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FACILITIES AND EQUIPMENT IN CHILDCARE SETTINGS: PROMOTING A SUSTAINABLE ENVIRONMENT FOR INFANTS AND TODDLERS

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Abstract

Well-designed physical spaces and appropriate equipment are crucial for enhancing the quality of care and education for infants and toddlers. Four key areas were examined hygiene and safety, learning and development, space and facility management, and sustainability. The study sampled childcare centers based on their geographic distribution and type, including 193 centers—155 public and 38 private. The findings reveal disparities in facilities and equipment between public and private centers, highlighting the need for more detailed regulations and sustainable practices. Public centers, which benefit from government funding, typically offer higher-quality facilities, whereas private centers, constrained by costs, often lack sustainable equipment and caregiver-friendly amenities. Additionally, the potential risks associated with over-reliance on soothing chairs, baby cradles, and playpens may impede toddlers' physical development. The results underscore the need for clear guidelines to help private centers enhance their facilities and call for more specific standards, especially in rapidly expanding public childcare services in Asian countries, to ensure that childcare environments support the well-being of both children and caregivers.
Keywords: *childcare settings, caring environment, infants and toddlers, sustainable environment*, age-*appropriate*

Introduction

Examining the facilities in childcare centers is essential to understanding how these environments support safe, nurturing, and stimulating experiences crucial for children's development. High-quality childcare settings significantly impact developmental outcomes, particularly in fostering cognitive, emotional, and social growth (Berti, 2019; Marshall, 2011). For instance, enriched environments with diverse resources encourage learning, creativity, and social skills, creating foundational benefits that extend throughout childhood and into adulthood (Chen & Wang, 2018; von Suchodoletz et al., 2023). This study addresses the need for comprehensive assessments of childcare environments, focusing on the availability of clean, safe, and developmentally appropriate resources that promote optimal growth and learning.

Studies have underscored the critical role of high-quality childcare in reducing educational disparities, particularly for children from low-income families (Donoghue, 2017; Vandell & Wolfe, 2000). By setting high standards for childcare facilities, countries enhance children's early learning experiences and long-term outcomes, thus contributing to broader educational

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and social benefits. However, existing research on childcare settings highlights a significant gap in knowledge regarding the age-appropriate design and equipment of these facilities, especially in relation to sustainable practices that benefit both children and the environment. This study addresses this gap by examining how the layout, materials, and environmental features of childcare centers affect children's health and well-being.

Furthermore, sustainable facility design gains increasing attention due to its potential to provide healthier, more eco-friendly spaces. Incorporating natural light, green spaces, and eco-friendly materials in childcare environments improves aesthetics and supports children's physical and mental well-being (Tonge et al., 2019; Ulset et al., 2017). Noise reduction, safe play areas, and natural lighting are vital components of a well-designed childcare center that prioritizes children's comfort and developmental needs. Notably, sleep-related safety guidelines and interventions for reducing illness through improved hygiene and disinfection standards illustrate the importance of facility design in safeguarding children's health (Moon et al., 2022; Staniford & Schmoidtke, 2020).

Despite these recognized needs, limited research exists on age-specific, sustainable facility practices for infants and toddlers in childcare settings. Addressing this gap, our study emphasizes the need for detailed planning and sustainable design in childcare environments to support both developmental outcomes and environmental sustainability. By examining childcare facilities with a focus on age-appropriate equipment and sustainable practices, this study contributes to a growing body of knowledge aimed at fostering safe, supportive, and eco-friendly environments for young children, which is of increasing relevance in both national and international contexts.

Research Focus and Research Questions

The extant literature on regulations and related research concerning the physical environment in childcare centers were reviewed. The evidence-based design approaches were applied to explore the relationships between the types of childcare settings (public/private), the different ages of young children, and the equipment and facilities in nursery rooms, with practical applications for educators. The discussions of childcare quality can be addressed in the physical environment of childcare centers.

The research questions were proposed as following:

1. Hygiene and Safety: How do the hygiene facilities in public and private childcare centers in Taiwan compare, and what impact do they have on the well-being of children and childcare providers?

2. Learning and Development: What are the specific facility needs for infants under 18 months compared to older toddlers, and how well are these needs being met in public versus private childcare centers?

