

THE IMPACTS OF PHYSICAL ENVIRONMENT TOWARDS CHILDREN WITH CEREBRAL PALSY

Nur Halinda Halimi
Kulliyah of Architecture and Environmental Design
International Islamic University Malaysia, 50728 Kuala Lumpur, Malaysia
Email: jclynda26@gmail.com

Norwina Mohd Nawawi
Kulliyah of Architecture and Environmental Design
International Islamic University Malaysia, 50728 Kuala Lumpur, Malaysia
Email: norwina@iium.edu.my

Srazali Aripin
Kulliyah of Architecture and Environmental Design
International Islamic University Malaysia, 50728 Kuala Lumpur, Malaysia
Email: srazali@iium.edu.my

ABSTRACT

The physical environment plays an important role for all persons with disabilities from various aspects. This includes persons with cerebral palsy, a common childhood disability affecting many children worldwide. Cerebral palsy affects approximately 2 to 3 in every 1000 births globally, which is attributed to brain injury occurring either during pregnancy, birth, or early years of life. Although several studies have discussed the role of the physical environment among children with disabilities, there are limited reviews on the impact of the physical environment on children with cerebral palsy. Therefore, this article reviews previous studies regarding the impact of the physical environment on children with cerebral palsy. This review was conducted by desktop analysis from various databases as adopted by previous scholars. Specifically, accessibility, participation, functionality, and quality of life were identified as the themes encompassing the impact of the physical environment on children with cerebral palsy. A critical analysis was performed in this study and the results would benefit both health sciences and built environment disciplines. Detailed information on the specific attributes or features in the physical environment that influence accessibility, participation, functionality, and quality of life among children with cerebral palsy were elucidated and recommended. This future study would be beneficial to stakeholders, professionals in the built environment, and medical fields, as well as caregivers who wish to create the appropriate physical environment for children with cerebral palsy.

Keywords: cerebral palsy, physical environment, accessibility, participation, quality of life

INTRODUCTION

Cerebral Palsy (CP) is a common childhood disability that occurs due to brain injury during pregnancy, birth, or early years of life (Novak et al., 2017). Depending on the brain injury, CP could lead to permanent disorders, causing limitations of mobility, movement, and in some cases impacting cognition, sensory, and communication. There are three (3) main types of CP, namely, spastic, dyskinetic, and ataxia. According to Padmakar et al. (2018), spastic CP is the most common globally affecting approximately 70% of CP patients. The incidence is reported to be 2 to 3 of every 1000 live births worldwide (Patel et al., 2020). Meanwhile, in Malaysia, detailed statistics of patients with CP are still inconclusive and inaccurate. In Malaysia, cerebral palsy registration is governed by the Department of Social Welfare (DSW) under the Persons with Disability (PWD) application. Based on the registration of DSW, 1147 applications were recorded between January 2019 and November 2021. However, it is strongly believed that many more have not come to get their children registered. Rigorous campaigns and roadshows are carried out annually to promote awareness in registering themselves or family members under the PWD application. Ying et al. (2021) reported that insufficient information on CP in Malaysia causes difficulties in research, as well as planning and providing better services to these patients including their caregivers. The accurate data is highly desirable to support and enhance current policies, and to improve guidelines, especially for children with CP and their caregivers. The absence of data at inception on CP impacts the delivery of services and facilities for the group.

Cerebral palsy is an incurable and irreversible condition. However, many health professionals believed that early detection and prompt treatment through clinical interventions and therapies will assist in improving one's health physically, mentally, and emotionally, thereby preventing further complications (Novak et al., 2017). Novak et al. (2017) reported that detailed investigation through clinical reasoning and standardised tools can accurately diagnose CP as early as a few months after birth. Health professionals assessed and monitor children with CP from the ages of two (2) to eighteen (18) years old through four motor functional classification systems as follows (Patel et al., 2020):

- i. Gross Motor Function Classification System (GMFCS),
- ii. Manual Ability Classification System (MACS),
- iii. Communication Function Classification System (CFCS)
- iv. Eating and Drinking Ability Classification System (EDACS)

Aside from medical treatments and therapy classes, the physical environment is sought to impact the wellbeing of children with CP. As most CP cases involve some sort of physical disability, it is evident that the physical environment is crucial to promote independence and self-care. Having a child with physical disabilities requires parents and families to undergo modifications and adaptations to their homes for their child to live independently or at least lift some burden off among family members. As quoted by Morgan et al. (2016), adaptations or modifications are needed and deep consideration is implemented to cater for the current and future demands. This statement was supported by Bray et al. (2020) who pointed out that modifications and adaptations to the built environment are needed to enhance accessibility and facilitate movement for people with limited mobility capabilities. Complication and intensity of home modification depend on the child's CP severity. Østensjø et al. (2005) reported that modifications performed increase with the level of the child's GMFCS, whereas 80% of modifications were conducted for children with the IV and V levels who are dependent on the caretaker and unable to move by themselves. The modifications have lessened the burden of care and made functioning and self-care more effective. Furthermore, Badia et al. (2016) reported that modified environments could prevent deterioration, improve health conditions, and outcomes for people with disabilities. Additionally, Colver et al., (2012) also remarked that the modified environment made for children with disabilities could be a therapeutic intervention to improve daily self-skills and movement.

This article discusses themes that impact children with CP: accessibility, participation, functionality, and quality of life. This study would critically analyse the impacts of the physical environment on children with CP, the outcome would be beneficial to both health sciences and built environment disciplines.

METHODOLOGY

This research used a desktop analysis approach to review and explore the common themes that were discussed in the scholarly articles on how the physical environment impacts children with CP. This review method and content analysis of numerous literature were adopted by previous scholars such as Yuvaraj (2020) and Beal et al. (2011) for similar purposes.

