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The children's built environment attributes scale: Development, validation, and implications for children living in institutional care

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Abstract The built environment of childcare spaces plays an important role in the psychosocial wellbeing of a child. An appropriate physical environment encourages curiosity, independence, and a sense of belonging by serving as an active contributor to a child's holistic growth. Natural light, safe and adaptable layouts, and access to outdoor spaces promote physical activity, cognitive engagement, and emotional well-being. Conversely, overcrowded and noisy spaces undermine a child's sense of autonomy and security. Therefore, designing spaces that are child-friendly and comprehensible, and measuring the attributes of such a built environment, is essential. In India, childcare institutions (CCIs) are a dominant form of alternative care for orphaned and vulnerable children. There are limited tools that comprehensively measure and evaluate the built environment attributes of CCIs. Thus, a new Children's Built Environment Attributes Scale (*CBEAS*) was constructed. Factor analyses of this scale yielded five factors: Crowding, Housing Quality, Space Personalization, Outdoor Spaces, and Spatial Autonomy. The scale showed internal consistency reliability (alpha). Data were collected from 147 Orphaned and Vulnerable Children (OVC) residing in three different CCIs in Maharashtra, India, using a paper-and-pencil method. Various factors showed association differently and significantly predicted children's well-being. These findings suggest the need to assess not only the overall built environment but also its individual components. A higher score for each component reflects a better built environment in relation to that specific component, except for crowding, where a higher score reflects lower crowding. The authors propose that the scale could be further modified and restandardized for use in various applications, such as childcare centers, residential schools, and similar settings.

Keywords: physical environment, orphanages, perceived spatial comfort, rating scale post-occupancy evaluation

1. Introduction

1.1. Background

The UN Convention on the Rights of the Child officially recognized the rights of children in 1989 (Quennerstedt et al., 2018), where children are not just viewed as developing individuals but are increasingly viewed as individuals with identities and experiences (Devine & Apperly, 2022; Osterhaus et al., 2025). The way in which the built environment shapes children's development and well-being, as well as their perceptions of it, has received attention over the past few decades. With respect to adolescents, Liu et al. (2020) suggested that a person's sense of well-being is not only shaped by the individual traits of a person or their living conditions, but also on the basis of their perceptions and experience of their surroundings. However, Cha (2023) suggested that studies correlating spatial characteristics with young children's development are scarce, where research in this area has traditionally leaned towards objective measures.

Internationally, research has sought to consult children regarding their experiences with issues concerning them (Darcy et al., 2024; Sommer et al., 2010). In this context, some studies have highlighted the relevance of including children's outlook in shaping their immediate surroundings, where an "insider" perspective on the quality of childhood settings would benefit their long-term development (Chen & Wang, 2018). Recent studies that have applied methods such as Clark (2005) "mosaic approach" deal with children being seen as active participants making sense of their environment and not just passive recipients of adult knowledge, ensuring that children's voices are heard (Biddle, 2017; Rayna & Garnier, 2018). Rosen (2010), through interviews, investigated Canadian preschool children's perceptions of their curriculum; the children had opinions on how to alter the curriculum in different ways. White (2015) reported inviting preschool children to share their nature-based experiences and perspectives on outdoor experiences through photographs.

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On the other hand, Blades and Kumari (2011) asserted that previous studies involving children sharing their perspectives through drawings and photography had certain drawbacks. According to these authors, photography did not yield useful information beyond interviews, apart from being time-consuming, whereas drawings did not always result in highlighted problems in the built environment. El-Husseiny et al. (2025), through their recent systematic review of children's built environment, reported that combining participatory methods with traditional approaches is more effective in capturing multiple facets of children's impressions of their physical surroundings. Another recent example is the multimethod illustrative model, the 'Jourchin approach' by Mani & Woolley (2023), which aims to understand the preferences of orphans regarding the outdoor space of their living environment. This suggests that a multimethod approach offering qualitative and quantitative insights would lead to a better understanding of children's experiences regarding their built environment.

Studies reporting children's perceptions in South Asia are still scarce in mainstream research approaches (Kousar & Abdul Mutalib, 2022). In a recent study of how the psychology of well-being in South Asia was underrepresented, Bernardo et al. (2022) focused on five years from 2017 to 2021, revealing that developed nations were extremely well represented. Furthermore, many of the above-cited methods involve children living in family-based care, whereas research examining perceptions of out-of-family care of marginalized children is limited. Orphaned and vulnerable children are devoid of parental care and live in formal arrangements, and there is limited information about their life experiences, socioemotional wellbeing, and aspirations (Rogers et al., 2021). Thus, recognizing the need for a region-specific measure involving perceptions of orphaned and vulnerable children, a rating scale was developed for the South Asian context to quantify their perceptions of their built environment. The present study focuses on children in the childcare institutions (CCIs) of India.

