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# Supportive indoor environments for functional play in ECEC institutions: a strategy for promoting well-being and physical activity?

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## ABSTRACT

The physical environment in Early Childhood Education and Care (ECEC) institutions provide children with possibilities for play. This study describes a physical environmental intervention aiming to increase the possibilities for functional play in the indoor environment, and its influence on children's well-being and physical activity. The intervention involved the establishment of a tumbling space with soft surfaces, mats and big construction materials. The sample consists of video observations of 65 children's free play in seven ECEC institutions at two data points. Multilevel regression analysis indicates that children's physical activity and functional play is strongly related to the use of a tumbling space, and that the intervention group had a higher increase in functional play following the intervention compared to the control group. The impact of the tumbling space on well-being is limited. The results indicate that targeting children's possibilities for functional play may be beneficial from a health promotion standpoint.

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## KEYWORDS

Tumbling space; indoor environment; well-being; physical activity; functional play

## Introduction

Most children aged 3–5 years in the Western world attend early childhood education and care (ECEC) institutions (OECD, 2018), making ECEC institutions an important arena for public health promotion. Well-being is often considered to be a central component in programme quality, but a common understanding on how ECEC institutions can promote well-being is lacking (Mashford-Scott, Church, & Tayler, 2012). More is known about the impact of the ECEC institution on children's physical activity. What type of ECEC institution children attend is found to be a strong predictor for children's physical activity and to account for about 40% of the variance in physical activity while in child care (Finn, Johannsen, & Specker, 2002; Pate, Pfeiffer, Trost, Ziegler, & Dowda, 2004). Structural differences between institutions in outdoor time and how much time children are able to engage in free play are possible explanations for the significant impact of the institution on children's physical activity (Pate et al., 2004). The association between time to engage in free play and physical activity may be explained by the fact that much of children's play behaviours involve physical activity, and that the achievement of fine and gross motor mastery in early years facilitates active play types (Johnson, 2006). Play where children engage in gross-motor activities and basic skill development and movement such as climbing, jumping, running and chasing are often defined as functional play (Fjørtoft & Sageie, 2000). Children's possibilities for free play may also be linked to well-being as children can experience enjoyment and positive feelings, flow and engagement, belonging and

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meaning in play (Holte et al., 2014). Hence, promoting children's possibilities for free play may enhance both well-being and physical activity in ECEC institutions.

Physically active children have healthier cardiovascular profiles, are leaner and develop higher peak bone mass (Boreham & Riddoch, 2001). Characteristics of the physical environment, as well as child characteristics such as gender and age are found to be correlated to physical activity in ECEC institutions (Tonge, Jones, & Okely, 2016). Mapping physical activity levels with objective measures in ECEC institutions have shown relatively high levels of sedentary behaviour (Reilly, 2010). Similar results are found in an observational study by Pate, McIver, Dowda, Brown, and Addy (2008) where children engaged in moderate or higher levels of physical activity in less than 3% of the observations and that children were sedentary for more than 80% of the time. New knowledge about how the ECEC institution may promote well-being and physical activity is highly needed, as children's experiences in ECEC institutions may influence their health status both in the present and in the future.

Well-being and physical activity are important elements in the framework plan for ECEC institutions in Norway, where this study was conducted. It is emphasized that the institutions shall promote psychical and mental health, provide children with daily physical activity and contribute to children's well-being (Norwegian Directorate for Education and Training, 2017). Physical activity and indicators for well-being are found to be associated in children and adolescents (Biddle & Asare, 2011). Findings of an association between well-being and functional play in an ECEC study (Storli & Sandseter, 2019) indicate that this also may be true for the context in this study. This possible association may be attributed to explanations like the biological effects of having physical activity (Silverman & Deuster, 2014), children's innate need for physical activity (Rowland, 1998), social interaction in physical activity (Lehto, Reunamo, & Ruismäki, 2012) and the association between play, well-being and physical activity (Sando, 2019). Allowing children to choose functional play activities that involve physical activity in ECEC institutions will most likely promote physical activity, and perhaps also well-being. Furthermore, mastering motor activities in functional play can enhance children's self-esteem and perceived competence.