Below are three steps in the methodology:

1. Searching for articles in the databases
2. Selecting and screening for relevant articles
3. Categorising the themes and reporting the findings

Step 1: Searching articles in databases

The literature search was performed in various databases mainly in Scopus, Google Scholar, and Mendeley. The search strings for published articles included "physical environment" and "cerebral palsy" and "children", "physical environment" and "physical disability" and "built environment." The initial search produced numerous articles, however, many of them were removed as their findings did not address the physical environment for children with CP or those with physical disabilities. Furthermore, some of the articles were incomplete. Some articles were inaccessible, unable to be downloaded, and had broken linkages. Most of these articles were written by researchers in the field of medicine, health science, and rehabilitation, which focused on medical issues that were not related to the discipline of built environment and architecture. Thus, the review for the relevant articles on CP had to be recalled for as far back as 20 years (i.e., from 2002 onwards).

Step 2: Selecting and screening for relevant research articles

The articles were selected based on the following predetermined criteria:

- i. Study population involving children with CP or children with disabilities as their sample population.
- ii. Studies that consist of any type of physical environment, such as schools, homes, community, and others.
- iii. Any type of study methodology and design.
- iv. Studies that mention the importance and significance of the physical environment.

Articles excluded were based on the following predetermined criteria:

- i. Articles that focus on medical and health science findings.
- ii. Articles of any sort of review method.

As a result, the final number of articles from 2002 to 2021 that were eligible for review were reduced to 33. The 33 articles were inserted in the ATLAS.ti 9 software as the main documents and subsequently were reviewed to identify the discussion themes as shown in Figure 1. The articles were reviewed and analysed individually to extract the findings as presented in Table 1.

Figure 1: List of papers reviewed and findings



Table 1: List of papers reviewed and findings

Author and Year of Publication	Findings
Arnaud et al., 2021	This article discussed the detailed methodology, which is a longitudinal approach on how the impact of the environment on participation and quality of life among young adults with CP was carried out. This method could be recommended for future studies on the appropriate physical environment for children with CP.
Rezaei et al., 2021	This article revealed that policymakers and authorised personnel should include more supportive laws for the betterment of the physical environment at home, community, school, public, and required services to enhance the quality of life in children with CP.
Taj Din et al., 2021	This study investigated that physical, social, and attitudinal environment influenced and may limit life participation among children with CP.
van Engelen et al., 2021	This research concluded that barriers in the physical environment were not the only factors restricting participation among children with physical disabilities. Emotional barriers, roles of professionals, and behavioural change in society were also included as vital factors influencing children with physical disabilities.
Gharib et al., 2021	This article discussed that the social participation in children with cerebral palsy spastic diplegia (CPSD) depended on the physical and attitudinal environments. Modifications at home, public areas, school, and transportation services could enhance their social participation.
Bray et al., 2020	This study identified accessibility, safety, relationships, social inclusion, participation, personal care, pain and discomfort, independence, energy, self-esteem, and mental-wellbeing as the issues associated with mobility and the quality of life among adults with various physical disabilities.
Bonehill et al., 2020	This study executed an audit on accessibility and mobility among adults with CP in the urban environment. It suggested that laws and regulations on urban design, transport services, and local accessibility should be further improved to accomplish the Equality's Act 2010, United Kingdom.
Longo et al., 2020	This article recorded the encounters by children with CP with regards to barriers and facilitators while participating in leisure activities under the International Classification of Functioning, Disability and Health, World Health Organisation (ICF-WHO) classifications: ICF classification: (1) Body Functions; (2) Body Structures; (3) Activities and Participation; (4) Environmental Factors; and (5) Personal Factors. Their findings suggested that more barriers were reported than facilitators in the children's experiences.
Cleary et al., 2019	This research demonstrated the importance to have an appropriate school setting to promote physical activities for children with CP. The children reported that a specially built school that incorporates special physical needs made them feel comfortable and safe.
Cho et al., 2019	This article concluded that laws and policies for accessibility and mobility in residential properties for patients with CP are still limited despite the enforcement of laws, such as the Convenience Act for the Disabled, the Residential Vulnerable Act, and the Health Rights Act for the Disabled, Korea.
Mohamed Sayed et al., 2019	This study stated that the modified and adapted physical environment in homes and care centres demonstrated positive effects in enhancing motor skills and performance among children with CP.
Earde et al., 2018	This article highlighted that caregivers' perception of barriers among children with CP were the improper design of public facilities, transportation, health facilities, and education.
Bourke-Taylor et al., 2018	This research demonstrated that cooperation and collective efforts from parents and schools are crucial to enhancing participation among children with CP.
Kang, Hwang, et al., 2017	This article identified the environmental barriers, which included inaccessibility in the physical environment, insufficient information, support in children's social activities, and limitation in communal resources.
Stephens et al., 2017	This study revealed that the built environments did not meet the minimal requirements for children with disabilities. Accessibility needs to be enhanced in all types of policies to support the notion of equity for all.