3. Space and Facility Management: How does the allocation of space in childcare centers contribute to creating an optimal environment for young children?

4. Sustainable Environment: How do childcare centers create a sustainable and supportive environment for both children and childcare providers?

The crucial role of well-designed physical spaces and appropriate equipment in enhancing the quality of care and education for infants and toddlers were addressed. It also provides practical suggestions for improving childcare environments.

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Research Methodology

Background

This research represents the first large-scale field investigation of facilities and equipment in childcare centers across Taiwan. Employing a quantitative approach, it examines the current facilities and equipment provided by these centers. The findings aim to depict the present conditions of the sampled childcare centers, and generate recommendations to support quality improvements in childcare centers.

Sample

The study population consisted of 1,506 childcare centers across Taiwan, as reported by the Social and Family Affairs Administration (2023). These centers are categorized into public childcare homes, public childcare centers, and private childcare centers. Public childcare homes, which care for up to 12 infants and toddlers aged 2 and under, along with public childcare centers, are government-funded and operated by non-profit organizations (NPOs). Of the 1,506 centers, 1,121 (74.4%) are private, 235 (15.6%) are public childcare centers, and 150 (10.0%) are public childcare homes. Notably, 78.6% (n=1,184) of these centers are located in high-density, urban areas.

To obtain a representative sample, centers were selected based on both geographic distribution (north, central, and south regions) and type (public or private). The sampling was conducted in two layers. The first layer involved selecting centers by type, resulting in 220 public and 80 private centers. This higher proportion of public centers reflects their adherence to stricter regulatory standards. However, private centers had a rejection rate of 19.8%, impacting participation levels.

The second layer accounted for geographic location, ensuring proportional representation of public and private centers from each city or county. Centers were randomly selected through computer algorithms, producing an initial total of 300 centers. If a center declined participation, a substitute from a reserve list was approached.

Ultimately 193 childcare centers participated in the study, comprising 155 public and 38 private centers. Among these, 67 centers were located in northern Taiwan, 34 in the central region, 79 in the southern region, and 13 in the eastern region and outlying islands. In terms of physical location, 58.1% of the centers were situated on the ground floor, 29.0% on the second floor, and 12.9% on the third floor.

Instrument and Procedures

The field investigation worksheet is a comprehensive tool designed to systematically assess the quality and safety of physical spaces in childcare centers. It is divided into five sections, each targeting specific areas critical to providing a supportive and sustainable environment for young children. (1) Basic information: This section records fundamental details about each center, including location (city/county), type (public or private), floors occupied, and the number of children authorized and currently enrolled. (2) Hygiene and safety: Focusing on health-related features, this section verifies the presence of essential hygiene facilities, such as continuous drinking water, baby bathtubs with handrails, anti-slip features, blanket cabinets with anti-pinch measures, and separate refrigerators for breast milk. (3) Learning and development: This area assesses the physical environment's suitability for promoting early childhood learning, including the availability of natural light, activity area illumination (measured with a light meter), air purifiers, and items such as soothing chairs, baby cradles, and playpens. (4) Space

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and facility management: Addressing the management of non-childcare facilities, this section includes restrooms, kitchens, and storage spaces. Key measures include the presence of shower facilities, tap and washbasin placement, pest prevention in kitchens, and smoke extraction systems, as well as whether children bring their own tableware. (5) Sustainable environment: This final section evaluates sustainability features, such as fire escape spaces, caregiver-friendly nursing/feeding chairs, windows, and adult toilets in childcare spaces.

Field data collection was conducted by rigorously trained interviewers who visited each participating center to ensure data quality and consistency. Interviewers initially contacted the sampled childcare centers to arrange appointments with those that agreed to participate. During each visit, interviewers completed field investigation worksheets, documenting the centers' current conditions. They used tools such as a light meter and ruler for accurate measurements. On average, it took approximately one hour to complete all items and measurements. Each completed worksheet was coded anonymously, omitting the names of individual childcare centers. Results are presented in aggregate form, ensuring that no individual center is identifiable.

Data Analysis

Descriptive statistics and cross-tabulation analysis were used to present the situation in childcare centers and to compare the results between welfare-oriented (public) and business-oriented (private) centers. Descriptive statistical parameters, including mode, median, and mean, were employed to evaluate the current state of facilities and equipment in the sampled childcare centers. These evaluations focused on aspects such as hygiene and safety, learning and development, space and facility management, and sustainable environment. Additionally, cross-tabulation analysis was conducted to compare different types of childcare centers and the ages of the children.