1.2. Past research on the built environment and child development

In most references, the term "environment" is primarily discussed in relation to the social environment of a setting, including the interaction between children and adults, with less attention given to the designed physical environment. The characteristics of the built environment of childcare centres, such as density, privacy, noise, and outdoor space, affect children's social-emotional development (Evans, 2021; Whipple & Evans, 2022). Globally, studies report that, in general, a smaller group size in childcare centres results in better-quality caregiving, leading to improved developmental outcomes among children (Bowne et al., 2017; Dalgaard et al., 2022), including improved child-caregiver attachment behaviours in institutional settings (Warner, et al., 2017). Through their study, Davies and Christensen (2016) underscore the importance of privacy, a relatively neglected topic thus far, where children seek opportunities for peace and quiet within their homes. Several studies have underscored the detrimental effects of noise on children's cognitive performance (Chere & Kirkham, 2021; Fernández-Quezada et al., 2025; Spiegel et al., 2021). In the case of outdoor spaces, multiple studies suggest that optimally designed outdoor play areas can significantly enhance sociocognitive activities in children while promoting stronger connections between children and nature (Park & Lee, 2019; Tang & Woolley, 2023; To & Grierson, 2024).

Kodali et al. (2023) emphasize that child wellbeing should not be viewed solely from a health perspective. They must include the diverse factors of the designed physical environment that are important for policy and design, as they affect children's quality of life. They further underscore the need to study how children discern the built environment's attributes and how social functions performed within the built environment correlate with children's well-being. Thus, the above studies collectively highlight the influence of the built environment on a child's development, establishing the foundation for further exploration in this field. However, in institutional care facilities, studies on orphaned and vulnerable children's perceptions of their built environment attributes, such as density, privacy, and noise, are rare. Thus, this paper intends to fill this gap by proposing a scale to assess the built environment of CCIs from the children's perspective.

1.3. Review of existing rating scales

Various existing scales, especially the Home Observation for Measurement of the Environment (HOME-21) (Lansford et al., 2003) and Wachs's (1990) seminal work, the Purdue Home Stimulation Inventory (PHSI), have been recently used to evaluate the sociophysical environment of homes (Hoyniak et al., 2022). The Infant/Toddler Environment Rating Scale (ITERS-3) (Harms et al., 2017) and the Early Childhood Environment Rating Scale (ECERS-R) (Harms et al., 2014) are used throughout developed countries. These scales assess educational programs, staff, and other social environment facets of early childhood settings, but do not address perceptions of the built environment. The Preschool Climate Scale (PSCS) measures the characteristics of schools, including their social and physical settings (İnceoğlu & Aslan, 2022). However, the built environment component of the scale only includes five items that address cleanliness, light, ventilation, and safety, lacking a holistic view of children's perceptions of their milieu. Rauktis et al. (2008) reconceptualized the 26-item Restrictiveness of Living Environment Scale, touching upon built environment attributes such as privacy, décor, and movement within the setting. In contrast, the recently developed PRS-ChEE scale evaluates only the CCI outdoor spaces from the child's viewpoint (Mani et al., 2023).

Despite the literature highlighting the significance of the designed physical environment, the above instruments reveal a limited number of items for assessing the built environment. To address this shortcoming, the Children's Physical Environment Rating Scale (CPERS) was developed by Moore and Sugiyama (2007) as a postoccupancy evaluation tool to measure the

characteristics of the physical environment of childcare centers. This physical environment rating scale is divided into four subscales that assess spaces based on planning: children's indoor spaces, the building as a whole, and outdoor spaces. The scale addresses all aspects of the immediate physical environment for early childhood care centres (for children up to 5 years of age). However, even though the scale is a holistic assessment tool for use in developed countries, its application in settings other than early childhood care centres requires modification based on the age and cultural context in which it is administered. A modified version of the CPERS was recently used by Amissah-Essel et al. (2020) to study early childhood schools in South Africa.

Childcare practices in South Asian countries significantly differ from those in developed nations. The institutional care centres in these countries often face challenges related to limited resources and inadequate infrastructure. The local standards of these countries may differ from the international frameworks on which the CPERS was constructed. Furthermore, its applicability in institutional care spaces such as CCIs that house children of all age groups, namely, early childhood, middle childhood, and adolescent children, would require the scale to be modified with items reframed and adapted to that setting.

Another drawback of the existing scales is that they have been constructed as an evaluation tool to be used by researchers, failing to consider the perspectives of the stakeholders (here, children), who are long-term occupants of those spaces.

Children's perspectives on matters related to child research have received increased attention over the years (Backe-Hansen, 2023). Therefore, Kelly et al. (2023) stress that incorporating children's subjective understanding and experiences through their participation would lead to a better interpretation of the meaning behind their expressions. Considerable attention has been given to children brought up in family settings, but the voices of orphaned and vulnerable children growing up in institutional care have been overlooked. A reliable and valid scale must assess institutionalized children's perceptions of their built environment to address this gap. The following section discusses the need for a culturally appropriate assessment tool to assess the built environment.

1.4. Need for a culturally appropriate built environment assessment tool

Studies on the psychology of well-being in South Asia are scarce, with a recent upward trend representing well-being among marginalized groups (Bernardo et al., 2022), especially in India. As iterated by Bernardo et al. (2022), many of these studies reference the marginalized groups adapting to or coping with challenging situations. Hence, Bernardo et al. (2022) suggest developing new measures to construct culturally context-specific well-being.