Boniface & Morgan, 2017	This article concluded that a specialist is needed to guide families and occupational therapists throughout the process of home modifications. The researchers reported that families were not equipped with the right information for their children with special needs.
Kang, Hsieh, et al., 2017	This research highlighted that parents of preschool children often face barriers, such as unavailability of information and government resources, family financial issues, public negative perceptions, inaccessible physical environment, and public transport services.
Espín-Tello & Colver, 2017	This study concluded that the right physical environment promotes social and communal participation in children with CP. The needed modification in the environment differs according to the child's age and, as well as policies and laws of a certain region or country.
Badia et al., 2016	This article demonstrated that the quality of life among children with physical disabilities depends on environmental barriers. The results showed that environmental accessibility could benefit the physical well-being of children and adolescents with CP.
Staples & Essex, 2016	This research discussed that most of the accommodations dwelled by families living with severely disabled children were inaccessible and does not meet the needs of the disabled. The authors also indicated that inclusive housing design is still not properly addressed even with the awareness from people in the built environment industry and planning authorities.
Morgan et al., 2016	This study concluded that some families living with a disabled child complained that the adaptations executed were poorly designed, the allocated space was insufficient, and did not focus on the child's needs. Furthermore, the adaptations were not performed holistically for the other family members and loss of identity in social spaces.
Anaby et al., 2014	This article depicted that the most common barriers in the environment for children and youth with or without disabilities are the physical environment, transportation services, lack of emotional support, attitudes, and government policies.
Law et al., 2014	This research highlighted that the condition of children with disabilities, their family background, and environmental barriers were the predictors in physical and psychosocial aspects.
Nobakht et al., 2013	This study indicated that the most common barriers experienced by children with CP were inadequate public facilities and services, policies and administration, and limitation of transport availability and education.
Svraka, 2013	This article investigated the architecture of the interior and exterior of persons with CP homes, which later introduced architectural solutions and guidelines to improve their quality of life.
A. Colver et al., 2012	This study concluded that environmental modification is essential for optimum participation among children with CP.
Darrah et al., 2011	This article demonstrated that the context therapy approach had a positive impact on children with CP given that it is not designed to change the child's impairment but to modify the surrounding environment and the activity to suit the child's abilities.
A. F. Colver et al., 2010	This research stressed the need for the physical environment to be improved in order to enhance the accessibility of children with CP through proper government policies and laws. Designers, health professionals, and families of children with CP should collaborate to help review the existing policies and regulations.
Lim & Wong, 2009	This study proved that quality of life was affected among children with CP and their caregivers. The authors also compared managing strategies and support towards CP in other countries that Malaysia could probably look up to.
Imms et al., 2008	This article reported higher participation in informal activities than formal activities among children with CP. Participation in active-physical activities was found to be lower.
Prellwitz & Skär, 2006	This research depicted a detailed description of spaces mostly used by disabled children. The authors differentiated the perception of accessibility and usability.
Østensjø et al., 2005	The study revealed that type of assistive devices chosen influences the functional skills and caregiving issues in children with CP. Environmental modifications also benefited mobility, self-care, and social function. Transportation services and residential designs need to be deliberately considered to encourage device usage.
Østensjø et al., 2003	This study uncovered the aspects influencing everyday functioning among young children with CP, which included skills, assistance from caregivers, and environmental adaptations.

Step 3: Categorising the themes and reporting the results

After reviewing the 33 articles individually, a list of common themes which included accessibility, participation, functioning, and quality of life were derived (Refer Figure 2). The next step is to use the ATLAS.ti 9 software to categorise the common themes on accessibility, participation, functioning, and quality of life in the context of physical environment towards CP as discussed in these articles. This study analysed the findings found in the research articles on the themes focusing on the physical environment impacting children with CP and provided adequate recommendations for future designs and guidelines.

FINDINGS AND DISCUSSION

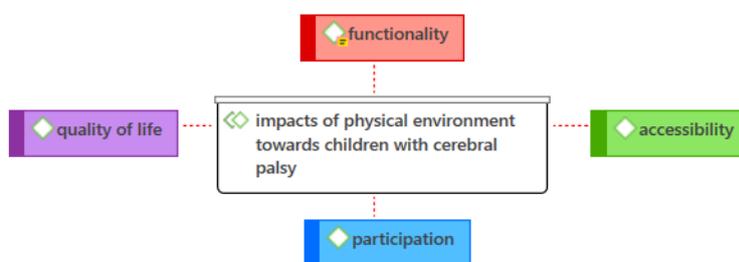
From the review process and preliminary findings from the articles listed in Table 1, most of the articles discussing the physical environments and their impact on children with CP or those with physical disabilities were written by scholars from the medicine and rehabilitation fields. Table 2 presents the list of related articles that were not written by scholars from the built environment discipline. Resultantly, the terminology used to reflect the surrounding or the environment in these articles was only the physical environment. Meanwhile, terms such as architecture or built environment or space were not used as part of the description or criteria. The findings also indicated that only very few of these articles discussed intricately the criteria, elements or features that are required for the general wellbeing of children with CP.

Table 2 : Papers reviewed according to discipline

Field of Discipline	Number of Papers Reviewed
MEDICINE AND CHILD NEUROLOGY	7
PAEDIATRICS AND PHYSICAL THERAPY	8
REHABILITATION	7
ORTHOPAEDIC	1
ENVIRONMENTAL RESEARCH, PUBLIC HEALTH AND HEALTH SCIENCE	5
DEVELOPMENTAL DISABILITIES	4
CHILDREN’S GEOGRAPHIES	1

As shown in Figure 2, this literature review revealed the impacts of the physical environment on children with CP, and the main themes were categorised as (i) accessibility, (ii) participation, (iii) functionality and (iv) quality of life. Figure 3 depicts the relationship of these themes concerning the contribution of the physical environment impact.