Research Results

Hygiene and Safety

Six items of hygiene and safety were measured, including the continuous supply of drinking water, baby bathtubs with child handrails, baby bathtubs with hand soap and paper towels, non-slip designs in baby bathtubs, blanket cabinets with anti-pinch measures, and separate breast milk refrigerators. The descriptive analysis shows that 97.7% of childcare centers are equipped with baby bathtubs that have hand soap and paper towels, but only 39.4% have child handrails to prevent slipping, and 36.7% have non-slip designs in the baby bathtubs. Among these features, significant differences were observed between public and private childcare centers in baby bathtubs with child handrail ($p < .001$***) and non-slip design in baby bathtubs ($p = .02$*) (Table 1).

Table 1
Chi-Square Test Results for Hygiene and Safety Facilities in Public and Private Sectors

Feature	Public (%)	Private (%)	Total (%)	χ^2	*p*-value
Continuous supply of drinking water	74.8	72.5	74.3	0.176	.68
Baby bathtub with child handrail	44.1	21.8	39.4	12.851	<.001***
Baby bathtub with hand soap and paper towels	98.4	95.5	97.7	2.586	.11
Non-slip design in baby bathtubs	39.7	25.6	36.7	5.197	.02*
Blanket cabinet with anti-pinch measures	87.2	82.9	86.3	0.982	.32
Separate breast milk refrigerator	54.3	51.2	53.6	0.231	.63

*$p < .05$, **$p < .01$, ***$p < .001$

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Classrooms for toddlers under 18 months showed significant differences from those for older children in the features of non-slip designs in baby bathtubs (p = .01*) and separate breast milk refrigerators (p = .001**) (Table 2). Classrooms for toddlers under 18 months were more likely to be equipped with non-slip designs in baby bathtubs and dedicated refrigerators for breast milk storage.

Table 2
Chi-Square Test Results for Hygiene and Safety Facilities in the Classrooms of Different Ages

Feature	<18 months (%)	>18 months (%)	Total (%)	χ^2	*p*-value
Continuous supply of drinking water	70.1	78.1	74.3	2.958	.09
Baby bathtub with child handrail	35.6	42.7	39.4	1.894	.17
Baby bathtub with hand soap and paper towels	97.6	97.8	97.7	0.01	.92
Non-slip design in baby bathtubs	43.8	31.1	36.7	6.241	.01*
Blanket cabinet with anti-pinch measures	87.4	86.5	86.3	0.068	.79
Separate breast milk refrigerator	62.8	45.9	53.6	10.241	.001*

*p < .05

Learning and Development

Five items related to learning and development were measured: natural light, air purifiers, soothing chairs or baby cradles, and playpens. Soothing chairs and baby cradles are intended to provide comfort and calm for infants.

According to our survey, 25.9% of the childcare centers use soothing chairs or baby cradles for toddlers, and 11.1% utilize playpens, potentially limiting toddlers' activity space. Additionally, only 78.9% of nursery classrooms provide natural light. In terms of illumination, 49.2% of the nursery classrooms had lighting levels exceeding 700 lux, although the recommended standard is between 350-700 lux.

Significant differences were identified between public and private childcare centers in several aspects, including activity area illumination (p < .001***), the presence of natural light in classrooms (p =.03*), and the use of soothing chairs or baby cradles (p = .01*) (Table 3). These results indicate that private childcare centers are more inclined to utilize soothing chairs or baby cradles to calm toddlers and employ playpens to restrict toddlers' movement. Conversely, public childcare centers reported a significantly higher percentage (54.3%) of activity area illumination exceeding 700 lux, compared to 32.7% in private centers. This finding suggests that caregivers in these settings may require greater awareness of the potential negative effects of excessively bright illumination on toddlers.