Enhancing children's possibilities for physical activity in the indoor environment may impact children's daily physical activity to a high degree, as the indoor environment is commonly associated with sedentary behaviour (Andersen et al., 2017; Klesges, Eck, Hanson, Haddock, & Klesges, 1990). Previous studies indicate that having an indoor recreation room that is supportive of motor activities is associated with less sedentary behaviour (Barbosa, Coledam, Stabelini Neto, Elias, & de Oliveira, 2016) and that using the indoor space for motor activities is positively associated with physical activity (Sugiyama, Okely, Masters, & Moore, 2012).

The possibilities for using the indoor environment for children's motor activities are highly dependent on the adults in the institution. Adult interaction with children and how the adults provide children with developmentally stimulating opportunities are important for child outcomes (Pianta, Barnett, Burchinal, & Thornburg, 2009). For well-being, caregiver interactions (de Schipper, Riksen-Walraven, & Geurts, 2006), caregiver stability (de Schipper, van Ijzendoorn, & Tavecchio, 2004), and caregiver sensitivity (Groeneveld, Vermeer, van Ijzendoorn, & Linting, 2010) have been found to be important aspects. Considering physical activity, staff members' training in physical activity is found to be positively associated with children's physical activity (Sugiyama et al., 2012). Studies have also demonstrated specifically that the social environment influences how the physical environment is associated with children's physical activity (Gubbels et al., 2011). Hence, the adults in the institution are an important contextual factor influencing how children can utilize the physical environment.

The scope for this study is to explore how the physical indoor environment can be changed to promote functional play, physical activity and well-being. Designing an indoor space that supports functional play may promote children's physical activity and possibly also their well-being as these concepts have been found to be related. This study is a design experiment in education (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003) and uses an iterative design to develop and test

interventions in a real-life context. The intervention developed and tested in this study is the establishment of a tumbling space in ECEC institutions. A tumbling space is a place for bodily play with a soft surface, mats, pillows and large construction materials. The research question that is explored in this study is How does the introduction of a tumbling space in ECEC institutions influence children's functional play, physical activity and well-being?

## 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. The project is a three-year study using mixed methods (Creswell, 2013) conducted in close collaboration with three ECEC owners in Norway. The project design included two data collections and an intervention. The data collection involved systematic and randomized video observations of two minutes during children's free play sessions. Results from the first data collection are described in previously published studies (Sando, 2019; Storli & Sandseter, 2019).

### *Procedure and sample*

The participating ECEC institutions were strategically selected among the partner institutions to have a variation in size, age, location and physical environment. The sample in this study includes seven ECEC institutions. One preschool teacher from each of the participating institutions was recruited to be a co-researcher in the project and was included in the extended project group. The extended project group included five researchers, eight preschool teachers, an architect and a landscape architect.

The first data collection (T1) was conducted in the fall 2017 when 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 received from parents. The participating children were informed about the video observations and were not filmed if they did not want to be. To ensure random filmed situations, the filming of the children followed a predetermined scheme that stated the order and time that the observations were to be conducted. Six video observations of two minutes of each child were recorded in the indoor environment at each data collection. With six video observations of 70 children, a total of 420 video clips in the indoor environment constituted a full sample at the first data collection. Actually, the final sample was made up of 419 video clips, with one clip excluded because the child was inside a tent and was hidden for the entire observation. Based on the results from the first data collection, discussions in the extended project group and in each of the participating institutions an intervention was conducted in the spring 2018.

The second data collection (T2) was conducted in the fall 2018, one year after the first data collection among the same children as in T1. Five children were excluded from the sample, four of the 70 previously participating children no longer attended the participating institution at T2, and one of the children was not included because of ethical considerations. A complete sample at T2 with six observations of each of the 65 remaining children in the indoor environment would consist of 390 video observations. However, the final sample at T2 includes only 381 video observations. Nine video clips were excluded. Four because the child was hidden, three because the child was occupied with the camera and two due to technical or human error.