A majority of deprived children exist in the Global South. However, most studies on the built or physical environment and child development have been conducted in North America and Western Europe (Ferguson et al., 2013). Within South Asia, India is home to 30 million orphaned and vulnerable children (OVCs), with an estimated 370,000 children living in 9589 CCIs (Keenan, 2025). Institutional care is dominant in India, as other alternative care options are still at an emerging stage. Adoption is a gruelling process that takes up to three years, and many of these children are compelled to live in CCIs. Ferguson et al. (2013) reported an important gap in the literature regarding the living conditions of children in the Global South. An extensive review of studies led to a call for an integrated approach to examine the role of the built environment in children's development by employing Bronfenbrenner's bioecological model (Bronfenbrenner, 1979; Bronfenbrenner & Morris, 1998) as a theoretical framework. While acknowledging a difference in the characteristics of children's built environment between developed nations and developing countries, in the Global South, almost no study has documented the impact of childcare environment quality on a child's development (Ferguson et al., 2013).

In the Indian context, Sinha's (1982) ecological model is more appropriate for understanding the development of the Indian child. The physical space (including overcrowding and lack of space to play outside the home), institutional setting, and general amenities are embedded in social interactions and have varying consequences for the child. (Sinha, 1982), including those under institutional care. Therefore, it is necessary to understand an individual in the context of their personal experiences. This necessitated the construction of a culturally and contextually appropriate assessment tool to measure children's perceptions of the built environment of childcare institutions.

The preliminary steps toward constructing a built environment assessment tool included the attributes of crowding and housing quality, as elaborated upon by Evans (2021) and Ferguson et al. (2013), as well as space personalization, spatial autonomy, and outdoor spaces, which were supported by the literature.

The following literature review explores the above attributes to construct the scale.

a. Crowding

There is a lack of studies measuring the impact of room size on individuals' well-being (Cha, 2023). Studies suggest that the most reliable way to measure crowding is the number of people per room (Evans, 2021; Ferguson et al., 2013). According to the U.S. Census, more than one person per room is considered crowded. At the same time, Evans et al. (1998) reported that densities ranged from 5 persons per room in working-class Indian families. High density is quite a common phenomenon in Indian households even today, but tolerance towards crowding has not been found to differ across cultural contexts (Ferguson et al., 2013). Wang et al. (2022) reported how crowded living conditions relate to mental health. Their study indicated that

crowded living conditions had a greater impact than other stressors did. Sia and Neethu (2022), in their cross-sectional study of residential crowding and subjective well-being, reported learned helplessness among residents in crowded Indian households. Ferguson et al. (2013) stress the importance of cognizance that children in South Asia live in overcrowded homes compared with North America and Western Europe. The present study aims to understand whether a child living in crowded conditions can occupy the same space as several others.

b. Noise

Chronic noise exposure is sometimes unpredictable and uncontrollable. As mentioned, environmental noise has been associated with cognition-related detrimental effects among children and adolescents (Fernández-Quezada et al., 2025). A study by Lepore et al. (2010) involving Indian school children reported decibel levels of 85 dBA, which is very loud, compared with 45 dBA, which is considered appropriate. Ferguson et al. (2013) suggest the need for studies about noise in the global South. Therefore, assessing children's sensitivity to and tolerance of noise should be further investigated.

c. Privacy and Territoriality

Like adults, children control their access to self through privacy (Laufer & Wolfe, 1977; Santos et al., 2024). One way to achieve this is by exercising territoriality by indicating a particular space as one's own by personalizing it and guarding it against encroachment (Altman, 1975; Lincoln, 2015). In some settings, children have very few choices for privacy, as they are defined as dependents (Hawk et al., 2008; Üzümcü, 2023; Zeegers et al., 1994). Through an empirical study, Santos et al. (2024) identified ways in which children and teenagers negotiated space, which included a need for privacy, the ability to make a choice regarding a space, and a sense of control over their environment. A primary territory is crucial for an individual's self-esteem and identity (Akesson, 2016; Altman, 1975). Privacy, territoriality, and children's perceptions of these concepts must be included for a culturally appropriate assessment.

d. Housing Quality

Evans (2021) asserts that inhabiting suboptimal physical settings has consequences for families or peers and has an adverse effect on the individual child. Many children in developing countries in the Global South live in substandard housing (Ferguson et al., 2013). In India, more than 430 million children are under the age of 18 (United Nations, 2025), 40% of whom need care and protection (Chandrakant, 2008). In addition to the multiethnic and multicultural nature of the Indian population, the country is overwhelmed with the colossal issue of economically backwards and socially marginalized groups, with children being the most vulnerable section. (Chandrakant, 2008). These children face issues related to inferior construction, cracks in walls, and leaking pipes (Bradley & Putnick, 2012). Furthermore, in unsafe homes, children's play is constrained by caregivers to reduce injury (Chaudhuri, 2004). Mura et al. (2023), in their study of partial home-work environments, also mentioned indicators of housing quality, such as air quality and visual comfort, that affect the well-being of an individual. Although the context differs with the items eliciting responses specifically regarding the remote workplace environment, it highlights the relationship between housing quality and well-being. Assessing housing quality should include children's perceptions of aspects of the built environment, such as light, ventilation, thermal comfort, and room cleanliness.