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Table 3
Chi-Square Test Results for Learning and Development Facilities in Public and Private Sectors

Feature	Public (%)	Private (%)	Total (%)	χ^2	*p*-value
Natural light	89.5	81.4	87.6	4.71	.03*
Activity area illumination				15.15	<.001***
<350lux	3.7	8.2	4.8		
350-700 lux	41.9	59.2	46.1		
>700lux	54.3	32.7	49.2		
Air purifier	64.0	59.8	62.9	0.586	.44
Soothing chair or baby cradle	22.9	37.0	25.9	6.627	.01*
Playpen	9.9	15.4	11.1	1.858	.17

*$p < .05$, ***$p < .001$

Classrooms for toddlers under 18 months exhibited significant differences compared to those for older children in various aspects, including the availability of natural light ($p = .04$*), activity area illumination ($p = .01$*), the use of soothing chairs or baby cradles ($p < .001$***), and playpens ($p = .03$*) (Table 4). The findings suggest that childcare centers catering to toddlers under 18 months are more likely to be equipped with facilities designed for rest, such as baby cradles and playpens. However, it is important to consider the potential risks associated with over-reliance on these facilities, which may limit toddlers' opportunities for physical activity and exploration for extended periods. Furthermore, the results indicate a potential misconception among caregivers that toddlers under 18 months primarily require sleep, leading to insufficient attention to the importance of natural light in these classrooms.

Table 4
Chi-Square Test Results for Learning and Development Facilities in the Classrooms of Different Ages

Feature	<18 months (%)	>18 months (%)	Total (%)	χ^2	*p*-value
Natural light	83.8	90.6	87.6	4.264	.04*
Activity area illumination				8.592	.01*
<350lux	6.3	3.5	4.8		
350-700 lux	51.7	40.3	46.1		
>700lux	42.0	56.3	49.2		
Air purifier	65.6	63.5	62.9	0.184	.72
Soothing chair or baby cradle	37.0	17.2	25.9	18.568	<.001***
Playpen	14.6	7.5	11.1	4.799	.03*

*$p < .05$, ***$p < .001$

Space and Facility Management

Nine items related to space and facility management were assessed: restrooms with hot and cold shower facilities, restrooms with taps at standard distances, washbasins at standard

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heights, kitchens with screen doors or plastic curtains to prevent bugs and mosquitoes, stainless steel kitchen counters, kitchens equipped with smoke extraction systems, children bringing their own tableware, fire doors or smoke extraction systems, and storage spaces. According to the survey, 92% of kitchens are equipped with screen doors or plastic curtains to prevent bugs and mosquitoes, but only 45.5% use stainless steel counters, and 55.2% of restrooms have taps at the standard distance. Therefore, it is recommended that childcare centers select appropriate materials for kitchen counters to enhance better health outcomes for toddlers.

Kitchens equipped with screen door or plastic curtain is essential to prevent bugs or mosquitoes while preparing food for toddlers, especially in tropical/subtropical regions. Childcare centers encourage toddlers to wash their hands, and this is an essential hygiene procedure, particularly after a pandemic period. Childcare centers have to provide sufficient amounts of taps for toddlers with suitable height and distance. It is suggested that two taps shall be at a distance of at least 15.75 inches according to the toddlers' shoulder to shoulder when two toddlers stand together.

Significant differences were observed between public and private childcare centers in several space and facility management items, including restrooms with two taps at standard distance (p = .01*), kitchens with smoke extraction system (p = .01*), and children with their own tableware (p < .001***). However, significant differences were not found in space and facilities management items between classrooms for different age groups of toddlers (Table 5).

Table 5

Chi-Square Test Results for Space and Facilities Management in Public and Private Sectors

Feature	Public (%)	Private (%)	Total (%)	χ^2	*p*-value
Restroom with hot and cold shower facilities	63.0	53.9	58.1	0.57	.45
Restroom with two taps at standard distance (15.75 inches)	60.1	33.3	55.2	8.510	.01*
Washbasin at standard height (19.69 inches)	75.4	61.5	72.5	3.945	.05
Kitchen with screen door or plastic curtains to prevent bugs and mosquito	90.6	95.4	92.0	1.878	.17
Stainless steel kitchen counter	45.0	47.4	45.5	0.07	.79
Kitchen equipped with smoke extraction system	97.4	80.5	84.0	6.37	.01*
Children bring their own tableware	93.3	63.2	87.2	24.571	<.001***
Fire door or smoke extraction system	81.6	66.9	69.8	3.122	.08
Storage room	79.2	73.0	78.0	0.679	.41

