# Motor Performance of Children in a Physical Education Kindergarten compared to Children in a Kindergarten without Physical Education

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## Abstract

*Movement as a basic need of children serves the development of their overall personality. This is why the difference in motor performance between children from kindergartens with and without physical education is investigated. Do children from a physical education kindergarten differ from children from a "normal" kindergarten in their motor performance? One kindergarten with and one without physical education were randomly selected. The sample consists of 57 girls and 46 boys (55.50 ± 10.93 months). The Movement Assessment Battery for Children 2 was used. Only Drawing trail shows a significant difference in favor of the physical education kindergarten. Excepting Posting coins, both groups achieve critical results in all tasks. For the total value, regression analysis shows a significant model F(3,99)=3.18 (p=.03) with a moderate multiple regression coefficient R=.30. Sex is the most important predictor as boys perform better than girls (non-standardized regression coefficient -1.99). Children in the physical education kindergarten perform in the subscale ball skills better than the children in the normal kindergarten (non-standardized regression coefficient 1.79) with increasing age, performance decreases (non-standardized regression coefficient -.84). For the total value, regression analysis shows a significant model F(3,98)=2.84 (p=.04) with a moderate multiple regression coefficient R=.28. Age is the most important predictor (non-standardized regression coefficient -3.45). Children in the physical education kindergarten perform in the total value better than the children in the normal kindergarten (non-standardized regression coefficient 2.58) and boys perform better than girls (non-standardized regression coefficient -1.32). Possibly the additional physical education in kindergarten has no effect on motor performance or the physical education program is not executed consistently. It may also be that this motor test is not appropriate. The kindergarten's physical education should be standardized. The study should be repeated with another test in a long-term study with a larger sample of persons.*

*Keywords: Kindergarten, Physical Education, Motor Performance*

## 1. Introduction

Movement is a basic need of children [1] and serves to a great extent to experience the world [2]. In early childhood, movement plays such an important role that it has a special place in early childhood education and development. Within the framework of movement promotion, children should experience the possibilities and limits of their abilities, through which a positive body and self-concept should develop. This lays the foundation for the development of the overall personality [3].

Therefore, it is of great importance that physical education is also offered in kindergarten in order to promote the overall personality of our children through a certain movement competence.

Movement competence in this context means the overall set of abilities, skills and cognitions as well as emotional, motivational and volitional prerequisites to move voluntarily, self-determined, joyfully and meaningfully. This requires a minimum level of motor competence, i.e. an appropriate development of motor skills and abilities. The regular sports programs are usually sufficient to sufficiently develop this movement competence in the majority of children in kindergarten [4;5]. In early childhood, however, motor development occurs rapidly, both as a quantitative increase in performance, qualitative improvement in movement processes, and as a variable capacity for application. It is assumed that boys and girls of preschool age differ only slightly in their performance [6]. Motor skills are understood here as dispositions for solving a wide range of movement problems [7]. They cannot be observed directly, but must be inferred via apparent indicators [8]. Motor skills are "specific, purposeful activities or their underlying dispositions" [9], which can be subdivided into gross and fine motor skills. In early childhood, the phase of acquiring and first combining elementary motor skills takes place, which lasts until about the age of six and is characterized by a particularly rapid acquisition of milestones and fundamental skills [7].

Another reason for the rapid development of skills is assumed to be the pronounced need for play and exercise in this age group [6].

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However, to this day, not every kindergarten offers sufficient exercise.

Therefore, the question arises here whether children from physical education kindergartens show a better motor performance than children in whose kindergartens no physical education classes are offered. This leads to the following hypothesis.

## 2. Hypothesis

Children in a physical education kindergarten have a better motor performance than children in a kindergarten without physical education.

## 3. Methods

The methods used in the present study are described below. The sample of persons is presented first, followed by the variable sample. Finally, the statistical procedure is described.