e. Outdoor Spaces

The importance of outdoor spaces has been reported above by Park and Lee (2019), Tang and Woolley (2023), and To and Grierson (2024), including the quality and safety of the outdoor spaces being more influential on children than quantity or accessibility (Kodali, et al., 2023). However, many existing scales evaluate these spaces from a researcher's perspective. Only the recently developed PRS-ChEE incorporates children's viewpoint of the restorative potential of the CCI outdoor spaces (Mani et al., 2023)

Ferguson et al. (2013) suggested that in the Global South, there is an increasing awareness of improving the quality of the built and psychosocial environment in childcare settings, with the existing ECERS-3 being a commonly used assessment tool for childcare environments. However, as mentioned above, there are limitations to the scale in assessing the built environment. Furthermore, Moore and Sugiyama's (2007) CPERS can be used as a comprehensive built environment assessment tool from a researcher's standpoint, but it does not consider children's perceptions regarding the built environment.

Therefore, the proposed CBEAS attempts to tap children's perceptions of the built environment by allowing them to express their opinions and experiences regarding the spaces they inhabit.

The proposed instrument intends to meet two purposes:

• To develop a reliable and valid perception rating scale for postoccupancy evaluation of children's built environments and identify areas needing overhaul or expansion.

• Develop a culturally appropriate standardized evaluation tool to compare children's perceptions across diverse childcare settings.

2. Materials and Methods

2.1. Proposed CBEAS: Theory and organization

Developmental theories such as those of Piaget and Inhelder (1969) and Bronfenbrenner (1979) stress that child–environment interaction is the foundation of their development. Piaget's theory emphasizes the active role of a child in learning and cognitive development. However, Bronfenbrenner's contextual theory focuses on the environment surrounding the child. Child development and well-being (dependent variable) is a dynamic interaction between the child and its immediate surroundings that includes the attributes of the designed environment (independent variable). The CBEAS uses contextual enquiry to understand users' interactions with their built environment and their perceptions of it. Moore and Sugiyama (2007) suggest that the child is an instrument of its own development, not a passive being bombarded by stimuli, and uses the milieu as an interactional medium. They further state that development occurs through the experience of the attributes of the built environment and responses from a child's actions towards it. On the basis of the literature and field research, a pilot study conducted at a CCI identified five domains for the study. Institutional care is the most widely used alternative care option for children despite being the least preferred alternative to adoption or foster care (Martínez-Usarralde et al., 2025; Pérez, 2015). A similar situation is prevalent in South Asian developing countries, particularly India. To identify the attributes of the built environment that are most likely to impact the resident children, the pilot study included a research protocol with extensive time spent within the premises of a CCI.

The CBEAS is constructed in five domains:

• Crowding

Items include statements concerning being comfortable in a space that is being occupied and used by other children.

• Housing Quality

Items relating to housing quality include statements linked to light, ventilation, room cleanliness, and occupants' thermal comfort throughout the year.

• Space personalization

Items for personalizing space to reflect one's personality and affinity towards a place have been included.

• Outdoor spaces

Items to check children's perceptions of outdoor spaces, their favourite outdoor places, and understand their preference for outdoor spaces.

• Spatial autonomy

Statements eliciting responses regarding children's territorial behavior, indicating the sense of spatial preference, have been included.

2.2. Study context and sampling strategy

Under the Juvenile Justice Act of 2015 and the Juvenile Justice Model rules of 2022 in India, care institutions are of various types, viz., children's homes (for children in need of care and protection), open shelters (for keeping children off the streets in safe short-term accommodations), and fit facilities (for temporary care of children). The study was carried out in CCIs (specifically children's homes) in Pune city, India, the eighth-highest populated city in the country according to the 2011 census.

As the data for CCIs were not readily available on the web, a right to information (RTI) with the Ministry of Women and Child Development (MWCD) was filed to procure the data. Of the 42 registered CCIs with a population of 1362 children without parental care, five CCIs with a sample size of 147 were permitted to carry out the study. The data were elicited from children of two age groups, middle childhood (7–12 years) and adolescence (13–18 years), who had resided in the CCI for more than a year.

2.3. Development and validation of the CBEAS

The development of the CBEAS followed a systematic approach to ensure its reliability and validity. A sample of 31 respondents from one CCI was utilized for pilot testing to evaluate item clarity and preliminary usability. The tool was then administered to the remaining 116 samples to collect data for further analyses.

Eleven subject matter experts evaluated the items to ensure that the key factors were captured. Factor analyses helped identify the underlying dimensions for further refinement of the tool. Internal consistency reliability analyses were conducted to evaluate the homogeneity of the test items, whereas factorial validity assessment confirmed the structural robustness of the instrument for practical applications. Finally, the CBEAS was administered alongside Liddle & Carter's (2015) Stirling Children's Wellbeing Scale to examine the relationship between CBEAS factors and children's wellbeing.