*p < .05, ***p < .001

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Table 6
Chi-Square Test Results for Space and Facilities Management in the Classrooms of Different Ages

Feature	<18 months (%)	>18 months (%)	Total (%)	χ^2	*p*-value
Restroom with hot and cold shower facilities	52.1	58.3	58.1	0.604	.44
Restroom with two taps at standard distance (15.75 inches)	45.7	56.5	55.2	1.336	.25
Washbasin at standard height (19.69 inches)	75.0	72.5	72.5	0.131	.72
Kitchen with screen door or plastic curtains to prevent bugs and mosquito	NA	NA	92.0	NA	NA
Stainless steel kitchen counter	NA	NA	45.5	NA	NA
Kitchen equipped with smoke extraction system	NA	NA	84.0	NA	NA
Children bring their own tableware	NA	NA	87.2	NA	NA
Fire door or smoke extraction system	NA	NA	69.8	NA	NA
Storage room	NA	NA	78.0	NA	NA

Notes: 'NA' indicates that a 2*2 table cannot be achieved, so chi-square test cannot be performed.

Sustainable Environment

Four items related to sustainable environment were measured: fire escape space, nursing chair/feeding chairs friendly to childcare givers, windows in childcare spaces, and adult toilets in childcare spaces. According to our survey, all childcare centers were equipped with windows. However, only 18.8% were equipped with fire escape spaces, 33.7% with feeding chairs friendly to caregivers, and less than half (44.6%) had adult toilets in the classrooms. Fire escape space showed significant differences (p= .004**) between public and private sectors (Table 7).

Table 7
Chi-Square Test Results for Sustainable Environment in Public and Private Sectors

Feature	Public (%)	Private (%)	Total (%)	χ^2	*p*-value
Fire escape space	34.2	14.3	18.8	8.118	.004**
Nursing chair/ feeding chair (friendly to childcare givers)	35.6	28.0	33.7	1.973	.16
Windows in childcare space	100	100	100	NA	NA
Adult toilet in childcare space	46.9	45.7	46.6	0.042	.84

**$p < .01$

Nursing chair (friendly to childcare givers) ($p < .001$***) and adult toilet in childcare space ($p < .001$***) showed significant differences between classrooms of different age groups (Table 8).

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Table 8
Chi-Square Test Results for Sustainable Environment in the Classrooms of Different Ages

Feature	<18 months (%)	>18 months (%)	Total (%)	χ^2	*p*-value
Fire escape space	NA	NA	18.8	NA	NA
Nursing chair/ feeding chair (friendly to childcare givers)	48.6	23.0	33.7	29.318	<.001***
Windows in childcare space	NA	NA	100	NA	NA
Adult toilet in childcare space	35.2	56.4	46.6	17.281	<.001***

***$p < .001$

Discussion

This study examines critical aspects of childcare center environments in Taiwan, focusing on hygiene and safety, learning and development, space and facility management, and sustainable environment. Through analyzing 193 centers, this research highlights essential differences in facility standards and reveals significant needs in sustainable practices, underscoring the importance of childcare facility quality for both developmental outcomes and the well-being of caregivers.

Key findings include high compliance in basic hygiene, such as the presence of baby bathtubs with hand soap and kitchens equipped with protective screens to prevent bugs. This level of compliance largely results from stringent hygiene regulations enforced following the pandemic, which have positively impacted practices across childcare centers. Yet, the study reveals considerable gaps, especially in sustainable practices. For instance, many centers lack essential sustainable features, such as fire escape provisions and ergonomically designed nursing chairs for childcare providers. These findings emphasize the critical role of sustainable facilities in supporting both children's safety and caregivers' well-being, revealing a need for stronger regulations in sustainability (Di Schino, 2020). This aligns with research by Lekan-Kehinde & Asojo (2021), which emphasizes that environments that consider children's sensory needs—avoiding excessive brightness, for instance—support focus and engagement by reducing visual discomfort and fatigue.

