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The physical indoor environment in ECEC settings: children's well-being and physical activity

Ole Johan Sandø

Department of Physical Education, Queen Maud University College, Trondheim, Norway

ABSTRACT

The physical environment in Early Childhood and Care (ECEC) settings is believed to be important for children's play and development. In this study, the influence of the physical indoor environment in ECEC settings on children's well-being and physical activity was explored. The data were obtained from video observations of the free play of 80 children in eight ECEC institutions. Multilevel regression analysis indicated that children's well-being was positively associated with the use of rooms for physical activity and negatively associated with the use of high tables. Children's physical activity was strongly positively associated with the use of rooms for physical activity and tumbling zones. Furthermore, open floor space and cubbies were positively associated with physical activity, whereas tables were negatively associated with children's physical activity. These results indicate that physical environments supportive of physical active play are beneficial and that dominating the indoor space with tables should be avoided.

KEYWORDS

Physical environment; indoor; play; well-being; physical activity

Introduction

During the last decade, substantial resources have been used to facilitate full Early Childhood Education and Care (ECEC) coverage in Norway, and many ECEC institutions have been designed and built. Today, more than 90% of Norwegian 1- to 5-year-old children are enrolled in ECECs (Statistics Norway 2018). ECEC settings therefore represent an important learning environment for children and are of great importance for the short- and long-term development of children (Phillips and Shonkoff 2000). The Norwegian Framework Plan for Kindergartens emphasizes that the design of the physical environment should give children the opportunity to play and that institutions should promote physical and mental health (Norwegian Directorate for Education and Training 2017). The aim of this article was to explore how the indoor environment in ECEC institutions can influence children's well-being and physical activity (PA). In this study, well-being is defined as a subjective and internal feeling of being/feeling 'well' (Koch 2018; Mashford-Scott, Church, and Tayler 2012), whereas PA is defined as any bodily movement produced by the skeletal muscles

CONTACT Ole Johan Sandø ✉ ojs@dmmh.no 📍 Thron Nergaards veg 7, Trondheim N-7044, Norway

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that results in energy expenditure (Caspersen, Powell, and Christenson 1985). Well-being and PA are both key elements in children's health (Boreham and Riddoch 2001; Mashford-Scott, Church, and Tayler 2012).

The theory of affordance (Gibson 2014) represents an important theoretical framework in this study. In this theory, the physical environment is believed to afford the child possibilities and actions. The characteristics and features of the indoor environment can therefore be hypothesized to influence children's play and activities, which in turn may influence well-being and PA. Play involves activities that children perform for the sake of enjoyment (Sutton-Smith 2009). Play and well-being are strongly related for children in ECEC institutions (Kennedy-Behr, Rodger, and Mickan 2015; Giske et al. 2018; Howard and McInnes 2013), and the key elements in play are important contributors to children's well-being (Ginsburg 2007). Given the relationship between play and well-being and the fact that children's play seems to be influenced by the physical environment (Shim, Herwig, and Shelley 2001; Torrens and Griffin 2013), it is also likely that children's well-being is influenced by characteristics of the physical environment.

Although ECEC settings have become a field of growing interest in research on child outcomes, there is a lack of studies assessing the impact of ECEC institutions on children's well-being (Holte et al. 2014). The literature is even more limited in regard to how the physical indoor environment influences well-being. In a study of the perspectives of 4- to 6-year-olds on their well-being, the physical environment, available materials, common activities, and the opportunity to influence their day were of crucial importance in ECEC institutions (Sandseter and Seland 2016). This result is in line with the findings of a previous Norwegian study, indicating that the materials and the arrangement of the physical indoor environment influence children's play experiences (Nordtømme 2016).

A previous systematic review aimed to evaluate the associations between the Early Childhood Environment Rating Scale (ECERS)/ECERS-Revised and children's well-being. A vast difference in methodological approaches and some minor positive associations between the overall quality of the institution and well-being were found (Brunsek et al. 2017). Since well-being is a complex and multifaceted concept, it may be difficult to isolate the effect of overall quality or the physical environment on children's well-being. The theoretical framework of this study implies that the physical indoor environment in ECEC institutions is important for children's well-being, but the extent and mechanism remain unknown.

More is known about the importance of the physical environment for children's PA. The physical environment is commonly believed to have a strong impact on children's PA in ECEC institutions (Brown et al. 2009; Sugiyama et al. 2010). However, this evidence is mainly based on studies on the outdoor environment and specific knowledge of the indoor environmental characteristics that influence PA is lacking.