Figure 2: Impacts of physical environment towards children with cerebral palsy using Atlas.ti 9 software



Accessibility

Generally, accessibility is understood as gaining access to something or somewhere without any barrier. It is also perceived as something that can be reached without obstruction. Persons with disabilities overcome their inaccessibility by using assistive aids and equipment to move around, such as wheelchairs, crutches, walkers, and pushchairs. As Bonehill et al. (2020) quoted that mobility is a medium to enable access for employment, leisure, social opportunities, and also as a means to manage daily routine activities. The right physical environment plays a vital role in achieving accessibility and mobility among these groups. According to the Persons with Disabilities Act 2008, accessibility in the built environment is a right for persons with disabilities. Section 26, Chapter 1 of Part IV of the Act, stated that public facilities, amenities, services, and public buildings shall be made accessible and have equal treatments for all persons regardless with or without disabilities. Likewise, Svraga (2013) also mentioned that accessibility is a basic right for everyone, including persons with disabilities. Any barrier or any sort of obstruction that reduces or creates inaccessibility is considered discrimination. This notion is also supported by Kang et al. (2017) who pointed out that accessibility to the environment is highly important for children regardless of whether they are disabled or not.

A study conducted by Stephens et al. (2017) reported that fundamental necessities were not fulfilled for home accessibility. The study also revealed that more than 90% of respondents stated that at least one of these accessibility criteria would be beneficial; handrails in corridors, functional doorknobs or kitchen taps; workable countertops, and accessibility to reach food

and cutleries. Among areas and rooms that were barrier-free includes the toilet and the washrooms at school, and in shopping malls around their neighbourhood. Not many complained of inaccessibility for these areas. They stated that facilities around the neighbourhood and public buildings were more users disabled and user friendly than their homes. Other studies also support this notion by highlighting the difficulty in accessing in and around the home for children with disabilities in Wales (Boniface & Morgan, 2017; Prellwitz & Skär, 2006). Hence, adaptations and modifications in houses are needed to enhance and improve the child's mobility and accessibility. Lim & Wong (2009) stressed that it is crucial to make the necessary modification to ensure optimum mobility is met and that facilities can be reached. On the other hand, Cleary et al. (2019) concluded that special schools for CP in Australia were well equipped and custom-built to accommodate physical activities.

Several studies concluded that accessibility in the physical environment is beneficial to children with CP and their caregivers. Badia et al. (2016) stated that the benefit of accessibility among children and adolescents with CP could improve their physical wellbeing. Meanwhile, Bray et al. (2020) reported that there is a significant influence on the quality of life when their participants gained access to both public and private spaces. This is also supported by findings from Rezaei et al. (2021) that more awareness to occupational therapists regarding the significance of barrier-free environments contributes to the quality of life among children with CP. When the barrier from the environment is addressed or eliminated, the focus could be shifted to their rehabilitation therapies and treatment interventions. Another advantage cited by Østensjø et al. (2005) is attaining independence via the child's self-mobility, thus reducing the caregivers' burden. However, Prellwitz & Skär (2006) cited that insufficient access to the external environment would also lead to lesser playtime other than homes while causing lesser social interaction with friends and peers.

Participation

Another impact of the physical environment on children with CP is participation. According to the World Health Organisation, Geneva (2002), participation is defined as involvement in a situation in life. Taj Din et al. (2021) emphasised that participation is a crucial health milestone for children with CP. It is also important in training and practicing daily chores and activities to prepare the child for adulthood (Imms et al., 2008). Therefore, numerous studies showed that participation has several advantages and benefits among children with CP. As concluded by Longo et al. (2020), enjoyment, relaxation, self-enrichment, and building the child's competence and determination are some participation-related benefits. Badia et al. (2016) quoted that barrier-free surroundings lead to positive findings in community participation among children with CP. Meanwhile, Arnaud et al. (2021) and Taj Din et al. (2021) also reported that participation could affect this group of children negatively, thus participation might be restricted if environmental barriers exist. Referring to Earde et al. (2018), the surrounding environment may either be a facilitator or a barrier to children with CP when performing activities. To improve participation among these children, barriers need to be minimised while enhancing facilitators (Nobakht et al., 2013).

Participation does not only apply to homes or during therapies and treatment sessions, it is also important in playtime, recreation, and leisure. A study by Rezaei et al. (2021) highlighted that participation levels are highly associated with increased access to the physical environment. These authors concluded that children with CP who can participate with ease in the community would improve their self-confidence. The right physical environment enables children with disabilities by exploring and experiment with objects while interacting with other children (Østensjø et al., 2005). Imms et al. (2008) reiterated that chores at home may be beneficial to children with CP as it prepares them towards independence in their future adulthood.

Functionality

Optimum functioning skills is key to independence and self-care. To achieve this, the physical environment has to be changed to suit the child's needs. Anaby et al. (2014) and Østensjø et al. (2003) concluded that changing the environment and removing barriers are more effective than trying to change the child's functional issues. This was also seconded by Darrah et al. (2011) who stated that changing the child's context through a contextual therapy approach and adjusting the task proved to be more effective than concentrating on changing the child's impairments. A physical environment that has been adjusted could increase the child's functioning skills and affect the family's life. Svřaka (2013) cited that even homes that are accessible to people with disabilities in the community promote an independent life. A study carried out by Østensjø et al. (2005) proved that making adjustments and usage of assistive equipment increased the child's independence and performance in daily routines of self-care, mobility, and social interaction. Another study conducted by Bourke-Taylor et al. (2018) found that students with CP loved to be at school because the environment was welcoming and inclusive. Bray et al. (2020) posited that physical functioning may be affected by mobility. This notion was also supported by Longo et al. (2020) who mentioned that there were more barriers than facilitators, which then influenced their participation and body functions.

Quality of life

Quality of life is essential to all human beings as a basis to live life to the fullest. It is known that being ill and living with a disability may contribute to an individual's quality of life and wellbeing. Despite limited information in Malaysia, CP is considered one of the most chronic conditions of disability in children (Lim & Wong, 2009). Besides affecting the child, quality of life also impacts the caregivers and parents. The studies conducted by Azar-Nassiry (2014), Ying et al. (2021) and Bahry et al. (2019), found that the quality of life in parents are affected when caring for their child with special needs. These authors highlighted that parents from the Islamic faith mostly turn to the Almighty to share their difficulties and sadness.