Another important finding relates to disparities between public and private centers. Public centers, benefiting from government funding, are generally better equipped with facilities like non-slip bathtubs, child handrails, and ample natural lighting. In contrast, private centers, often limited by budget constraints, show lower compliance with certain standards, underscoring the need for clear guidelines and support to help these centers achieve sustainable quality in their facilities. The chi-square test results further illuminate these disparities, demonstrating the structural inequities between public and private centers. Enhancing quality standards for private childcare facilities is vital to ensure equitable access to high-quality, safe environments for all children, regardless of center type. The importance of high-quality environments for young children is further supported by studies showing that quality early care is linked to positive cognitive and social development outcomes, particularly in children from low-income families (Donoghue, 2017; Vandell & Wolfe, 2000).

Findings also indicate that soothing chairs, baby cradles, and playpens are more prevalent in classrooms for toddlers under 18 months, often used to manage children's behavior. However, an over-reliance on these items can restrict physical movement, limiting opportunities for exploration and gross motor development, which are crucial in early childhood (Yogman et al., 2018; Sharyn et al., 2023). Public centers, benefiting from better caregiver-to-child ratios, are

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less dependent on such equipment, fostering more active engagement and physical development in young children. This insight emphasizes the importance of age-appropriate practices and highlights a critical area where caregiver training on equipment use and child development could greatly benefit childcare settings. These findings align with the broader recommendations from NAEYC (2019), which encourage environments that promote active exploration while minimizing the use of restrictive items, supporting children's physical development.

In terms of caregiver-friendly amenities, the study identified considerable gaps, particularly in the provision of facilities like feeding chairs and adult toilets across different age groups. These amenities are essential for a supportive environment that sustains caregiver well-being, irrespective of children's ages. Improving these aspects can help establish a sustainable and supportive environment in which caregivers can comfortably attend to children's needs without compromising their own health or comfort. These findings are consistent with Di Schino (2020), who underscores the importance of ergonomic design and high-quality materials for ensuring caregiver and child well-being in childcare environments. Similarly, standards such as those put forth by NAEYC (2019) recommend detailed guidelines for maintaining a safe, clean, and well-equipped childcare setting.

Furthermore, the importance of high-quality childcare facility design is corroborated by longitudinal research. For example, the NICHD Early Child Care Research Network (2006) found that children in higher-quality environments—those with clean, safe, and well-resourced facilities—showed improved cognitive, language, and social development through elementary school. This finding is echoed in the Effective Provision of Pre-School Education (EPPE) Project in the UK, which demonstrated that well-resourced, safe, and organized physical environments positively affected children's academic and behavioral outcomes (Sylva et al., 2010). Moreover, the Quality Interventions for Early Care and Education (QUINCE) Study also found that facility quality improvements, such as better hygiene practices and material organization, significantly benefited children's language and social skills (Bryant et al., 2006). These studies align with our findings and support the importance of infrastructure and resource quality for long-term developmental benefits in children.

The findings underscore the need for more specific guidelines, beyond general standards, to ensure high-quality childcare environments. This is particularly crucial in Asian contexts where public childcare services are expanding rapidly in response to low fertility rates. Countries such as Korea, Japan, Singapore, and Taiwan stand to benefit from targeted standards that address the unique needs of infants, toddlers, and caregivers while emphasizing sustainability. High-quality childcare encompasses not only educational aspects and staff ratios but also infrastructure and equipment standards that holistically support children's developmental needs and caregivers' work conditions. These findings resonate with international recommendations for sustainable design in childcare, where eco-friendly materials and careful facility planning are shown to enhance both child and caregiver well-being (Lekan-Kehinde & Asojo, 2021).

Conclusions and Implications

This study highlights the complex interplay of hygiene and safety, learning and development, space and facility management, and sustainable environment appropriateness in childcare settings. The findings call for stricter, more detailed regulations, particularly concerning sustainable practices, to enhance childcare quality in Taiwan. Addressing these needs is essential to create environments conducive to healthy development and caregiver support.

For educational and research practice, these results point to several implications. Firstly, educational initiatives should prioritize caregiver training on age-appropriate equipment use, emphasizing the importance of active engagement over reliance on restrictive items like

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soothing chairs and playpens. Furthermore, research should continue exploring the impact of sustainable design features on children's development and caregiver well-being, as this area remains under-researched, particularly in childcare settings for very young children.

Additionally, future studies could focus on longitudinally examining the impact of facility quality on developmental outcomes, especially in private centers where resources may be limited. Longitudinal findings, such as those demonstrating that high-quality physical environments have lasting impacts on children's cognitive and social development, encourage further exploration of infrastructure quality as a crucial component of early childhood environments. Such research would support policymakers in designing interventions that ensure high standards across both public and private centers.