### 3.1. Participants

Two German kindergartens (one with and one without physical education program) were randomly selected:

The physical education kindergarten (PEK) is characterized by the fact that the children are given a variety of opportunities for movement through appropriate rooms and large outdoor areas, an open gymnasium, free and guided movement times, movement building site and many materials and equipment that motivate movement. Each kindergarten group has a special movement day each week. In addition, the kindergarten teachers are licensed exercise instructors or trained moto pedagogues. In this way, not only general contents of the culture of exercise and sports can be experienced, but also contents of psychomotricity or moto pedagogy. In this case, a local sports club is the sponsor of the kindergarten [10]. Exercises and sport are thus omnipresent in a physical education kindergarten.

The Kindergarten without physical education is a kindergarten that still works predominantly in a closed form, does not participate in any movement project or offers independently guided movement lessons/ physical education ("normal" kindergarten, NK).

All children from three years, zero months to six years, eleven months were included after the heads of the kindergartens and then the children's legal guardians had consented in writing to the examination. All data were stored and processed anonymously.

A total sample of 103 children (55.50 ± 10.93 months mean age ± standard deviation, 57 girls, 46 boys) participated in this study. Table 1 shows all characteristics of the participants.

Table 1: Characteristics of the sample of persons: number of girls and boys per group, age in months, weight in kg, height in m and Body mass index BMI (PEK = Physical education kindergarten, NK = "normal" kindergarten without physical education)

| Kinder-garten | Girls/ Boys | Age (M ± SD) | Weight (M ± SD) | Height (M ± SD) | BMI (M ± SD) |
|---|---|---|---|---|---|
| PEK (n=52) | 30/ 22 | 53.96 ± 10.57 | 17.6 ± 2.88 | 1.07 ± .06 | 15.28 ± 1.49 |
| NK (n=51) | 27/ 24 | 57.06 ± 11.17 | 19.05 ± 4.48 | 1.11 ± .08 | 15.41 ± 1.80 |
| T | | -1.45 | -1.97 | -2.47* | -.42 |

Comparing both groups, only for height a significant difference can be found. The children of kindergarten without physical education (NK) a taller.

### 3.2. Variable sample

The Movement Assessment Battery for Children Second Edition (M-ABC-2, German version) was selected as the variable sample.

The test has good psychometric properties (Interrater reliability: .79, Internal Consistency.: .62-.67, Retest reliability: .80, Construct validity: assumed model confirmed by CFA, Criterion validity: .40-.49) and is composed of the following items:

Posting coins, Threading beads, Drawing trail, Catching beanbag, Throwing beanbag, One-leg balance right and left, Walking heels raised and Jumping on mats. A percentile rank of higher than 15 means an age appropriate result, between six and 15 a critical result and lower than six a need of therapy [11].

### 3.3. Statistics

SPSS Version 26 was used for statistical analyses. A t-test was conducted to evaluate the differences between the kindergartens for all items, subscales and total score of the M-ABC-2. In a further step, a multiple linear regression was calculated to check age, sex, and kindergarten as predictors for the subscales and the total score of the M-ABC-2. Significance level was set at $p<.05$.

## 4. Results

Data showed a normal distribution. Table 2 shows the results of the t-test for the items, subscales and total value of the M-ABC-2, comparing the kindergarten with and without physical education.

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Table 2: Means and Standard deviations (M ± SD) for all items (percentile ranks), subscales and total value of the M-ABC-2, comparing kindergarten with physical education program (PEK) and "normal" kindergarten without physical education program (NK) by t-test (n = sample size, p = significance)

| M-ABC-2 Items, scales and total | PEK (n=52) M ± SD | NK (n=51) M ± SD | T | p |
|---|---|---|---|---|
| Posting coins | 43.69 ± 14.91 | 42.88 ± 12.54 | .30 | .77 |
| Threading beads | 3.04 ± 3.38 | 3.12 ± 2.96 | -.13 | .90 |
| Drawing trail | 10.02 ± 2.57 | 8.76 ± 3.60 | 2.04 | .04 * |
| Catching beanbag | 11.19 ± 3.24 | 10.25 ± 3.27 | 1.46 | .15 |
| Throwing beanbag | 10.12 ± 3.19 | 9.45 ± 2.78 | 1.13 | .26 |
| One-leg balance right | 10.71 ± 2.46 | 10.39 ± 2.90 | .60 | .55 |
| One-leg balance left | 10.94 ± 2.68 | 10.37 ± 2.74 | 1.07 | .29 |
| One-leg balance Mean | 10.88 ± 2.68 | 10.37 ± 2.91 | .93 | .36 |
| Walking heels raised | 10.88 ± 2.80 | 10.57 ± 2.64 | .59 | .56 |
| Jumping on mats | 11.58 ± 2.16 | 11.55 ± 1.94 | .07 | .95 |
| Subscale hand coordination | 31.75 ± 8.96 | 30.45 ± 6.00 | .86 | .39 |
| Subscale ball skills | 21.54 ± 5.29 | 19.71 ± 5.24 | 1.77 | .08 |
| Subscale balance | 34.04 ± 6.43 | 32.49 ± 5.41 | 1.32 | .19 |
| Total value | 87.33 ± 17.03 | 82.65 ± 12.87 | 1.57 | .12 |