Law et al. (2014) reported that quality of life in children with physical disabilities is affected by issues relating to environmental barriers, function in families, physical functioning, general health, and behavioural difficulties. Scholars such as Badia et al. (2016) and Arnaud et al. (2021) agreed that barriers in the surrounding environment influence the level of quality of life among children and adolescents with CP. Stephens et al. (2017) mentioned that the municipalities in Canada offered small funding for home modifications that would help improve the quality of life for children with disabilities. As highlighted by Rezaei et al. (2021),

the surrounding aspects contributing to the quality of life among children with CP are services, systems, and policies implemented by the government.

Many literature sources emphasised the benefits of implementing modifications and adaptations in homes. Bray et al. (2020) pointed out that modifications and adaptations to the built environment are needed to enhance accessibility and facilitate movement for people with limited mobility capabilities. Complication and intensity of home modification depend on the severity of the child's condition. Østensjø et al. (2005) reported that modifications performed increase with the level of the child's GMFCS, whereas 80% of modifications were conducted for children with the IV and V levels who are dependent on the caretaker and unable to move by themselves. These modifications have lessened the burden of care and made functioning and self-care more effective. Furthermore, Badia et al. (2016) reported that modified environments could prevent deterioration, improve health conditions, and outcomes for people with disabilities. In addition, Colver et al. (2012) suggested that the modified environment made for children with disabilities could be a therapeutic intervention to improve daily self-skills and movement. However, despite the several advantages, some families of children with CP or disabilities may have insufficient funds to make the necessary modifications and adaptations. Another study by Bridge (2019) revealed that 83% of mothers had to release their employment and their jobs to care for their children full time. This is probably due to the many rehabilitation sessions and medical appointments to be committed at the health facility. Stephens et al. (2017) highlighted that lack of funding, insufficient finance sources, and denial in rental agreements were some of the main causes that hindered fulfilling the home modification needs. These modifications are costly, just as purchasing a customised home that is purposely built for individuals with physical disabilities. Staples & Essex (2016) stressed that to meet marginal profits, housing developers build residences based on the market land and construction costs, thereby causing the dwelling to be disabled unfriendly and inaccessible. These financial burdens also contribute to the emotional distress in the family, thus affecting their quality of life.

LIMITATION OF RESEARCH

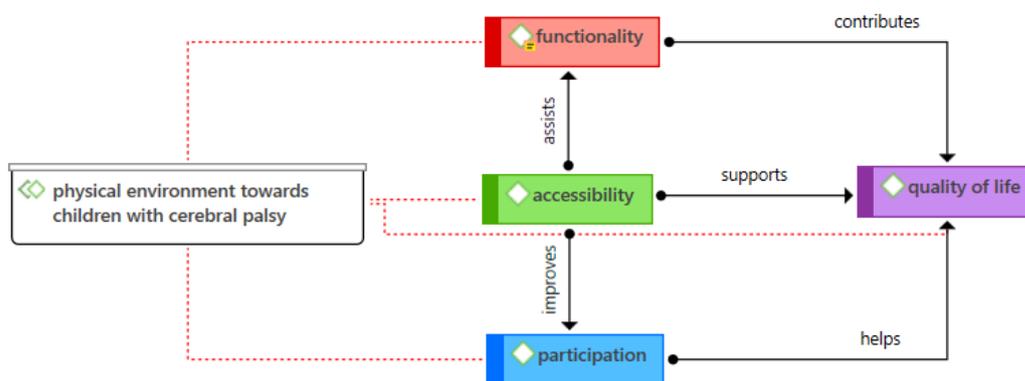
Undeniably, there are numerous and a variety of articles focusing on children with CP and those with disabilities. Nevertheless, most scholars were from the field of medicine and rehabilitation, thus only a few were from the built environment field. Therefore, there is data paucity and limited studies that focused on the appropriate physical built environment for children with CP. Notwithstanding, the reviewed studies highlighted the significance of the physical environment towards children with CP and their caregivers. The present findings reveal that architects, designers and planners have a huge obligation to ensure the best and utmost appropriate physical environment for this group of disabilities.

The search databases were only limited to Google Scholar, Mendeley, and Scopus. The literature search and retrieved articles were not extended to other databases, such as WOS and Science Direct. Several other themes might be discovered should more articles be reviewed. Other suggested themes might include safety and therapeutic significance.

CONCLUSION

This article has demonstrated the impacts of the physical environment on children with CP under the aspects of accessibility, participation, functionality, and quality of life. Figure 3 depicts the relationship of these themes in relation to the impact contributed by the physical environment.

Figure 3: Relationship of themes using Atlas.ti 9 software



Based on the literature reviewed, it is evident that the physical environment impacts children with CP. Cerebral palsy is a disorder that may involve physical disabilities, therefore the best physical environment should be built to support their incapability and encourage independence. The physical environment settings discussed were at homes and residences, schools, public places, and transportation services. Many scholars stressed that there were more barriers in the environment, rather than facilitators to help and assist children with CP in terms of accessibility, participation, functionality, and quality of life. Figure 4 displays the relationships between the four themes. The aspect of participation, accessibility, and functionality contributes to the quality of life among children with CP. A barrier-free environment that results in accessibility improves the child's participation and functionality.