In summary, this research highlights significant disparities and improvement areas in Taiwanese childcare facilities, with an emphasis on sustainability, hygiene, and developmental appropriateness. These findings provide valuable insights for policymakers, educators, and researchers focused on enhancing childcare quality, underscoring the need for targeted interventions that address both the immediate safety and the long-term developmental benefits of young children in childcare settings.

Limitations and suggestions

The findings of this study indicate several practical implications for improving childcare center quality and sustainability. There is a critical need for more detailed regulations and standards, particularly in private childcare centers, to ensure consistent care quality. Investments in facility upgrades, particularly regarding hygiene and caregiver-friendly features, are essential. Creating a supportive environment for both caregivers and toddlers is crucial, including reducing reliance on soothing chairs and playpens and preventing exposure to intense light in activity areas. Furthermore, continuous caregiver training is necessary to balance rest and physical activity for toddlers, alongside regular monitoring of childcare centers to ensure adherence to these standards.

This study presents survey results from 193 childcare centers, yet it does not address the long-term effects of facilities and equipment on toddlers, which represents a significant limitation. Additionally, the study suggests that private childcare centers may prioritize cost considerations, leading to disparities in facilities compared to publicly funded centers. While the study highlights certain deficiencies in private centers, the question of whether these centers should be held to the same standards as public ones or whether selected features should be mandated by official regulations remains a consideration for policymakers.

Addressing these limitations and incorporating the suggested improvements would provide a more comprehensive understanding of the factors influencing the quality of childcare environments. Future research may aim to create a holistic picture that includes physical facilities, caregiver interactions, and broader socio-economic contexts to inform policies and practices that support the optimal development of young children.

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Declaration of Interest

The authors declare no competing interest.

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References

Berti, S., Cigala, A., & Sharmahd, N. (2019). Early childhood education and care physical environment and child development: State of the art and reflections on future orientations and methodologies. *Educational Psychology Review, 31*, 991–1021. https://doi.org/10.1007/s10648-019-09486-0

Bryant, D., Zaslow, M., & Tout, K. (2006). Quality interventions for early care and education (QUINCE). *Journal of Early Childhood Research*, *4*(4), 339–355. https://fpg.unc.edu/projects/quality-interventions-early-care-and-education

Chen, H., & Wang, X. (2018). Children's evaluation of the physical environment quality in kindergarten: A case study from China. *International Journal of Early Childhood, 50*, 175–192. https://doi.org/10.1007/s13158-018-0219-7

Di Schino, A. (2020). Manufacturing and applications of stainless steel. *Metals*, *10*, Article 327. https://doi.org/10.3390/met10030327

Donoghue, E. A. (2017). Quality early education and child care from birth to kindergarten. *American Academy of Pediatrics, 140*(2), Article e20171488. https://doi.org/10.1542/peds.2017-1488

Lekan-Kehinde, M., & Asojo, A. (2021). Impact of lighting on children's learning environment: a literature review. *WIT Transactions on Ecology and the Environment, 253*, 371–380. https://doi.org/10.2495/SC210311

Marshall, J. (2011). Infant neurosensory development: Considerations for infant child care. *Early Childhood Education Journal, 39*, 175–181. https://doi.org/10.1007/s10643-011-0460-2

Moon, R. Y., Carlin, R. F., Hand, I. & Task Force on Sudden Infant Death Syndrome and the Committee on Fetus and Newborn (2022). Sleep-related infant deaths: Updated 2022 recommendations for reducing infant deaths in the sleep environment. *Pediatrics, July, 150* (1), Article e2022057990. https://doi.org/10.1542/peds.2022-057990

NAEYC (2019). *NAEYC Early learning program accreditation standards and assessment items*. National Association for the Education of Young Children. https://www.naeyc.org/sites/default/files/globally-shared/downloads/PDFs/accreditation/early-learning/standards_assessment_2019.pdf#:~:text=URL%3A%20https%3A%2F%2Fwww.naeyc.org%2Fsites%2Fdefault%2Ffiles%2Fglobally