Thus, the final sample included 770 video observations of 65 children from T1 ( $N = 389$ ) and T2 ( $N = 381$ ) of 33 girls and 32 boys. The children's mean age was 3.8 years ( $SE = 0.6$ ) at T1 and 4.7 years ( $SE = 0.6$ ) at T2.

### *Intervention*

All participating institutions carried out an intervention in the spring 2018. The intervention was based on preliminary criteria for good physical environments established in workshops with the

extended research group following the first data collection. These criteria were inspired by the 7Cs (Herrington, Lesmeister, Nicholls, & Stefiuk, 2007), and included for the indoor environment characteristics like an inviting atmosphere, richness, clarity, accessibility, connectivity, transformability, and variety. Although the interventions were built on the same knowledge base, the intervention was unique in each of the participating institutions. The intervention had to be low-cost and each institution had 1000 euros that could be spent on the intervention. The overarching aim for the intervention was to promote play, and specifically to increase children's possibilities for symbolic play in the outdoor environment and for functional play in the indoor environment, as environments supporting these play types seemed to be lacking in the first data collection (Storli & Sandseter, 2019). This article focuses on the promotion of functional play in the indoor environment.

One of the participating ECEC institutions had a tumbling space at T1. This was a place for different types of physical play with soft surfaces, pillows and gymnastics equipment. This space showed promising possibilities for promoting functional play, well-being and physical activity in the indoor environment. An important asset with this tumbling space was that it was integrated into the department and therefore accessible to children throughout the day. This was in contrast to the specialized rooms for physical activity in some of the other institutions that were placed outside the department, had to be booked in advance and were shared with other departments. Hence, the tumbling space was used much more frequently than the specialized rooms for physical activity and could therefore be expected to have a greater impact on children.

Based on the findings in the first data collection, five of the participating institutions established a tumbling space in the intervention. Children getting access to a tumbling space at T2 were placed in the intervention group, while children who did not have a change in access to a tumbling space were placed in the control group. An overview of the participating institutions and the interventions are presented in Table 1.

The tumbling spaces in the participating institutions are quite different since the institutions have different buildings, room plans, grouping of children and materials for bodily play. All tumbling spaces did, however, include soft surfaces, mats and some larger materials that children could use for functional play. It is important to emphasize that other considerable changes were made in the participating institutions from T1 to T2. Many of the institutions established new play zones and increased the availability and quality of play materials. Specialized rooms for physical activity varied in availability from group to group of children and data collections. Structural changes from T1 to T2 were also conducted, and some of the participating children were moved to another department within the institution they attended. Changes in the staff were also made, and the staff's

**Table 1.** Participating institutions.

Institution	N children (Observations)	Tumbling intervention	Group
<b>A</b>	8 (48)	A tumbling space was established in both participating departments.	Intervention group
<b>B</b>	9 (54)	A tumbling space was established in a common room outside the department.	One child had access to the tumbling space during the observational period. This child was placed in the intervention group. The other children were in the control group.
<b>C</b>	10 (59)	A tumbling space was established in the department.	Intervention group
<b>D</b>	8 (48)	This institution had a tumbling space at both T1 and T2.	Control group
<b>E</b>	10 (60)	No tumbling intervention.	Control group
<b>F</b>	10 (60)	Tumbling space established in the intervention. The room was locked and unavailable for two days.	The children with access to the tumbling space were in the intervention group. The other children were in the control group.
<b>G</b>	10 (60)	Tumbling space was established in one of the two participating departments.	The children with access to the tumbling space were in the intervention group. The other children were in the control group.

competence regarding the physical environment and its importance for children's play most likely increased because of their participation in this project. This illustrates the complexity and context-dependent nature of naturalistic research in education, and this lack of control over important contextual factors must be considered when drawing conclusions from the findings in this study.