Only the item Drawing trail shows a significant difference between both groups. The means of the percentile ranks range for PEK from 3.04 (Threading beads) to 43.69 (Posting coins) and for NK from 3.12 (Threading beads) to 42.88 (Posting coins). Only for the item Threading beads, the NK shows a higher percentile rank than the PEK. The PEK shows in all subscales and total value a higher score than the NK.

The multiple linear regression for the subscales balance and hand coordination show non-significant models. The subscale ball skills shows a significant model. The ANOVA shows for the regression a significant value of F(3,99)=3.18 (p=.03). The model has no auto-correlation as the value of the Durbin-Watson statistic is 2.11. There is no multi-collinearity between the predictors found. Multiple regression coefficient is at R=.30 and $R^2$=.09. Table 3 shows non-standardized and standardized coefficients, their T-values and partial correlation for sex, age, and kindergarten for the subscale ball skills.

Table 3: Results of the multiple linear regression analysis for the subscale ball skills (RC = non-standardized regression coefficient, SE = standard error, B = standardized coefficient Beta, T = T-value, p = significance, PC = partial correlation)

| Predictors | RC | SE | B | T | p | PC |
|---|---|---|---|---|---|---|
| Sex | -1.99 | 1.02 | -.19 | -1.94 | .05 | -.19 |
| Age | -.84 | .54 | -.15 | -1.55 | .12 | -.15 |
| Kinder-garten | 1.79 | 1.02 | .17 | 1.76 | .08 | .17 |

None of the predictors is significant.

In the multiple linear regression analysis for the M-ABC-2 total score, one case was identified as an aberration (more than three standard deviations) and removed from the data set. The ANOVA shows for the regression a significant value of F(3,98)=2.84 (p=.04). The model has no auto-correlation as the value of the Durbin-Watson statistic is 1.78. There is no multi-collinearity between the predictors found. Multiple regression coefficient is at R=.28 and $R^2$=.08. Table 4 shows non-standardized and standardized coefficients, their T-values and partial correlation for sex, age, and kindergarten.

Table 4: Results of the multiple linear regression analysis for the M-ABC-2 total score (RC = non-standardized regression coefficient, SE = standard error, B = standardized coefficient Beta, T = T-value, p = significance, PC = partial correlation)

| Predictors | RC | SE | B | T | p | PC |
|---|---|---|---|---|---|---|
| Sex | -1.32 | 2.52 | -.05 | -.53 | .60 | -.05 |
| Age | -3.45 | 1.34 | -.25 | -2.58 | .01 | -.25 |
| Kinder-garten | 2.58 | 2.52 | .10 | 1.03 | .31 | .10 |

Only the predictor age shows a significant result.

## 5. Conclusion

The present study was intended to show whether the children of kindergartens with and without physical education differ in their motor performance.

Although both groups do not differ in their anthropometric data except for height, a difference in motor performance would have been expected due to the fact that physical education is conducted in one kindergarten and not in the other. However, since percentile ranks or T-scores were analyzed in this study and the raw scores were thus normalized for age and gender, this difference in height does not matter.

With the exception of the Threading beads item, the PEK children perform better than the NK children. Nevertheless, only the item Drawing trail

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shows a significant difference between the two groups.

With the exception of the item Posting coins (age-appropriate results), the children of both kindergartens show results in the critical range (between the sixth and 15th percentiles) and even in the range requiring therapy (Threading beads, below the sixth percentile).