Previous studies have found that the size of the play area (Gubbels et al. 2012; Olesen et al. 2013), having an indoor recreation room (Barbosa et al. 2016) and using indoor space for motor activities (Sugiyama et al. 2010) are positively associated with PA. The association between indoor subscales of the Environment and Policy Assessment and Observation (EPAO) tool and PA is unclear (Gubbels et al. 2011; Bower et al. 2008; Peden et al. 2017; Tucker et al. 2015; Vanderloo et al. 2015). In one study, Gubbels et al. (2011) found that the social environment interacts with the physical environment with regard to children's PA. This finding may explain some of the inconsistencies in the

associations among EPAO subscales and measured PA. Even the most appealing room for PA will not promote PA if children are prohibited from running indoors.

Little is known about the influence of the indoor physical environment on children's well-being and PA. The lack of previous research in the field implies that this study has to be explorative in the search for associations between the physical indoor environment and children's well-being and PA. The research question for this article is as follows: What characteristics in the ECEC physical indoor environment influence children's well-being and PA?

Materials and methods

This study was conducted within the project 'Competence for developing ECEC institutions' indoor- and outdoor environments', which was funded by The Research Council of Norway and approved by the Norwegian Social Science Data Services. This project is a three-year study with a mixed-method design (Creswell 2013) conducted in close collaboration with three ECEC owners in Norway. The data collection involves systematic and randomized video observations of children in the indoor environment during free play sessions. 'Free play sessions' implies that children can decide what they want to do, where they want to be and who they want to be with in the available indoor space. Adults are present and may interact with and invite the children to participate in different activities, but the children are free to engage in other activities as they wish.

Procedure and sample

The sample consists of 479 video observations of 80 children from eight ECEC institutions with a mean duration of 121 s. The eight ECEC institutions were strategically selected among the partner ECEC institutions to vary in size, age, location and physical environment. Five girls and five boys in each institution were randomly selected among the 3- and 4-year-old children, and written consent to participate was obtained from parents. The children were informed about the video observations and were not filmed if they did not want to be filmed. Data collection was performed over one week in each ECEC institution during the fall of 2017 by four researchers and eight co-researchers. The researchers developed a strict data collection protocol that was followed in each of the ECEC institutions. A preschool teacher from each ECEC institution was recruited as a co-researcher and conducted the filming with a small GoPro Hero action camera. The researcher wrote field notes and ensured that the protocol was followed. The co-researcher was asked to regularly perform video observations prior to the data collection to allow the co-researcher and children to become accustomed to filming. Cameras were also used regularly for other pedagogical purposes at all participating institutions. A person familiar to the children performed the video recordings using small neutral cameras with wide-angle lenses to reduce any impact on the children's behaviour under the observed situations. The co-researcher attempted to get as close as possible to capture speech, body language and facial expressions without affecting the situation. However, the presence of the co-researcher filming may still have influenced the children's behaviour and is a limitation of the design.

To ensure that random situations were filmed, the filming of the children followed a predetermined schedule that stated in what order and at what time observations were

to be conducted. Each day, two children were filmed. The first child was filmed for two minutes followed by a six-minute break. Then, child two was filmed for two minutes, followed by a break of another six minutes. This alternation between the first and the second child was repeated until six video observations (12 min) of each child were recorded in the indoor environment. If the children were in situations in which filming was not an option due to ethical considerations (such as toilet visits, the child refusing to be filmed or similar), the video observation was postponed. The co-researcher, who knew the children well, was very conscious to refrain from filming in sensitive situations and kept an ongoing dialogue with the children about the filming to ensure assent to participation. With six video observations of 80 children, a total of 480 video clips in the indoor environment constituted a full sample. With a total of 479 video clips in the final sample, one clip was missing. This clip was excluded because the child was inside a tent and was hidden for the entire period. In one institution, only four girls were available to participate; therefore, an extra boy was randomly selected to replace the unavailable girl, and the final sample included 39 girls and 41 boys aged 2.8–4.8 years.