## Measures

The Leuven Well-Being Scale (Laevers, 2005) was used to measure the *well-being* of the children. The Observational System for Recording Physical Activity in Children–Preschool (OSRAC-P) (Brown et al., 2006) was used to measure physical activity. Both instruments use a scale from one to five. Each video observation was scored by two independent researchers. Disagreements 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. Using weighted kappa (Cohen, 1968), inter-rater agreement was 89% for well-being with a kappa value of 0.44. This indicates moderate agreement and agreements above 80% and with kappa values above 0.40 are often viewed as acceptable agreements (McHugh, 2012). For physical activity, the inter-rater agreement was 94% with a kappa value of 0.70, indicating good agreement.

Children's 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 & O'Connell, 2013; Fjørtoft & Sageie, 2000; Luchs & Fikus, 2013). In this article, a variable describing the percentage of time the child was engaged in functional play were used. Play was coded by one researcher for the entire sample, and a random sample of 10% of the video observations was reviewed by a second researcher to ensure consistent coding. To measure the use of the tumbling room, a variable describing the percentage of time in the tumbling room was generated. Further variables describe children's age and gender, if the child had access to a tumbling space and if the child was in the intervention or control group used in the analysis.

## Analysis

The scoring of well-being and physical activity was performed on an Excel spreadsheet. The use of tumbling spaces was coded using the Observer XT 12.5 behaviour coding (Noldus), analysis and management software for observation data (Zimmerman, Bolhuis, Willemsen, Meyer, & Noldus, 2009). The Observer XT data were paired with the spreadsheet of scores for well-being and physical activity and imported to Stata MP 15.1 (StataCorp, College Station, TX, U.S.A.), which was used for the statistical analysis. Given the hierarchical structure of the data with nested observations of children within ECEC institutions, multilevel regression analysis (Goldstein, 1986) was used to investigate the associations of tumbling rooms and children's well-being, physical activity and functional play. Multilevel analysis makes it possible to control for contextual factors and increases the accuracy of the predictions (Gelman, 2006).

## Results

The mean duration of the 770 video observations in the full sample was 122 s (SE = 6). The average scores were 3.7 (SE = 0.7) for well-being and 2.7 (SE = 0.8) for PA. Tumbling spaces were used for 12% (SE = 32) of the observed time and accessible to children in 35% (SE = 48) of the observations. Children engaged in functional play for 11% (SE = 29) of the time. To examine the effect of establishing a tumbling space on well-being, physical activity and functional play, the participating children were placed in a control group or an intervention group based on the information given in Table 1. Descriptive statistics for the full sample and for the two groups at the two data points are presented in Table 2.

The use of the tumbling spaces varied across the institutions and the two data points. At T1, the tumbling space was in use for 46% of the time in institution D. The other institutions did not have a

**Table 2.** Descriptive statistics.

	Full sample	Control group		Intervention group	
		T1	T2	T1	T2
N children	65	36	36	29	29
N boys	32	15	15	17	17
N observations	770	216	208	173	173
Age, mean (s.e.)	4.2 (0.7)	3.8 (0.5)	4.8 (0.5)	3.7 (0.6)	4.6 (0.6)
Functional play, mean % (s.e.)	12 (29)	10 (27)	15 (33)	5 (19)	19 (34)
Well-being, mean (s.e.)	3.7 (0.7)	3.5 (0.6)	3.8 (0.7)	3.7 (0.6)	3.9 (0.6)
Physical activity, mean (s.e.)	2.7 (0.8)	2.5 (0.7)	2.8 (0.8)	2.6 (0.6)	2.9 (0.8)
Tumbling use, mean % (s.e.)	12 (32)	10 (30)	7 (24)	0 (0)	34 (46)
Tumbling access, mean (s.e.)	0.35 (0.5)	0.22 (0.4)	0.22 (0.4)	0 (0)	1 (0)

tumbling space at T1. At T2, the tumbling space was used 14% of the time in institution A, 7% of the time in institution B, 28% of the time in institution C, 30% of the time in institution D, 28% of the time in institution F and 17% of the time in institution G. Institution E did not have a tumbling space at either of the data collections.