The average age of the participating children was about four and a half years. Therefore, some tasks may still have been too difficult for most of the children. In the area of gross motor skills, jumping develops quite slowly, although children enjoy jumping [12]. At about five years of age, 80% of children can jump up in place [13]. Jumping distances increase tremendously from about four to seven years of age [6]. This would explain the poor result in jumping on mats.

From about four years of age, the child can balance independently on a line or gymnastics bench, and a little later can stand on one leg for a short time (about 3 to 4 s) [12]. That's why the items One-leg balance and Walking heels raised seem to have been too difficult.

Until about four years of age, catching is only successful with direct throwing into the arms, after which coordination of ball movement and catching attempts becomes increasingly successful. From about six years of age, the child can move his arms towards the incoming ball, as he is better able to estimate the flight phase of the ball. When throwing, he or she can introduce a foot and coordinate the lunging and throwing motion. After that, the transfer of movement from the outswing movement to the throw is also successful [12]. At this point, this raises the question of how the bean bag was thrown to the children.

In the area of fine motor skills, it is assumed that at around four years of age the child can string small beads and has sufficient strength in the fingers to pin on clothespins. The child can also fold paper. By about the age of five, the child learns to make a different movement with each hand at the same time. About six months later, he succeeds in cutting out a shape exactly on a line and grabbing smaller beads with tweezers. He also tries to tie a bow on his shoes. By the age of six, the child learns various work techniques [14]. Because of this, it would have been reasonable to assume that all children would do well not only in Posting coins (which is also the fact), but also in Threading beads.

The requirements for multiple linear regression were all met for the subscales and the total score.

Regression analysis shows for the subscale ball skills that R and $R^2$ are weak to moderate. Kindergarten, sex and age were able to statistically significant predict M-ABC-2 total value. The non-standardized regression coefficient shows that in physical education kindergarten, the subscale ball skills is on average 1.79 points higher, that boys score on average 1.99 points higher than girls and that with increasing age the subscale value decreases on average by .84 points. The B-value of -.19 shows that the influence of sex is the largest among the predictors.

Regression analysis shows for the M-ABC-2 total score that R and $R^2$ are weak to moderate. Kindergarten, sex and age were able to statistically significant predict M-ABC-2 total value. The non-standardized regression coefficient shows that in physical education kindergarten the total value is on average 2.58 points higher, that boys score on average 1.32 points higher and that with increasing age the total value decreases on average by 3.45 points. The B-value of -.25 shows that the influence of age is the largest among the predictors.

It is possible that the sample was too small here. In addition, the children could not be randomly assigned to a kindergarten. Instead, one kindergarten with physical exercise and one kindergarten without physical exercise were randomly included in the study. This may have led to a bias, since children who are already fit or athletic without physical exercise may have been enrolled in the sports kindergarten.

It may not make a difference whether physical education is offered in kindergarten or not. Children in this age range generally have a high urge to play and move and live out this urge outside of physical education classes and also outside of the kindergarten [6].

However, it may also be due to the fact that physical education is not consistently provided in the kindergarten studied.

## 6. Future work

The present study was designed to compare differences in motor performance between children from a kindergarten with physical education and from a kindergarten without physical education. It turns out that only the item Drawing trail shows a significant difference between both groups. Overall, the children from both kindergartens are in a critical range in almost all tasks (percentile rank between six and 15). It is possible that physical education is not consistently implemented in the kindergarten, which is why the children do not differ. It is also possible that the tasks of the M-ABC-2 are too difficult for this age group, which may be a reason for the poor performance in general. Therefore, kindergartens with physical education should be checked to see to what extent this is carried out consistently and purposefully. Possibly, a standardization with specifications for input and output has to take place here; process-related data have to be collected in this context. However, this was only a snapshot (cross-sectional study), so the effects of the exercise

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programs may not be clear enough. Therefore, the study should be repeated as a long-term study, preferably with the older children (5- and 6-year-olds) and a larger sample of persons. In addition, it should be recorded whether the children also participate in sports in a club. Furthermore, it makes sense to repeat the examination with another motor test, such as the MOT 4-6 or the MobiScreen 4-6.

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