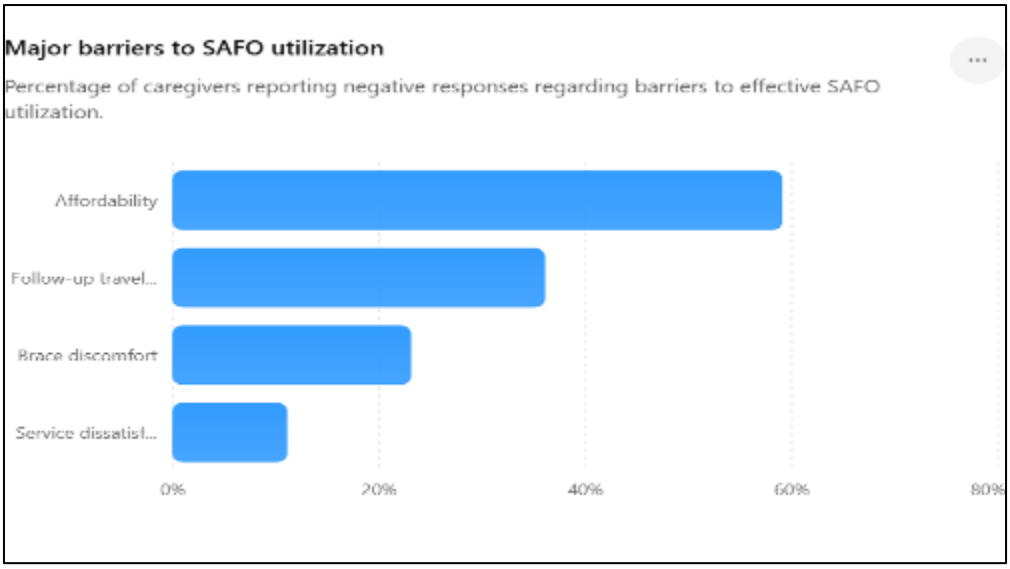

Figure 2 Major Barriers to SAFO Utilization Reported by Caregivers

4. Discussion

This study examined the influence of parental education on SAFO utilization and quality of life in children with CP in Bangladesh. The main finding was that parental education was not significantly associated with either SAFO utilization or quality of life. However, a moderate positive relationship was observed between SAFO use and quality of life, suggesting that orthotic adherence may have a more direct impact on child outcomes than parental education alone.

The lack of association between parental education and SAFO use may appear unexpected, as education is often linked with health literacy and service utilization. However, in rehabilitation contexts, formal education is not the only source of caregiver knowledge. Caregivers frequently acquire practical understanding through therapist demonstrations, repeated follow-up visits, peer learning, and experiential caregiving. In the present study, most caregivers reported adequate understanding of SAFO purpose and usage, suggesting that clinical instruction may help reduce disparities associated with educational differences.

These findings align with family-centered rehabilitation approaches, which emphasize collaboration between professionals and caregivers in managing childhood disability (12). Rather than relying on educational background as a predictor of adherence, clinicians should focus on structured training, clear communication, and ongoing support. Massey et al. emphasized the importance of co-designed interventions with parents in pediatric rehabilitation, particularly for complex therapy regimens (12).

The positive association between SAFO utilization and quality of life is clinically meaningful. SAFOs improve ankle stability, alignment, and gait efficiency, which may enhance functional mobility and participation. Previous systematic reviews have demonstrated improvements in gait performance, including stride length, balance, and walking efficiency in children with CP using ankle-foot orthoses (4,6). This study supports these findings by demonstrating that higher SAFO utilization is associated with better quality-of-life outcomes.

Quality of life in children with CP is multidimensional and extends beyond physical impairment. It includes mobility, participation, emotional wellbeing, social inclusion, school engagement, and family support. In this study, relatively higher scores were observed in domains such as family acceptance, peer interaction, and general wellbeing, while independence in self-care remained limited. This suggests that while orthotic use improves mobility-related aspects of life, additional rehabilitation interventions are required to address functional independence.

Affordability emerged as a major barrier to SAFO utilization. Many caregivers reported financial constraints related to device procurement, maintenance, and follow-up visits. This finding is consistent with social determinant frameworks, which emphasize that health outcomes are shaped by economic and structural factors rather than knowledge alone (9). In low-resource settings such as Bangladesh, financial barriers significantly influence access to assistive technology and rehabilitation services (3).

Comfort and usability were also important considerations. Although many caregivers reported positive experiences, some identified issues such as discomfort, skin irritation, difficulty in footwear compatibility, and child resistance. Previous research has shown that user perception strongly influences orthotic adherence, and discomfort may lead to reduced use even when clinical benefits are understood (7,8).

These findings have important clinical implications. First, caregiver training should be standardized and provided irrespective of educational background, focusing on practical skills such as orthosis application, skin inspection, wearing schedules, and footwear selection. Second, regular follow-up is essential to ensure appropriate fit and function, particularly as children grow. Third, rehabilitation systems should address affordability through subsidized services and improved access pathways. Finally, quality-of-life assessment should be integrated into routine clinical evaluation alongside functional outcomes.

This study has several limitations. The cross-sectional design limits causal inference. The purposive sampling from two centers may reduce generalizability. The sample size was smaller than the calculated requirement, reducing statistical power. SAFO utilization was based on caregiver report, which may introduce recall bias. In addition, clinical factors such as spasticity severity, orthosis fit, and environmental influences were not fully controlled. Future longitudinal, multicenter studies are recommended to explore causal relationships between orthotic use, functional outcomes, and quality of life.

5. Conclusion

Parental education was not significantly associated with SAFO utilization or quality-of-life outcomes among children with cerebral palsy in this study. However, SAFO utilization showed a moderate, statistically significant positive correlation with CPQOL scores, indicating that regular, effective orthotic use is associated with better well-being. The findings suggest that clinical outcomes may depend less on formal parental education alone and more on practical caregiver training, professional follow-up, affordability, comfort, and family-centered rehabilitation support. Strengthening orthotic services and caregiver education may improve mobility, participation, and quality of life for children with CP in Bangladesh.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

Marzana Shelly declares no financial or non-financial conflicts of interest. Md. Ismail Hossen declares no financial or non-financial conflicts of interest

Statement of ethical approval

The study was approved by the Institutional Review Board of the Bangladesh Health Professions Institute (Ref: CRP-BHPI/IRB/09/2025/1141). It involved human participants and was conducted in accordance with institutional ethical requirements.

Statement of informed consent

Informed consent was obtained from all parents or primary caregivers of each participant included in the study.

Data Availability

The datasets generated and analyzed in the current study are available from the corresponding author upon reasonable request, subject to institutional permission and confidentiality requirements.

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