NICHD Early Child Care Research Network (2006). Child care effect sizes for the NICHD study of early child care and youth development. *American Psychologist*, *61*(2), 99–116. https://doi.org/10.1037/0003-066X.61.2.99

Sharyn E., Parks, C. L., DeSisto, K. K., Bombard, J. M., & Shapiro-Mendoza, C. K. (2023). Risk factors for suffocation and unexplained causes of infant deaths. *Pediatrics, 151*(1). https://doi.org/e2022057771.10.1542/peds.2022-057771

Social and Family Affairs Administration (2023). *National distribution map of childcare centers and public nursery homes*. Ministry of Health and Welfare. https://www.sfaa.gov.tw/SFAA/Pages/List.aspx?nodeid=970

Staniford, L. J., & Schmidtke, K. A. (2020). A systematic review of hand-hygiene and environmental-disinfection interventions in settings with children. *BMC Public Health*, *20*, Article 195. https://doi.org/10.1186/s12889-020-8301-0

Sylva, K., Melhuish, E., Sammons, P., Siraj-Blatchford, I., & Taggart, B. (2010). *Early childhood matters: Evidence from the effective pre-school and primary education project*. *Routledge*.

Tonge, K. L., Jones, R. A., & Okely, A. D. (2019). Quality interactions in early childhood education and care center outdoor environments. *Early Childhood Education Journal, 47*, 31–41. https://doi.org/10.1007/s10643-018-0913-y

Ulset, V., Vitaro, F., Brendgen, M., Bekkhus, M., & Borge, A. I. H. (2017). Time spent outdoors during preschool: Links with children's cognitive and behavioral development. *Journal of Environmental Psychology, 52* (Supplement C), 69–80. https://doi.org/10.1016/j.jenvp.2017.05.007

Vandell, D. L., & Wolfe, B. (2000). *Child care quality: Does it matter and does it need to be improved?* Office of the Assistant Secretary for Planning and Evaluation. https://aspe.hhs.gov/reports/child-care-quality-does-it-matter-does-it-need-be-improved

von Suchodoletz, A., Lee, D. S., Henry, J., Tamang, S., Premachandra, B., & Yoshikawa, H. (2023). Correction: Early childhood education and care quality and associations with child outcomes: A meta-analysis. *PLOS ONE*, *18*(10), Article e0293056. https://doi.org/10.1371/journal.pone.0293056

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Appendix 1

Field Investigation Worksheet of Facilities and Equipment in Childcare Centers

I. Basic information
1. Location: _____city/county
2. Type of the childcare institution: A. Public Childcare Center B.Private Childcare Center C. Public Childcare Home
3. Floor(s) of the childcare institution (multiple ticks): A. 1st Floor B.2nd Floor C.3rd Floor
4. Number of children they are authorized to take: _____ and they actually take:_____

II. Hygiene and Safety
5. Continuous supply of drinking water (Y/N)
6. Baby bathtub with child handrail (Y/N)
7. Baby bathtub with hand soap and paper towels (Y/N)
8. Non-slip design in baby bathtubs (Y/N)
9. Blanket cabinet with anti-pinch measures (Y/N)
10. Separate breast milk refrigerator (Y/N)

III. Learning and Development
11. Nursery room with nature light (Y/N)
12. Activity area illumination: measure with light meter
13. Air purifier (Y/N)
14. Soothing chair or baby cradle (Y/N)
15. Playpen (Y/N)

IV. Space and Facility Management (Non Childcare Facilities)
16. Restroom with hot and cold shower facilities (Y/N)
17. Restroom with two taps at standard distance (regulation: 15.75 inches): measure with a ruler
18. Washbasin at standard height (regulation: 19.69 inches): measure with a ruler
19. Kitchen with screen door or plastic curtains to prevent bugs and mosquitoes (Y/N)
20. Stainless steel kitchen counter (Y/N)
21. Kitchen equipped with smoke extraction system (Y/N)
22. Children bring their own tableware (Y/N)
23. Fire door or smoke extraction system (Y/N)
24. Center equipped with storage room (Y/N)

V. Sustainable Environment
25. Fire escape space (Y/N)
26. Nursing chair/ feeding chair (friendly to childcare givers) (Y/N)
27. Windows in childcare space (Y/N)
28. Adult toilet in childcare space (Y/N)

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