2.4. Purpose and administration of the CBEAS

The CBEAS was designed to assess children's perceptions of their built environment. Based on earlier studies, it was assumed that children living in CCIs are affected by crowding, noise, privacy, and issues related to territorial behaviour and housing quality. Perceptions are intangible, but they can be measured and ranked based on preferences.

The CBEAS was designed to ensure that the respondents comprehended the statements, with minimum acquiescence bias (tendency to agree with statements) or extreme response bias (tendency to select extreme response options). The CBEAS is constructed as a five-point Likert scale where participants can indicate their responses ranging from never (0), rarely (1), sometimes (2), often (3), and always (4).

Ethical considerations included having the tool approved by the university ethics committee with a project number. IEC/MITBIO/2024/07. As the children were OVC living in CCIs, permission was obtained from the trustees of the CCIs to administer the questionnaire to them. Only those children who gave verbal consent were subsequently included in the study sample. In the main sample, the second author engaged with the girls in the study to ensure that they felt safe and comfortable answering the statements.

3. Results

3.1. Pilot testing

Pilot testing was conducted on a sample of 31 OVC (12 boys aged 7–12 years and 19 boys aged 13–18 years) living in a CCI in Pune, India. The initial scale, consisting of 25 items, was administered to these 31 OVC. Item analyses were conducted via Kelley's (1939) item discrimination method (27% lower and upper group size cut-off) as well as the corrected item–total correlation method (Liu et al., 2020; Metsämuuronen, 2020). Items 5, 6, 7, 10, 11, 14, 16, 17, and 19 yielded discrimination values of less than 0.20 and corrected item-total correlation coefficients of less than 0.20, suggesting that these items require reframing.

3.2. Main sample

After the items were reframed, the 26-item CBEAS was administered to 116 OVC for item analysis and scale standardization. Children with known severe cognitive or psychological impairments were excluded based on information provided by caregivers and institutional staff. After removing outliers—defined as cases falling 1.5 times the interquartile range below the first quartile or above the third quartile—and unengaged respondents identified by low response variability, the final sample consisted of 80 OVC (aged 9–18 years; mean age = 13.00; SD = 2.67; 30 males and 50 females).

3.3. Content validity

Content validity ratios (CVRs) were computed via Microsoft Excel 2019 to validate the scale items. A quantitative approach was used to calculate content validity, as outlined by Charles Lawshe (1975). Lawshe's (1975) formula, termed the content validity ratio (CVR): "CVR = (Ne – (N/2))/(N/2)" was employed, where Ne = the number of subject matter experts (SMEs) indicating the item as essential and N = the number of SMEs. CVR yields values ranging between -1 and +1. A value of CVR greater than zero indicates that more than half of the SMEs indicated the item as essential. The critical values for CVR given by Wilson et al. (2012) were referred to, which provide critical values of CVR up to 40 SMEs. In this study, the number of SMEs was 11, which requires a minimum CVR value greater than or equal to 0.59 (Wilson et al., 2012). Thus, researchers have retained items with a CVR of 0.59 or greater. Out of 26 items, five items, viz., 6, 17, 19, 21, and 24, yielded a CVR below 0.59. The remaining 21 items' CVRs ranged from a minimum of 0.82 to a maximum of 1.00. Furthermore, factor analyses were conducted on 26 items to check the model fit.

3.4. Factor analyses

First, the factorability of the 26 items was investigated. Several widely accepted criteria for the factorability of a correlation were used. First, all 26 items correlated at least 0.3 with at least one other item from the same construct, indicating reasonable factorability. The Kaiser–Meyer–Olkin measure of sampling adequacy was 0.683, exceeding the recommended value of 0.6 (Kaiser & Rice, 1974). Additionally, Bartlett's test of sphericity was significant ($\chi 2$ (325) = 1185.87, $p < 0.01$). Finally, the communalities were all greater than 0.3, indicating that each item shared some variance with other items. Given these overall indicators, factor analysis was appropriate for all 26 items.

The principal component analysis factor extraction method was employed for exploratory factor analysis. The initial eigenvalues (> 1.00) indicated that the first eight factors explained approximately 19%, 12%, 8%, 8%, 6%, 5%, and 4% of the variance, respectively. The solution for eight factors was tested via Promax with Kaiser normalization rotations [oblique rotation was used because, in the social sciences, factors often correlate since behaviors rarely function independently (Costello & Osborne, 2005)]. The pattern matrix showed multiple cross-loadings.