Measures

The key measurements in this study were children's well-being, PA and environment. In addition, variables such as social characteristics, play, age and gender were included to control for the context of the observation. The Leuven Well-Being Scale (Laevers 2005) was used to measure the *well-being* of the children on a scale from one to five. The Leuven Well-Being Scale was developed as a tool to improve the quality of ECEC institutions through self-assessment (Laevers 2005) but has also been previously used in research in the ECEC context (Declercq et al. 2011; Bjørgen 2015). A score of 1 on the scale is given when children show clear signs of discomfort, such as whining, screaming, anger or sadness. A score of 5 is given when the child shows signs of appearing happy, expressive, lively or relaxed. Level 3 indicates a neutral posture, and levels 2 and 4 indicate signs of either discomfort or happiness that are not consistently present. To promote consistency in the coding and interpretation of the scale, training videos and workshops were conducted by the three researchers performing the coding. The training videos included 40 clips of children recorded in early settings in Flanders with justifications of each of clip rating. During the workshops, video observations was reviewed, scored and discussed by the researchers. Each video observation was scored by two independent researchers, and one score was established for each two minute video observation. Differences greater than one point were reviewed again and discussed in the research group until a mutual understanding was reached. For differences of one point, an average of the two scores was used.

To determine the inter-rater reliability, weighted kappa values (Cohen 1968) were used. The inter-rater agreement was 89% for well-being with a kappa value of 0.42. A kappa value of 0.42 indicates a moderate agreement, and agreements above 80% and kappa values above 0.40 are often viewed as acceptable agreements (McHugh 2012). Given the complex phenomena of well-being and the naturalistic data collection method of observing children in their everyday environment, an inter-rater agreement in the lower range of what is acceptable was anticipated and must be considered a limitation of the study.

Children's PA was measured using the Observational System for Recording PA in Children-Preschool (OSRAC-P) (Brown et al. 2006), which codes PA from one (stationary) to

five (fast movement). One score was established for each video observation. Scores were based on speed and characteristics of the movement, such as assisted movement and moving heavy objects. To evaluate PA, the same procedures described for well-being were used, except for the training videos, as follows: workshops, scoring by two independent researchers, discussions, and average scores. For PA, the inter-rater agreement was 93% with a kappa value of 0.65, indicating good agreement. OSRAC-P has been previously used in several studies in the ECEC context and in studies specifically linking PA to the physical environment (Gubbels et al. 2011; Gubbels et al. 2012; Hannon and Brown 2008; Nicaise, Kahan, and Sallis 2011).

To measure which places the children used, place categories were developed, which were based on categories used in previous research (Acer et al. 2016) and discussions within the project group and constant dialogue with the data. The categories had to be quite broad in order to be used in all eight institutions with substantially different indoor environments. After some adjustments, the final categories included the following:

- Open Floor Space: spaces between other zones and furniture, places not specifically coded for any activity or purpose.
- Low Tables: child-height tables.
- High Tables: adult-height tables.
- Cubby: cubbies for children's outdoor gear, rain clothes, boots, etc.
- Room for PA: spacious rooms (approx. 50 m²) designed specifically for PA.
- Tumbling Zone: areas with soft surfaces, large construction materials, pillows and blankets for physical play.
- Play Zone: a zone offering materials such as building blocks, outfits, kitchen equipment, play animals, etc.
- Subspace: fixed smaller subspaces such as cubes and dens.
- Window: window posts.
- Bathroom: changing rooms, toilets or bathrooms.

Places were coded continuously, and the categories were mutually exclusive. The variables for places were coded as the percentage of time spent in different places during each video recording. The coding was conducted by one researcher, and a random sample of 10% of the video observations was reviewed by a second researcher to ensure consistent coding and interpretation. Given the theoretical framework, purpose of the study and the limited use of the window, bathroom and subspace categories, these spaces were excluded from the analysis and together constituted the 'other' category shown in Table 1. Not all place categories were present in all institutions, as presented in Table 1.

The contextual variables describing the social characteristics and play in the observation were coded continuously, and the categories were mutually exclusive. Group composition categories in the OSRAC-P (Brown et al. 2006), were used to capture the social setting of the observation. In this study, the initial group variables were reduced to two variables describing the percentage of time the child was with other children and the percentage of time an adult was present. Play was coded using categories for functional play, constructive play, symbolic play, mixed play, non-play and talking, which were adapted from previous play-categorizing studies (Dyment and O'Connell 2013; Fjørtoft 2004; Luchs and Fikus 2013). In this article, the categories were combined to describe the

percentage of time the child was playing (functional play, constructive play, symbolic play and mixed play). Both social characteristics and play were coded by one researcher for the entire sample, and a random sample of 10% of the video observations was reviewed by a second researcher, similar to the procedure for the categories describing places.