The correlation matrix presented in Table 3 shows that well-being is positively correlated with physical activity ( $r = .29, p < .001$ ), use of tumbling space ( $r = .12, p < .01$ ), having access to a tumbling space ( $r = .20, p < .001$ ) and functional play ( $r = .25, p < .001$ ). Physical activity is positively correlated to age ( $r = .13, p < .001$ ), use of tumbling space ( $r = .39, p < .001$ ), having access to a tumbling space ( $r = .22, p < .001$ ) and functional play ( $r = .57, p < .001$ ). Functional play is positively correlated to use of tumbling space ( $r = .42, p < .001$ ) and having access to a tumbling space ( $r = .24, p < .001$ ).

### Use of and access to the tumbling space

To analyse the association between the outcome variables well-being, physical activity and functional play, and the variables describing the use of and access to the tumbling space, multilevel regression analysis was applied. This was done to control for the nested data structure and the children's age and gender. Random intercept models were used in all multilevel analysis. The data are nested at three levels: observation level (level 1) ( $N = 770$ ), child level (level 2) ( $N = 65$ ) and institutional level (level 3) ( $N = 7$ ). The variance partition coefficient (VPC), with a limit of 5% variance, was used to determine the number of levels in the model (Mehmetoglu & Jakobsen, 2017). VPC calculations for well-being indicate that there is 4% variance at the institutional level and 16% variance at the child level. For physical activity, there is 2% variance at the institution level and 6% variance at the child level. Similar variances are found in the functional play, with 4% variance at the institution level and 5% variance at the child level. A two-level model is selected for further analysis.

Well-being, physical activity and functional play were used as dependent variables in the analysis to investigate the association with use of and access to a tumbling space. A stepwise inclusion of variables starting at the lowest level in the model (Hox, 2010) was performed. An intercept-only

**Table 3.** Correlation matrix ( $N = 866$  observations).

	1.	2.	3.	4.	5.	6.	7.
1. Age	–						
2. Boy (0 = girl)	.13***	–					
3. Functional play	.09*	.01	–				
4. Well-being	.08*	.03	.25***	–			
5. Physical activity	.12***	.03	.57***	.29***	–		
6. Tumbling use	.11**	.04	.42***	.12**	.39***	–	
7. Tumbling access	.22***	.03	.24***	.20***	.22***	.53***	–

\* $p < .05$ .

\*\* $p < .01$ .

\*\*\* $p < .001$ .

**Table 4.** Models for well-being, physical activity and functional play: use of and access to a tumbling space.

Model	M0: Functional play	M3: Functional play	M0: Well-being	M3: Well-being	M0: Physical activity	M3: Physical activity
Fixed part	Coeff.(s.e.)	Coeff.(s.e.)	Coeff.(s.e.)	Coeff.(s.e.)	Coeff.(s.e.)	Coeff.(s.e.)
Intercept	12.4 (1.3)	-.59 (6.1)	3.72 (.04)	3.23 (.17)	2.68 (.04)	2.11 (.17)
TumblingUse		.372(.04)***		.000 (.001)		.009 (.001)***
TumblingAccess		.47 (2.5)		.17 (.07)*		-.04 (.07)
Age		2.04 (1.5)		.10 (.04)*		.11 (.04)**
Boy		-.78 (2.2)		.02 (.08)		-.00 (.06)
Random part						
Level 1 Variance	820 (44)	694 (37)	.36 (.02)	.35 (.02)	.55 (.02)	.47 (.03)
Level 2 Variance	44 (20)	19 (14)	.06 (.02)	.06 (.02)	.04 (.02)	.03 (.01)
Deviance	7384	7241	1464	1441	1764	1632
AIC	7390	7255	1470	1455	1770	1646
BIC	7404	7288	1484	1487	1784	1678