As a part of the confirmatory factor analysis, the maximum likelihood method of factor extraction was used, as the data were normally distributed. According to Fabrigar et al. (1999), maximum likelihood is the best option for data that are relatively

normally distributed because “it allows for the computation of a wide range of indices of the goodness of fit of the model [and] permits statistical significance testing of factor loadings and correlations among factors and the computation of confidence intervals.” (Fabrigar et al., 1999) (p. 277). For factor rotation, Promax with the Kaiser normalization rotation method was employed. Bartlett's test of sphericity was significant ($\chi 2$ (105) = 369.92, $p < 0.01$), and the Kaiser–Meyer–Olkin measure of sample adequacy was 0.707, which is significantly greater than the generally advised threshold of 0.6. All of the communalities were higher than 0.30.

The expected number of factors (five) was extracted via confirmatory factor analysis (see figure 1). Eleven items, 5, 6, 7, 8, 17, 18, 19, 21, 22, 24, and 25, were removed because they had cross-loadings of 0.3 or higher and did not contribute to a simple factor structure. The five-factor solution, which accounted for 68.47% of the variance, was preferred because (a) its prior theoretical support and test constructor is a priori hypotheses and (b) the scree plot's eigenvalues “leveling off/flattening” (Cattell, 1966) after five factors (the scree test, according to Costello and Osborne (2005), entails exploring the graph of the eigenvalues and locating the data's natural bend or break point, where the curve flattens out. The number of factors to keep is often determined by the number of data points above the "break," that is, excluding the point at which the break occurs, and (c) the lack of primary loadings and the challenge of interpreting the sixth factor and subsequent factors, as shown in Table 1. The five factors explained 25.96%, 14.15%, 10.95%, 9.01%, and 8.39% of the variance, respectively.

Table 1 Factor loadings and communalities based on a maximum likelihood extraction method with promax with kaiser normalization rotation for 15 items (N = 80).

Item	Crowding	Housing Quality	Space Personalization	Outdoor Spaces	Spatial Autonomy	Communality Extraction
Item 1	.706					.617
Item 2	.605					.379
Item 3	.813					.586
Item 4	.595					.432
Item 9					.998	.535
Item 10					.566	.555
Item 11			.998			.999
Item 12			.566			.388
Item 13		.325				.300
Item 14		.954				.807
Item 15		.664				.460
Item 16		.650				.520
Item 20				.950		.832
Item 23				.431		.387
Item 26				.606		.459

Note: Factor loadings < 0.3 are suppressed. *Source:* Field (2024).

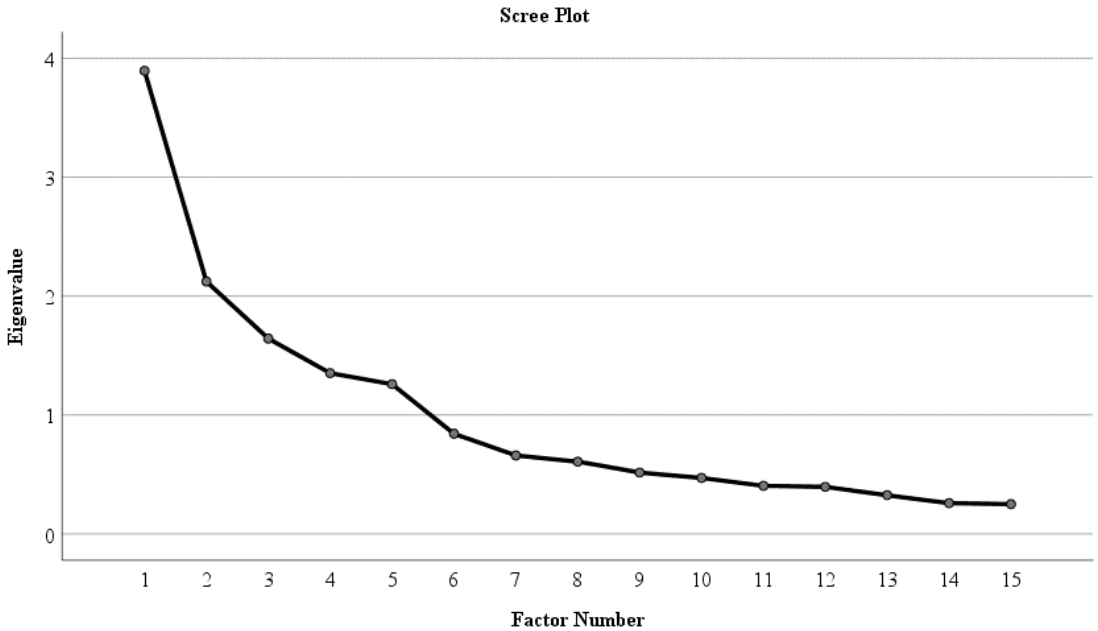

Figure 1 Scree plot for the factors of the CBEAS. *Note:* Table created using IBM SPSS Statistics. *Source:* Version 30.0; IBM Corp. (2024).

Table 2 shows the model fit indices for the confirmatory factor analysis (CFA). The comparative fit index (CFI) was found to be 0.981, indicating a good fit of the model to the data, as values above 0.90 are considered acceptable. The Tucker–Lewis index (TLI) of 0.975 also suggests that the model is a good fit. A root mean square error of approximation (RMSEA) of 0.030 indicates a close fit of the model, as RMSEA values below 0.08 are acceptable, and a lower bound of the CI 90% below 0.05 supports a good fit (Radu et al., 2025; Schreiber et al., 2006). The chi-square test for exact fit yielded a nonsignificant value that reflected the model's fit. Overall, these indices suggest that the model for the CBEAS demonstrates an acceptable to good model fit to the data. Figure 2 illustrates the confirmatory factor analysis model.