Awareness and knowledge were frequently discussed in the literature gathered. As Lim & Wong (2009) cited that lack of awareness among the public in Malaysia caused children with CP to receive minimal support from the public. Hence, this situation has created limited access to facilities and resources by families caring for children with CP. This notion is also supported by Kang, Hwang, et al., (2017) who found that parents complained about the limited availability of resources, communal programmes and services for the family and the community, and little information on the child's illness and treatment. The local government must provide the best facilities for social, cultural and leisure events to have an inclusive society for people with disabilities. To create or design the appropriate physical environment for children with CP, awareness and knowledge regarding the needs and routines of these children should be digested. This event was also seconded by Badia et al. (2016), acknowledging it as the first crucial step to eliminate negative perceptions towards children and adolescents with CP. Longo et al. (2020) cited children with CP may sometimes feel embarrassed, intimidated, and being discriminated against from taking part in leisure and sports activities, thus creating a relationship barrier between them and their social context. Bray et al. (2020) highlighted that participants in their study felt frustrated and feeling isolated due to inaccessibility.

It can be summarized that awareness is the first crucial factor in order to implement or enforce policies and requirements. Staples & Essex, (2016) stressed the importance of high awareness of different disciplines in the housing sector and the government to enforce regulatory and statutory control in order to provide for an inclusive society. The introduction and formulation of statutory policies cannot be imposed on the government and local authority personnel without understanding and having appropriate knowledge about children with CP. Professionals and authorised individuals should take the opportunities to implement the needs of CP or any disability in the built environment development as a social obligation while considering it as *maslahah*, an Islamic value of welfare deed towards the public interest. Prior researchers demonstrated that inclusive society was not enforced and promoted enough laws and policies globally. All professionals from different backgrounds of disciplines should come together and work on a comprehensive policy to ensure that children or people with physical disabilities are comfortable and inclusive in the built environment. Doctors and therapists are experts from the field of medicine and therapy should sit eye to eye with architects, engineers and contractors who are professionals from the built environment. Results from a study by Rezaei et al., (2021) concluded that policymakers from the health discipline should assist in developing additional laws for the adaptation of the physical environment in homes, schools, workplace, rehabilitation services, and others as one of the ways to improve quality of life of children with CP.

The review process has revealed a substantial gap in the provision of a physical environment for CP. These studies carried out by researchers in various fields have combined aspects of CP management care from multiple disciplines of health, medicine, environmental science, and rehabilitation. Despite discussing the importance and benefits of the physical environment to children with disability, mainly CP, however, these articles did not elaborate on the criteria and specifications of the physical built environment. This is probably due to the fact that very few articles were written by scholars from the built environment. With this significant gap, in the current studies on the impact of the built environment for CP, detailed studies are highly recommended. In summary, the aspects of the physical environment towards children with CP is inconclusive. Detailed research on the built environment needs to be conducted to identify the key success factors in built environments that are most appropriate to be implemented for the wellbeing of children with CP. Conclusively, this study will provide stakeholders, authorised personnel, designers and builders, health professionals, and families from different backgrounds to improve the obstacles and difficulties experienced daily by children with CP.

REFERENCES

- Anaby, D., Law, M., Coster, W., Bedell, G., Khetani, M., Avery, L., & Teplicky, R. (2014). The mediating role of the environment in explaining participation of children and youth with and without disabilities across home, school, and community. *Archives of Physical Medicine and Rehabilitation*, 95(5), 908–917. <https://doi.org/10.1016/j.apmr.2014.01.005>
- Arnaud, C., Duffaut, C., Fauconnier, J., Schmidt, S., Himmelmann, K., Marcelli, M., Pennington, L., Alvarelhão, J., Cytera, C., Rapp, M., Ehlinger, V., & Thyen, U. (2021). Determinants of participation and quality of life of young adults with cerebral palsy: longitudinal approach and comparison with the general population - SPARCLE 3 study protocol. *BMC Neurology*, 21(1), 254. <https://doi.org/10.1186/s12883-021-02263-z>
- Azar-Nassiry, M. Z. (2014). *Muslim Mothers' Use of Spirituality When Parenting a Child with Special Needs A Dissertation Presented to the Graduate Faculty of the Couples and Family Therapy Program California School of Professional Psychology Alliant International University Irvine*. Alliant International University.
- Badia, M., Begoña Orgaz, M., Gómez-Vela, M., Verdugo, M. A., Ullán, A. M., & Longo, E. (2016). Do environmental barriers affect the parent-reported quality of life of children and adolescents with cerebral palsy? *Research in Developmental Disabilities*, 49–50(October 2017), 312–321. <https://doi.org/10.1016/j.ridd.2015.12.011>
- Bahry, N. S., Mat, A., Kori, N. L., Ali, A. M., Munir, Z. A., & Salleh, M. Z. M. (2019). Challenges Faced by Malaysian Parents in Caregiving of a Child with Disabilities. *GATR Global Journal of Business Social Sciences Review*, 7(2), 118–124. [https://doi.org/10.35609/gjbssr.2019.7.2\(2\)](https://doi.org/10.35609/gjbssr.2019.7.2(2))
- Beal, C., Beal, C. D., Sharma, & A., Gardner, T., Chong, M., Beal, C. D., & Sharma, A. (2011). *A Desktop Analysis of Potable Water Savings from Internally Plumbed Rainwater Tanks in South-East Queensland, Au... Related papers A Desktp op Analysis of Pot able Wat er Savings from Int ernally Plumbed Rainwat er Tanks in So... A Desktop Analysis of Potabl*. <https://doi.org/10.1007/s11269-011-9973-0>
- Bonehill, J., Vob Benzon, N., & Shaw, J. (2020). "The shops were only made for people who could walk": impairment, barriers and autonomy in the mobility of adults with Cerebral Palsy in urban England. <https://doi.org/10.1080/17450101.2020.1746057>
- Boniface, G., & Morgan, D. (2017). *The Central Role of the Occupational therapist in Facilitating Housing Adaptations/Home Modifications for Disabled Children*. <https://doi.org/10.1177/0308022616680216>
- Bourke-Taylor, H. M., Cotter, C., Lalor, A., & Johnson, L. (2018). School success and participation for students with cerebral palsy: A qualitative study exploring multiple perspectives. *Disability and Rehabilitation*, 40(18), 2163–2171.