\* $p < 0.05$ .\*\* $p < 0.01$ .\*\*\* $p < 0.001$ .

model was run first (M0), followed by a model including a variable describing use of the tumbling space (M1). Next, a variable describing if the child had access to a tumbling space was added (M2), and lastly the second-level variables describing age and gender were added (M3). Deviance, Akaike's Information Criterion (AIC) and Schwarz's Bayesian Information Criterion (BIC) are presented to indicate how well the model fits the data and to compare the final model to the intercept-only model (Hox, 2010). Table 4 presents M0 and M3 for well-being, physical activity and functional play.

The final model for functional play indicates that there is a positive association between the use of a tumbling space and functional play. The amount of functional play is estimated to increase by 37% when children are in a tumbling space for the entire observation (100%). There is no significant association between age, gender or having access to a tumbling space and functional play, when it is controlled for the use of the tumbling space. The first model (M1) for functional play is a significant improvement compared to the intercept-only model using likelihood-ratio test ( $p < .001$ ). M2 and M3 do not contribute significantly to explaining the variance in functional play compared to M1.

The final model for well-being (M3) indicates that there is no association between use of the tumbling space and children's well-being. There is, however, a small positive association between having access to a tumbling space and well-being. Children's well-being is estimated to be 0.17 higher on the Leuven Well-being Scale when children have access to a tumbling space. There is also a positive association between age and well-being, and being one year older is estimated to increase well-being by 0.1. There is no significant association between gender and well-being. For well-being, only M2 is a significantly improved model compared to the previous ( $p < .001$ ) using a likelihood-ratio test. M1 and M3 do not significantly improve the explanatory value, and the overall explanatory impact of the independent variables on the variance in well-being is limited.

Physical activity is positively associated with the use of a tumbling space. If the child uses a tumbling space for the entire observation, children's physical activity is estimated to be 0.9 higher on the OSRAC-P scale. There is a positive association between age and physical activity, and being one year older is estimated to increase physical activity by 0.1. There is no significant association between gender or having access to a tumbling space and physical activity. The first model (M1) for physical activity is a significant improvement compared to the intercept-only model using the likelihood-ratio test ( $p < .001$ ). M2 does not contribute significantly to explaining the variance in physical activity compared to M1, whereas M3 is a significant improvement ( $p < .05$ ) over M2.

To test if there is any difference between boys and girls in how use of and access to the tumbling space influence well-being, physical activity and functional play, models with an interaction term for tumbling use/tumbling access and gender were conducted for each of the outcome variables controlling for age. No differences between the boys and girls were found in how use of or access to



the tumbling space influences well-being, physical activity and functional play. Nor is there any difference between boys and girls in how much the tumbling space is used.

### **Between-group analysis**

Mean levels of well-being, physical activity and functional play increased from T1 to T2 for both groups (Table 1). A random-intercept model controlling for age and gender was used to examine if the intervention effect was statistically significant and if the intervention effect was different between the groups. An intercept-only model was run first (M0), followed by a model including age, gender and a variable for the intervention group (M1). Next, a variable for T2 was added (M2), and lastly, an interaction term for the intervention group and T2 was included in the model (M3).

Well-being was estimated to increase by 0.3 from T1 to T2 ( $p < .001$ ), controlling for age and gender. Physical activity also increased by 0.2 from T1 to T2 ( $p < .01$ ), controlling for age and gender. For well-being and physical activity there was no intervention effect, indicating that the increase is similar for the intervention group and the control group. Functional play shows an estimated increase of 10% following the intervention ( $p < .01$ ), controlling for age and gender. Notably there was an intervention effect present in the case of functional play, estimating the intervention group to have an 8% higher increase ( $p < .05$ ) in functional play compared to the control group from T1 to T2.