Table 2 Fit Measures and Test for Exact Fit for CBEAS (N = 80).

CFI	TLI	RMSEA	RMSEA 90% CI	
			Lower	Upper
0.981	0.975	0.030	0.000	0.071

Note: RMSEA p = 0.744. Exact Fit χ^2 (80) = 85.8, p = 0.308.

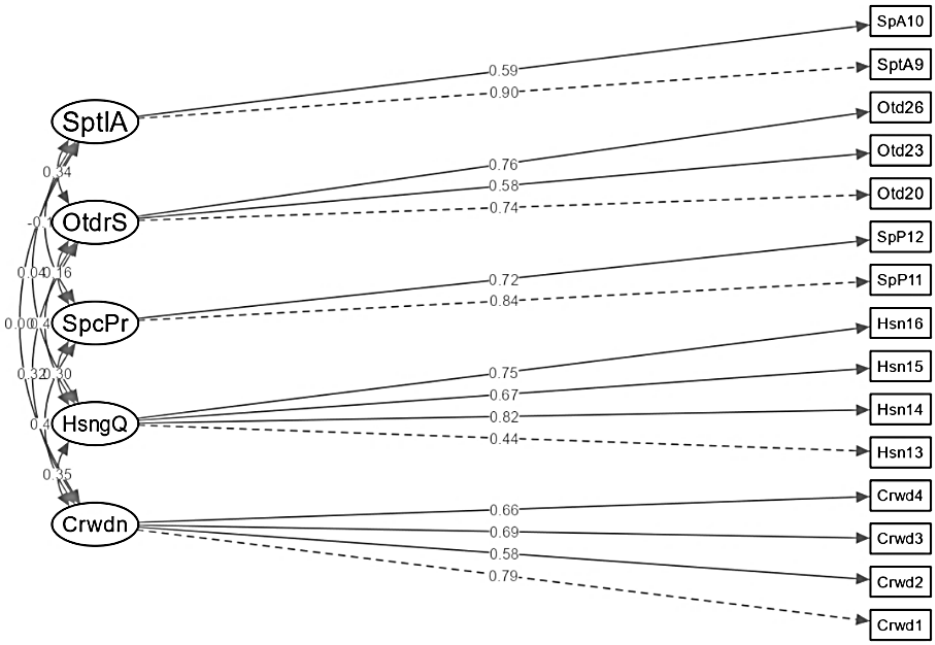

Figure 2 Confirmatory factor analysis model. *Note:* Figure created using Jamovi. *Source:* Version 2.6.44; The Jamovi Project, (2023).

3.5. Internal consistency reliability analyses

Table 3 provides descriptive and reliability statistics for the five-factor model of CBEAS. Cronbach's alpha for all five factors ranged from 0.695 to 0.770, indicating acceptable to good internal consistency reliability. Means and standard deviations are provided, and the authors recommend using these values to convert raw scores to z scores for interpretive purposes.

Table 4 shows the correlations between the five dimensions of CBEAS and the two dimensions of the Stirling Children's Wellbeing Scale. The results indicate that children's positive emotional state is positively correlated with the spatial autonomy provided to them, r (78) = 0.273, p < 0.05. Simple linear regression analysis revealed that special autonomy significantly predicts a positive emotional state, R2adj = 0.62, F (1, 78) = 6.26, p < 0.05.

Table 3 Descriptive and reliability statistics for five factors of the CBEAS.

Sr. No.	Factor	No. of items	M (SD)	Cronbach's α	McDonald's ω
1	Crowding	4	12.48 (2.87)	0.77	0.78
2	Housing Quality	4	13.39 (2.35)	0.75	0.77
3	Space Personalization	2	5.59 (3.53)	0.75	0.76
4	Outdoor Spaces	3	10.19 (2.01)	0.72	0.72
5	Spatial Autonomy	2	4.09 (2.51)	0.70	0.73

Note: N = 80. The commonly accepted cut-off for Cronbach's alpha is 0.70, which suggests acceptable internal consistency or reliability. Values above 0.80 are considered good. Similar cut-offs are recommended for McDonald's ω. *Source:* Nunnally & Bernstein, (1994); Hayes & Coutts, (2020).

Table 4 Pearson's correlations between the dimensions of CBEAS and stirling children's wellbeing scale.