Analysis

The scoring of well-being and PA was performed in an Excel spreadsheet with a score for each of the observations. Places, materials, social characteristics and play were coded using Noldus Observer XT 12.5 behavioural coding, analysis and management software for observation data (Zimmerman et al. 2009). The Observer XT data were paired with the spreadsheet of the well-being and PA scores and imported to Stata (MP 15.1), which was used for the statistical analysis. Descriptive statistics and correlation analyses were conducted to provide an overview of the data and the relationships among the variables. Given the hierarchical structure of the data with nested observations of children within ECEC institutions, a multilevel regression analysis (Goldstein 1986) was conducted to investigate the association among the indoor environment and children's well-being and PA. Multilevel analysis enables the control of contextual factors and increases the accuracy of the predictions (Gelman 2006).

Results

The mean duration of the 479 video observations was 121 s. The descriptive statistics for these 479 video observations are presented in Table 1. The average scores were 3.6 (SD = 0.6) for well-being and 2.6 (SD = 0.8) for PA. The children played for an average of 73% of the time, they were with other children 80% of the time, and adults were involved in the activity 30% of the time. The most frequently used place among all the institutions was the open floor space, with 37% of the time spent in this category, followed by play zones with 20% of the time spent in this category. High and low tables were both used for 10% of the time, whereas children used the tumbling zones for 8% of the time. Cubbies were used for 7% of the time, and rooms for PA were used for 2% of the time. The remaining time was

Table 1. Descriptive statistics ($N = 479$ observations).

	Overall Mean	Overall SD	Overall Min	Overall Max	Coded in N Institutions	Mean in N Institutions
Well-being	3.6	0.6	2	5	8	–
PA	2.6	0.8	1	5	8	–
Age	3.8	0.5	2.8	4.8	8	–
Play	73	36	0	100	8	–
With Children	80	36	0	100	8	–
Adult Present	30	42	0	100	8	–
Open Floor Space	37	42	0	100	8	–
Low Tables	10	28	0	100	6	13
High Tables	10	28	0	100	5	16
Cubbies	7	23	0	100	7	8
Rooms for PA	2	14	0	100	3	6
Tumbling Zone	8	27	0	100	2	33
Play Zone	20	37	0	100	8	–
Other	6	23	0	100	6	8

Table 2. Correlation matrix ($N = 479$ observations).

	1	2	3	4	5	6	7
1. Age	—						
2. Boy (0 = girl)	.10*	—					
3. Well-being	-.06	.04	—				
4. PA	.03	.08	.28***	—			
5. With Children	.05	.03	.09*	.05	—		
6. Adult Present	-.01	-.06	-.11*	-.17***	.13**	—	
7. Playing	-.06	.12*	.42***	.05	.07	-.18***	—

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

spent in the other category, which is composed of bathrooms, windows and subspaces. Since not all categories were present in all eight institutions, the mean use of each category within the institutions with said category is also of interest. In the six institutions with low tables, these tables were used for 13% of the time, whereas in the five institutions with high tables, these tables were used for 16% of the time. Cubbies were used for 8% of the time in the seven institutions in which this category was available; rooms for PA were used for 6% of the time in 3 institutions. Only two of the institutions had a tumbling zone, which was used for 33% of the time in these institutions.

The correlation matrix presented in Table 2 shows that well-being was positively correlated with PA ($r = .28, p < .001$), being with other children ($r = .09, p < .05$) and playing ($r = .42, p < .001$). Well-being and PA were negatively correlated with the presence of adults ($r = -.11, p < .05$; $r = -.17, p < .001$, respectively).

Multilevel analysis

With six observations of 80 children nested within eight ECEC institutions, the data have a hierarchical structure in which the assumption of the independence of units was breached. A random intercept model was chosen to account for the nesting of the data. First, an intercept-only model was run to calculate the variance at the three levels: institutional (level 3), child (level 2) and observational (level 1). The variance partition coefficient (VPC) with a limit of 5% variance was used to determine the number of levels in the model (Mehmetoglu and Jakobsen 2017). For well-being, the VPC resulted in an estimate that 3% of the variance was at the institutional level and 27% was at the child level. This estimate indicates that there were some structural differences in child-level well-being among the eight institutions, although the differences were not above the selected threshold. However, there is a substantial amount of variance at the child level that needs to be controlled for. For the PA VPC estimates, there was 2.5% variance at the institution level and 15% variance at the child level. A two-level model was selected for both well-being and PA.