<https://doi.org/10.1080/09638288.2017.1327988>

- Bray, N., Spencer, H., Tuersley, L., & Edwards, R. T. (2020). *Disability and Rehabilitation Development of the MobQoL patient reported outcome measure for mobility-related quality of life Development of the MobQoL patient reported outcome measure for mobility-related quality of life*. <https://doi.org/10.1080/09638288.2020.1741701>
- Bridge, G. (2019). Parents as care managers: The experiences of those caring for young children with cerebral palsy. *Parents as Care Managers: The Experiences of Those Caring for Young Children with Cerebral Palsy, January*, 1–308. <https://doi.org/10.4324/9780429443893>
- Cho, G. H., Chung, C. Y., Lee, K. M., Sung, K. H., Cho, B. C., & Park, M. S. (2019). Study of the Residential Environment and Accessibility of Rehabilitation for Patients with Cerebral Palsy. *Journal of the Korean Orthopaedic Association*, 54(4), 309. <https://doi.org/10.4055/jkoa.2019.54.4.309>
- Cleary, S. L., Taylor, N. F., Dodd, K. J., & Shields, N. (2019). Barriers to and facilitators of physical activity for children with cerebral palsy in special education. *Developmental Medicine and Child Neurology*, 61(12), 1408–1415. <https://doi.org/10.1111/dmcn.14263>
- Colver, A. F., Dickinson, H. O., Parkinson, K., Arnaud, C., Beckung, E., Fauconnier, J., Marcelli, M., McManus, V., Michelsen, S. I., Parkes, J., & Thyen, U. (2010). Access of children with cerebral palsy to the physical, social and attitudinal environment they need: A cross-sectional European study. *Disability and Rehabilitation*, 33(1), 28–35. <https://doi.org/10.3109/09638288.2010.485669>
- Colver, A., Thyen, U., Arnaud, C., Beckung, E., Fauconnier, J., Marcelli, M., McManus, V., Michelsen, S. I., Parkes, J., Parkinson, K., & Dickinson, H. O. (2012). Association between participation in life situations of children with cerebral palsy and their physical, social, and attitudinal environment: A cross-sectional multicenter European study. *Archives of Physical Medicine and Rehabilitation*, 93(12), 2154–2164. <https://doi.org/10.1016/j.apmr.2012.07.011>
- Darrah, J., Law, M. C., Pollock, N., Wilson, B., Russell, D. J., Walter, S. D., Rosenbaum, P., & Galuppi, B. (2011). Context therapy: A new intervention approach for children with cerebral palsy. *Developmental Medicine and Child Neurology*, 53(7), 615–620. <https://doi.org/10.1111/j.1469-8749.2011.03959.x>
- Earde, P. T., Praipruk, A., Rodpradit, P., & Seanjumla, P. (2018). Facilitators and Barriers to Performing Activities and Participation in Children with Cerebral Palsy: Caregivers' Perspective. *Pediatric Physical Therapy*, 30(1), 27–32. <https://doi.org/10.1097/PEP.0000000000000459>
- Espín-Tello, S. M., & Colver, A. (2017). How available to European children and young people with cerebral palsy are features of their environment that they need? Europe PMC Funders Group. *Res Dev Disabil*, 71, 1–10. <https://doi.org/10.1016/j.ridd.2017.09.018>
- Gharib, M., Shayesteh Azar, M., Vameghi, R., Hosseini, S. A., Nobakht, Z., & Dalvand, H. (2021). Relationship of Environmental Factors With Social Participation of Children With Cerebral Palsy Spastic Diplegia: A Preliminary Study. *Journal of Rehabilitation*, 21(4), 422–435. <https://doi.org/10.32598/rj.21.4.426.11>
- Imms, C., Reilly, S., Carlin, J., & Dodd, K. (2008). Diversity of participation in children with cerebral palsy. *Developmental Medicine and Child Neurology*, 50(5), 363–369. <https://doi.org/10.1111/j.1469-8749.2008.02051.x>
- Kang, L. J., Hsieh, M. C., Liao, H. F., & Hwang, A. W. (2017). Environmental barriers to participation of preschool children with and without physical disabilities. *International Journal of Environmental Research and Public Health*, 14(5). <https://doi.org/10.3390/ijerph14050518>
- Kang, L. J., Hwang, A.-W., & Chen, C. L. (2017). Participation and Environmental Factors of Children with Physical Disabilities in Taiwan. In *Intech: Vol. i* (Issue tourism, p. 13).
- Law, M., Hanna, S., Anaby, D., Kertoy, M., King, G., & Xu, L. (2014). Health-related quality of life of children with physical disabilities: A longitudinal study. *BMC Pediatrics*, 14(1). <https://doi.org/10.1186/1471-2431-14-26>
- Lim, M. S. Y., & Wong, C. P. (2009). Impact of cerebral palsy on the quality of life in patients and their families. *Neurology Asia*, 14, 27–33.
- Longo, E., Regalado, I. C. R., Galvão, E. R. V. P., Ferreira, H. N. C., Badia, M., & Baz, B. O. (2020). I Want to Play: Children with Cerebral Palsy Talk about Their Experiences on Barriers and Facilitators to Participation in Leisure Activities. *Pediatric Physical Therapy*, 32(3), 190–200. <https://doi.org/10.1097/PEP.0000000000000719>
- Mohamed Sayed, R., Shafiq Ahmed, J., & Abdel Maqsood, J. M. (2019). The physical environment and its relationship to the development of motor functions in children with cerebral palsy : A study on the environment of the dwelling and the care center. *Journal of Environmental Science*, 46. <https://doi.org/10.1016/j.jaapos.2015.07.102>
- Morgan, D. J., Boniface, G. E., & Reagon, C. (2016). The effects of adapting their home on the meaning of home for families with a disabled child. *Disability and Society*, 31(4), 481–496. <https://doi.org/10.1080/09687599.2016.1183475>
- Nobakht, Z., Rassafiani, M., Rezasoltani, P., Sahaf, R., & Yazdani, F. (2013). Environmental barriers to social participation of children with cerebral palsy in Tehran. *Iranian Rehabilitation Journal*, 11.
- Novak, I., Morgan, C., Adde, L., Blackman, J., Boyd, R. N., Brunstrom-Hernandez, J., Cioni, G., Damiano, D., Darrah, J., Eliasson, A. C., De Vries, L. S., Einspieler, C., Fahey, M., Fehlings, D., Ferriero, D. M., Fethers, L., Fiori, S., Forssberg, H., Gordon, A. M., ... Badawi, N. (2017). Early, accurate diagnosis and early intervention in cerebral palsy: Advances in diagnosis and treatment. *JAMA Pediatrics*, 171(9), 897–907. <https://doi.org/10.1001/jamapediatrics.2017.1689>
- Østensjø, S., Brogren Carlberg, E., & Vøllestad, N. K. (2005). *The use and impact of assistive devices and other environmental modifications on everyday activities and care in The use and impact of assistive devices and other environmental modifications on everyday activities and care in young children with cerebral* . <https://doi.org/10.1080/09638280400018619>
- Østensjø, S., Carlberg, E. B., & Vøllestad, N. K. (2003). Everyday functioning in young children with cerebral palsy: Functional skills, caregiver assistance, and modifications of the environment. *Developmental Medicine and Child Neurology*, 45(9), 603–612. <https://doi.org/10.1017/S0012162203001105>
- Padmakar P, P., kumar, K. S., & S Parveen, P. (2018). Management and Treatment for Cerebral Palsy in Children. *Indian Journal of Pharmacy Practice*, 11(2), 104–109. <https://doi.org/10.5530/ijopp.11.2.23>
- Patel, D. R., Neelakantan, M., Pandher, K., & Merrick, J. (2020). Cerebral palsy in children: A clinical overview. *Translational*