Variable	M	SD	1	2	3	4	5	6	7
1. Crowding	12.48	2.87	1						
2. Housing Quality	13.39	2.35	.292**	1					
3. Space Personalization	4.09	2.51	.316**	.224*	1				
4. Outdoor Spaces	10.19	2.01	.266*	.358**	0.112	1			
5. Spatial Autonomy	4.86	2.38	-0.005	0.044	-0.108	.225*	1		
6. Positive Emotional State [a]	22.59	3.52	0.132	0.205	-0.145	0.183	.273*	1	
7. Positive Outlook	23.75	3.36	.360**	0.210	0.106	.264*	0.064	.368**	1

Note: N = 80. a. Dimensions of Stirling Children's Wellbeing Scale. *p < .05 (2-tailed), **p < .01 (2-tailed). *Source:* Liddle & Carter, (2015).

Children's positive outlook is negatively correlated with crowding (a higher score on crowding indicates lower crowding), r (78) = 0.360, p < 0.01. Children's positive outlook is positively correlated with the dimension of outdoor spaces, r (78) = 0.264, p < 0.05. Multiple linear regression analysis revealed that 13.8% of children's positive outlook variance can be attributed to crowding and outdoor spaces, R2adj = 0.138, F (2, 77) = 7.35, p < 0.001. These findings underscore the significance of built environment attributes in enhancing children's wellbeing.

4. Discussion

The study's objective was to develop and validate a scale for measuring children's built environment attributes in institutional care, which is more suited to the cultural context of South Asia, by employing both exploratory and confirmatory factor analyses. The results of exploratory factor analysis indicated that this construct has eight factors, which explain approximately 62% of the variance. However, the fit indices associated with the confirmatory factor analysis, scree test, arm break method, and the researchers' a priori hypotheses, along with theoretical support, motivate the choice of a five-dimensional model established by the confirmatory factor analysis. The final scale (see Supplementary Material - Appendix A) comprises 15 items. The internal consistency reliability established by using Cronbach's alpha coefficients ranged from 0.70 to 0.77 (Tavakol & Dennick, 2011), and McDonald's omega coefficients ranged from 0.72 to 0.78, indicating sufficient to high reliability of the factors (Rodrigues et al., 2025). Intercorrelations between the factors are moderate, indicating that the five dimensions are related yet distinct constructs. The correlations between the dimensions of CBEAS and the dimensions of the Stirling Children's Wellbeing Scale suggest the importance of the CBEAS in understanding the role of the built environment in children's wellbeing.

The proposed CBEAS was essentially constructed to assess the built environment of childcare institutions in South Asia due to the region's unique sociocultural context. As mentioned before, standardized tools from developed countries may not include items linked to the built environmental factors affecting children in the developing countries of the Global South. Thus, the CBEAS is a culturally appropriate assessment tool that captures children's perceptions of built environment attributes by incorporating context-appropriate indicators.

One limitation of this study is the geographical location of the participants, as all the CCIs are located within a single city. The study employed purposive sampling, and the approach to CCIs was based on networks with NGOs, as very few CCIs permitted data collection. The second limitation pertains to the sample size. Although the sample comprising 147 OVC is relatively small, it is justified given the hard-to-reach nature of the population—orphans and vulnerable children—who are often underrepresented in empirical research. The KMO measure of sample adequacy was 0.707, indicating acceptable suitability for factor analysis. Furthermore, model fit indices (e.g., CFI = 0.981, TLI = 0.975, RMSEA = 0.030) support the robustness and validity of the factor structure despite the limited sample size. A simulation study by de Winter et al. (2009) demonstrated that reliable factor structures can be obtained from smaller samples, even those with fewer than 50 participants, particularly when communalities and factor loadings are strong. The final version of the CBEAS retained 15 items, with a sample size of 80 meeting the commonly accepted participant-to-item ratio of approximately 5:1 for factor analysis (Gorsuch, 1983; Hatcher, 1994; Suhr, 2006).

5. Final Considerations

The study is exploratory, attempting to understand orphaned and vulnerable children's perceptions of the built environment. The results confirm the internal consistency and construct validity of the proposed CBEAS for evaluating the built environment of CCIs. The study also demonstrated the effectiveness of the proposed CBEAS as a tool in perception studies. The scale can be administered in various childcare settings and is not limited to CCIs. It may also be adapted for research in nonresidential childcare environments. It can serve as a postoccupancy evaluation guide for renovating existing facilities or designing new centers on the basis of children's perceptions of current spaces. The scale could offer evaluated insights into children's built environment quality for educators, policymakers, and architects. The proposed CBEAS has not been constructed to replace other methods of perception studies involving children living in institutional care. The scale is a quantitative

assessment tool that can complement qualitative research methods to understand orphans' perceptions of the built environment comprehensively. The existing ECERS-3 is already in use by regulators for the assessment of the quality of childcare, along with the existing CPERS in developed countries. The proposed CBEAS is a perception rating scale tailored to be administered in child care institutions in South Asia, given the similarities in the cultural context and considering the similar characteristics of childcare institutions in these countries.

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Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of MIT Art, Design, and Technology University, Pune, India, with project number IEC/MITBIO/2024/07, dated April 5, 2024. Informed consent was obtained from all the subjects involved in the study. Consent was obtained from the directors of the CCIs to conduct the study. Verbal consent was obtained from the children. Children who did not agree to participate in the study were excluded.

Conflict of Interest

The authors declare that they have no conflicts of interest.

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