A stepwise inclusion of variables starting at the lowest level in the model (Hox 2010) was performed. Contextual variables (step 1) describing the play, being with children and the presence of an adult were added to the model first. Next, the variables describing the places were added (step 2), and the second-level variables describing age and gender were added last (step 3). A likelihood-ratio test was performed between each step to determine whether the more complex model was an improvement. For well-being, step 1 (p

< .001) and step 2 ($p < .01$) were significant improvements. For PA, step 1 ($p < .01$) and step 2 ($p < .001$) improved the model. The inclusion of gender and age did not contribute significantly to the model for either well-being or PA, indicating that these background variables are not associated with well-being or PA in the present data. The regression coefficients in Table 3 reflect the full models for well-being and PA and show the predicted effect of a one-unit increase in the independent variables on well-being and PA, controlling for the effect of the other independent variables in the model.

The multilevel regression analysis showed that there is an association between children's well-being and playing. The model estimates that for each 1% increase in time children played during the observation, an increase in 0.007 on the Leuven Well-Being Scale would result. If the child played during the whole observation, a 0.7 increase in well-being was expected. Neither background variables, such as age or gender, nor whether children were with other children or adults emerged as significant predictors of well-being in the indoor environment. Two variables describing different places in the indoor environment stood out as significant predictors of well-being. Being at high tables for the whole observation was estimated to reduce the level of well-being by 0.3, and being in a room for PA was expected to increase well-being by 0.4.

The PA model indicated that age, gender, playing and being with other children were not significantly associated with PA in the indoor environment. There was a small significant negative effect of adults being present, with an estimated decrease in PA of 0.2 on the OSRAC-P scale if the child was with adults for the entire observation. The open floor space, cubbies, rooms for PA and tumbling zone categories were all significantly positively associated with PA. The use of open floor space during the entire observation was estimated to increase PA by 0.4, whereas being in the cubby during the whole observation

Table 3. Multilevel model of well-being and PA in the indoor environment.

Predictors (fixed effects)		Physical activity	Well-being
Constant		2.3	3.4
Background	Age	.008	-.048
	Boy	.034	-.023
Context	Playing	.000	.007***
	With Children	.001	.001
	Adult Present	-.002**	-.001
Place	Open Floor Space	.004**	-.001
	Low Tables	-.003*	-.002
	High Tables	-.004*	-.003*
	Cubbies	.005**	.001
	Rooms for PA	.017***	.004*
	Tumbling Zone	.013***	.001
	Play Zone	.002	-.002
Model statistics (including random effects)			
Observation level	Sample Size	479	479
	Residual Variance Empty Model	.493	.294
	Residual Variance Full Model	.318	.240
Child level	Sample Size	80	80
	Residual Variance Empty Model	.086	.109
	Residual Variance Full Model	.044	.077
Variance at the child level (%)		15%	27%
Goodness of fit -2LL (empty – full model)		220***	105***

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

was associated with a 0.5 increase in PA. The two strongest predictors of PA in the model were being in rooms for PA or tumbling zone. Using rooms for PA during the entire observation was estimated to increase PA by 1.7, and the use of a tumbling zone was estimated to increase PA by 1.3. Using tables was expected to reduce PA, with an impact of 0.3 for the use of low tables during the entire observation and 0.4 for the use of high tables during the entire observation.

Discussion

The findings in this study imply that the physical indoor environment influences children's well-being and PA. The magnitude of the impact of the place variables and the model statistics indicates that the physical environment has a stronger impact on PA than on well-being. The clear association between the characteristics of the physical environment and PA is in line with previous research in the field (Brown et al. 2009; Sugiyama et al. 2010). The few moderate associations between the physical environment and well-being may be in line with previous research that has struggled to find clear associations between environmental quality and children's well-being in ECEC institutions (Brunsek et al. 2017). The amount of variance at the child level in the multilevel analysis shows that well-being is more stable and internalized than PA. Well-being may therefore be less prone to influences by external factors such as the physical environment, and other external factors such as the quality of the caregiver interactions (de Schipper, Riksen-Walraven, and Geurts 2006) may be more important for children's well-being.

The only contextual factor that was found to be related to children's well-being in this study was playing. The positive association between playing and well-being adds to the existing evidence (Kennedy-Behr, Rodger, and Mickan 2015; Howard and McInnes 2013), suggesting that playing and well-being are strongly related in ECEC institutions. Strategies to support, guard and facilitate playing in ECEC institutions are highly important.