### **Discussion**

Well-being and physical activity have been previously found to be related concepts in the outdoor environment of ECEC institutions (Sando, 2019), and the initial correlation analysis showing a moderate correlation ( $r = .29$ ,  $p < .001$ ) indicated that this also may apply to the indoor environment. The relatively weak association between physical activity and well-being was in line with previous studies of different mental health indicators associated to physical activity (Biddle & Asare, 2011). Functional play was positively correlated to well-being ( $r = .25$ ,  $p < .001$ ) and physical activity ( $r = .57$ ,  $p < .001$ ), indicating that the engagement in functional play may be beneficial from a health promotion perspective.

The amount of variance in well-being at the institutional level (4%) indicates that there are some structural differences between the participating institutions when it comes to children's well-being. With only seven institutions in the sample and without explanatory variables at the institutional level, this study is not suited to explain institutional influences on children's well-being, leaving the topic for investigation in future research. For physical activity there was limited variance at the institutional level (2%), a finding in contrast to previous studies indicating more than 40% variance at the institutional level (Finn et al., 2002; Pate et al., 2004). These studies, however, measured physical activity through the whole day in different environments, whereas the present study measured physical activity specifically during free play in the indoor environment. The structural differences discussed by Pate et al. (2004) as possible explanations to the large variances at the institutional level were controlled for in the present study. Findings were, therefore, interpreted in support of outdoor time and time for free play being crucial for children's physical activity levels in ECEC institutions.

The amount of variance at the child level in well-being demonstrates that this is a more internalized concept that varies less across different observations than is the case for physical activity and functional play. The child's home situation, self-esteem and feeling of self-worth are quite stable entities that may influence children's expressions of well-being. It has been previously demonstrated that caregivers in different ways influence children's well-being (de Schipper et al., 2004; de Schipper et al., 2006; Groeneveld et al., 2010), and perhaps the social environment in the institution is more important for children's well-being than the physical environment. Although children's physical activity is influenced by their preferences for physical activity and the extent to which the child has an innate

need for physical activity (Rowland, 1998), environmental and contextual factors may impact children's physical activity and functional play to a higher degree. The fact that physical activity and functional play varied more across each observation compared to well-being indicated that the potential for explaining variance in physical activity and functional play at the observational level is higher than for well-being. Thus, the impact of the child's experiences in the ECEC institution on well-being may be more long-term than is the case for physical activity and functional play. Other methods for examining well-being than direct observation may be needed to tease out such long-term effects.

Child characteristics measured in this study – age and gender – show a limited association with well-being, physical activity and functional play. Well-being and physical activity are positively associated with age with an estimated increase of 0.1 in both measures if the child is one year older. Functional play is not associated with age. Nor are well-being, physical activity or functional play related to gender, and no differences were found between the genders when it comes to the impact of the tumbling space on the outcome variables. Previous studies have found boys to be more physically active than girls (Tonge et al., 2016). In light of this finding, one could hypothesize that boys would utilize the tumbling space for physical activity and functional play to a larger degree than girls, but this was not the case in the present sample. These results show that there are no differences between boys and girls in how much the tumbling space is used or how this space influences their well-being, physical activity and functional play. These rooms provided possibilities with open-ended materials that are not coded for special purposes or gendered roles and thus may be used in a multitude of ways by children with different interests. The fact that the tumbling space offers equal opportunities for functional play and physical activity for boys and girls is interpreted as a positive finding, and adds to the positive benefits of having access to a tumbling space.

Results also showed that access and use of the tumbling space explained little of the variance in well-being. There was a small positive association between having access to a tumbling space and children's well-being, but no associations between the use of the tumbling space and well-being. This may indicate that having access to a tumbling space allowing children to engage in bodily play has a positive influence on children's well-being through the day, a notion also supported by the correlation between physical activity and well-being. However, to what degree an estimated increase in well-being of 0.17 on the Leuven scale translates to an actual improvement in well-being in real-life is uncertain. The limited impact, the complexity of the concept and the challenges with the measurement of well-being (Mashford-Scott et al., 2012) illustrated with an inter-rater agreement in the lower acceptable spectrum, calls for a cautious interpretation of this finding.