- Pediatrics*, 9(1), S125–S135. <https://doi.org/10.21037/tp.2020.01.01>
- Prellwitz, M., & Skär, L. (2006). How children with restricted mobility perceive the accessibility and usability of their home environment. *Occupational Therapy International*, 13(4), 193–206. <https://doi.org/10.1002/OTI.216>
- Rezaei, A., Raji, P., Mousavi, S. T., Mahmoodian, M., & Baghestani, A. R. (2021a). Study of environmental factors and quality of life in children with cerebral palsy based on international classification of functioning, disability and health. *British Journal of Occupational Therapy*, 1–7. <https://doi.org/10.1177/03080226211008724>
- Rezaei, A., Raji, P., Mousavi, S. T., Mahmoodian, M., & Baghestani, A. R. (2021b). Study of environmental factors and quality of life in children with cerebral palsy based on international classification of functioning, disability and health. *British Journal of Occupational Therapy*, May, 2021. <https://doi.org/10.1177/03080226211008724>
- Staples, J., & Essex, S. (2016). Design, Disability and the Planning Challenge: The Reality of Living with Severely Disabled Children. *Planning Practice and Research*, 31(3), 327–346. <https://doi.org/10.1080/02697459.2016.1174974>
- Stephens, L., Spalding, K., Aslam, H., Scott, H., Ruddick, S., Young, N. L., & McKeever, P. (2017). Inaccessible childhoods: evaluating accessibility in homes, schools and neighbourhoods with disabled children. *Children's Geographies*, 15(5), 583–599. <https://doi.org/10.1080/14733285.2017.1295133>
- Svraka, E. (2013). Cerebral Palsy and Accessible Housing. *Intech*, 32(July), 97–120.
- Taj Din, S., Hafeez, N., Hameed, F., Ahmed, S., Iftikhar, N., & Ahmad, W. (2021). To Evaluate the Life Participation of Cerebral Palsy Children with their Environment. 15(4), 681.
- van Engelen, L., Ebbers, M., Boonzaaijer, M., Bolster, E. A. M., van der Put, E. A. H., & Bloemen, M. A. T. (2021). Barriers, facilitators and solutions for active inclusive play for children with a physical disability in the Netherlands: a qualitative study. *BMC Pediatrics*, 21(1), 1–13. <https://doi.org/10.1186/s12887-021-02827-5>
- World Health Organization Geneva. (2002). Towards a common language for functioning, disability and health: ICF. *International Classification*, 1149, 1–22. <http://www.who.int/classifications/icf/training/icfbeginnersguide.pdf>
- Ying, K., Van Rostenberghe, H., Kuan, G., Mohd Yusoff, M. H. A., Ali, S. H., & Yaacob, N. S. (2021). Health-related quality of life and family functioning of primary caregivers of children with cerebral palsy in malaysia. *International Journal of Environmental Research and Public Health*, 18(5), 1–13. <https://doi.org/10.3390/ijerph18052351>
- Yuvaraj, M. (2020). *Global responses of health science librarians to the COVID-19 (Corona virus) pandemic: a desktop analysis*. <https://doi.org/10.1111/hir.12321>