The only physical environmental variable in this study that was significantly positively associated with well-being was rooms for PA. This place variable was also strongly positively associated with PA, which is in line with previous studies (Barbosa et al. 2016; Sugiyama et al. 2010). The correlation analysis indicated that children's well-being and PA are related in the indoor environment, and the positive association between rooms for PA and well-being can be interpreted in this regard. The possibilities for physically active play and the freedom to be active in these rooms may also promote well-being. Having an indoor room for PA in ECEC institutions may therefore be considered important for both children's well-being and PA, depending on the children using the room. The limited use of this room in this study may imply that the overall impact of such a room on children's well-being and PA is limited. However, the data in this study is too limited to draw such a conclusion. The limited number of observations in this category also calls for caution when interpreting the association of the rooms for PA with children's well-being and PA.

The use of high tables in this study was found to be negatively associated with children's well-being. The role of tables in ECEC institutions was discussed in a previous Norwegian study about playing, space and materiality (Nordtømme 2016). In this study, tables were found to have a very central place in the institutions, taking up much of the available floor space and facilitating sedentary behaviour. Furthermore, the arrangement of tables and the other furniture signalled to children that they were expected to be seated at the tables and

that physical and active play would not be tolerated. Nordtømme (2016) suggested that this normative arrangement of the room and the available materials may limit children's possibilities for participation and choice. The negative association between well-being and the use of high tables identified in the present study may support this idea. The results of this study indicate that dominating the indoor play space with high tables should be avoided.

The presence of adults was significantly negatively associated with PA, but the effect was small. None of the other contextual or background variables were significantly related to PA in this study. The negative association between the adult presence and PA is in line with a previous study in which children were found to be less active when there were more adults present indoors (Gubbels et al. 2011). This finding may indicate that for the most part, adults encourage sedentary behaviour and play activities that do not foster PA.

Many institutions may have a shortage of rooms that support PA, and allowing running and chasing in the existing environment may be challenging. The positive association between the use of the cubbies and children's PA may indicate that this room can function as a room for PA. The cubbies are often in open spaces or halls and have benches or other furniture that allows children to climb or jump, and outdoor clothing provides hiding places. With the theory of affordance in mind, it is no surprise that children utilize such environments for PA. Affordance involves what the environment affords the child and the complementarity of the child and the environment (Gibson 2014). Children often have an urge for play involving PA, and the cubbies may afford running, climbing and hiding. Seeing and designing cubbies as a place for physically active play may heighten the quality of the indoor environment and support children's possibilities for PA. Furthermore, open floor spaces were positively associated with PA, and tables were negatively associated with PA. These relations also makes sense from an affordance perspective, as open floor space affords activities such as running, chasing and gross motor movements, while the tables facilitate sedentary behaviour, often including fine motor activities.

Tumbling zones were found to be a strong positive predictor of PA, which is in line with a previous study that found the use of indoor spaces for motor activities to be positively associated with PA (Sugiyama et al. 2010). While rooms for PA were often unavailable for most of the day, the tumbling zones in this study were an integrated part of the indoor space that children could access freely. The tumbling zones were therefore used very frequently and were very popular in the two institutions offering them in this study. The positive association with PA and the frequent use of these areas indicate that including tumbling zones in the indoor space may be a promising strategy to promote children's PA in ECEC institutions. The practical implications for planning, designing and developing ECEC setting indoor environments based on the main findings in this study are as follows:

- emphasizing the provision of supportive environments for play
- highlighting the importance of indoor environments affording physical active play
- avoiding dominating the indoor space with high tables

Limitations

As a cross-sectional study conducted within the children's everyday environment, there are several limitations to this study. No causal inferences can be established based on

the results of this study; only associations between the physical environment and children's well-being and PA could be determined. The inter-rater reliability test indicated that there was some uncertainty related to the measurement of children's well-being, and the contextual variable describing whether children were playing may also be questioned in terms of how accurately one can determine whether children are playing.

With little previous research on how the physical indoor environment influences children in ECEC settings, this study had to develop new categories for the physical indoor environment. Hence, there is little previous research available for comparison, and more studies are needed to confirm the findings in this study. Other variables describing the physical environment, such as noise, daylight, overall quality of the building, etc. that were not included in this analysis may also influence children's well-being and PA. An influence is also seen for the social context in the institution, including caregiver quality, ratio, sensitivity and knowledge of children's well-being and PA.

Nevertheless, analysing a vast number of video observations from several institutions and analysing these video observations from different perspectives has provided new knowledge of the role of the physical indoor environment in ECEC institutions in children's well-being and PA. Future research may build on these findings and put the results of this study to test in more rigorous and controlled experiments to build much needed knowledge of how the physical environment in ECEC institutions influences children's well-being and PA.

Disclosure statement

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