Physical activity and functional play was, however, strongly associated with how much time the children spent in the tumbling space. The results in this study indicated that physical activity could be expected to be 0.9 higher on the OSRAC-P scale and the amount of functional play to be 37% higher when children are in the tumbling space for the entire observation. This adds to previous evidence suggesting that the possibility to use rooms in the indoor environment for motor activities is positively associated with children's activity levels (Barbosa et al., 2016; Sugiyama et al., 2012). Targeting the possibilities for functional play in the indoor environment may, therefore, be a successful intervention strategy in order to promote physical activity in ECEC institutions.

The implementation of tumbling spaces in five of the participating institutions was done in order to test the hypothesis that such an environment could promote functional play, well-being and physical activity. Functional play increased significantly more in the intervention group following the intervention, indicating that the introduction of a tumbling space provided opportunities for functional play that children actualized. Although there is a significant increase in well-being and physical activity from the first to the second data collection, the increase is equal for the intervention group and the control group. Children in the intervention group utilized the tumbling space for almost one-third of the observed time, showing that this space was very popular. However, the between-group analysis does not support the hypothesis that the establishment of this environment leads to higher well-being and physical activity. Still, the increase in functional play in the intervention

group may have possible positive benefits in itself for children's social and motor development even if well-being and physical activity are stable.

The increase in well-being and physical activity following the intervention may be explained by other changes in the physical environment, by rater bias as the researchers doing the scoring of well-being and physical activity have been involved in the interventions, or by other aspects. It is also possible that the increase in physical activity in the intervention group was primarily related to the introduction of the tumbling space, and by other factors in the control group. The clear association between use of the tumbling space and physical activity and the popularity of the room in the intervention group may support this notion. The lack of control over potentially important contextual factors such as the staff, what department children attend and access to other supportive environments for physical activity such as a specialized room for physical activity may also explain the lack of difference between the intervention and the control group.

Although the intervention in this study focused on the physical environment, another more unspoken 'intervention' has targeted the social environment. The importance of physical activity for children in the indoor environment has been highlighted in the discussions in the extended project group and in formal and informal meetings in each of the participating institutions. This has most likely influenced the staff's attitude towards physical activity in the indoor environment, and possibly also to the degree to which functional play is promoted in the indoor environment. This effect may be illustrated by the increase in functional play in the control group from T1 to T2, while children's use of the tumbling space decreased. This may indicate that the social acceptance for functional play increased in both groups following the intervention. The social environment has been found to be important for how children can utilize the physical environment for physical activity (Gubbels et al., 2011), and the degree to which the adults in the institutions have integrated this attitude may influence children's possibilities for functional play in the indoor environment. The lack of difference between the control group and the intervention group in physical activity may indicate that the social environment can override the physical environmental intervention. Perhaps the social environment represents the most important limiting factor for children's physical activity in the indoor environment and, if allowed, most children will engage in physical activity. A more rigorous study design examining combinations of interventions targeting both the physical environment and the social environment in a larger sample may be needed to develop knowledge on how to most effectively to promote physical activity in the indoor environment.

## Conclusion

The variability in access to tumbling spaces across the two data points allowed for a quasi-experimental analysis studying the effect of establishing a tumbling space on children's well-being, physical activity and functional play. The main finding in this study is that the introduction of tumbling space in ECEC institutions increases the amount of functional play in the indoor environment for boys and girls alike. The lack of randomization and the changes in other environmental and contextual factors from T1 to T2 in all institutions, call for caution when interpreting the results from the between-group analysis. It is important to highlight that the aim for design research in education is to generate and develop hypotheses, not testing them (Kelly, 2006). Hopefully, the results from this study can be adapted to more general knowledge claims and theory building that can be tested in more rigorous studies later. Still, the positive associations between the use of the tumbling space and the children's physical activity and functional play are promising from a health promotion standpoint and shows that an environment supportive of functional play is associated with physical activity.

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