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Intervention Effects of the School-Based Health Promotion Program "Join the Healthy Boat" on Motor Abilities of Children with Migration Background

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Abstract

Purpose: Motor abilities of migrant children show worse performance compared with children without migration background. This study investigated whether a one-year intervention, which aimed to increase physical activity (PA), could influence the motor performance of these children positively. **Methods:** A sub-sample of 525 migrant children (7.1 ± 0.7 years; 48.6% male), participated in the study and included an intervention (IG) and control group (CG). The Dordel-Koch-Test was used to assess motor performance. An exploratory factor analysis was performed. Differences between IG and CG were examined using ANCOVA. **Results:** Boys in the IG showed a significant improvement in the conditional skills ($F(1, 201) = 8.02$, $p \leq 0.005$) and girls showed a tendency towards better results. Additionally, girls showed a significant improvement in flexibility ($F(1, 226) = 10.72$, $p \leq 0.01$) compared with the CG. **Conclusion:** The intervention affects parts of motor skills of migrant children significantly. Future interventions should aim at a target-group-specific promotion to get a holistic improvement in their motor abilities.

Keywords

Physical Activity, Prevention, School-Based Intervention

1. Introduction

Various health benefits of sufficient physical activity (PA) at every stage of life are well known and have been investigated in many previous studies [1] [2]. It is well established that regular PA can reduce the prevalence of cardiovascular risk factors

in children [3] [4], type II diabetes, or depression in adulthood [5] [6] [7].

Apart from long-term effects in later life, it should not be underestimated that the foundation for an active and healthy lifestyle is laid in childhood [8]. Regular PA participation during childhood has numerous positive effects on children's healthy growth, as well as, their motor, emotional and social development [4] [9]. With regards to the development of motor abilities, childhood is a sensible period [10], and studies show that PA is indispensable for reaching an adequate level of motor performance [11] [12].

The development of motor abilities depends on several aspects, such as biological factors like growth and maturity characteristics, and environmental factors, for example, social class affiliation or parental variables [10] [13]. Further, it has been shown that migrant status affects children's activity levels and motor abilities negatively [13]. A Swedish study showed that children whose parents were born abroad had a higher risk of being less physically active [14]. This risk increased even further if both parents matched this characteristic [14]. Additionally, offsprings of migrant parents are known to have a high risk of developing low levels of physical fitness (PF) [15].

Levels of PA and PF, as well as, children's motor abilities are characteristics which are strongly connected [16] [17]. Especially PA participation in childhood and youth is positively related to children's fundamental motor skill competence [8] [16] [18] [19] and on the other hand, well-pronounced motor abilities are essential for PF [17]. However, particularly children with migration background are at risk of insufficient PA. Therefore, their participation in plenty PA should be promoted as early as possible to gain adequate levels of motor abilities.

Hence, a teacher-centered school-based health promotion program called "Join the Healthy Boat" was developed and had been implemented in primary schools in south-west Germany. The intervention focuses on three main topics: increasing daily PA, reducing media screen timer and healthy diet.

Centers of this paper are the intervention effects of increasing daily PA regarding children's motor skills. The intervention lasted one school year and consisted of one lesson per week (on physical activity, screen media use or diet) and various instructions for short daily exercises in class of about 10 to 15 minutes each, to increase daily PA. This also aims at an increase in children's motor abilities, especially their flexibility, coordinative and conditional skills (for more detailed information see [20]). In order to reach parents with a migration background, information for parents focusing on PA is also provided in Turkish and Russian which are the two largest groups of migrants in Germany (28% and 30%, respectively) [21].

The aim of this paper is therefore, to examine the influence of the one-year intervention program "Join the Healthy Boat" on motor abilities of primary school children with migration background.

2. Methods

2.1. Intervention and Evaluation Design

"Join the Healthy Boat" is a health promotion program for primary school child-

ren, the classroom teacher incorporated the contents of the program into the regular school-curriculum without any extra lessons.

The materials have been developed for one school year, including one weekly teaching unit (on physical activity, screen media use or diet) and various instructions for short daily exercises, lasting 10 to 15 minutes, materials for parental information and so-called "family homework". The aim of this intervention is to offer action alternatives and increase children's daily physical activity to affect children's motor abilities positively. Further information on the program's development, materials, implementation and recruitment of teachers and pupils can be found elsewhere [20] [22] [23].

The evaluation of this school-based, teacher-centered intervention ("Join the Healthy Boat") is a prospective, stratified, cluster-randomized, and longitudinal study including an intervention (IG) and a control group (CG). After baseline measurements (T1) were taken, the intervention started in the IG. Simultaneously, the CG followed the regular school curriculum. Follow-up measurements (T2) were taken after one year. After T2, the CG started with the intervention, too. Prior to data collection, parents provided written informed consent and children provided their assent to taking part in the study.

The study was approved by the Ministry of Culture and Education and the university's ethics committee and is in accordance with the Declaration of Helsinki. The study is also registered at the German Clinical Trials Register (DRKS00000-494).

2.2. Participants

At baseline, data of 1943 primary school children (7.1 ± 0.6 years; 51.2% male) in 154 classes (80 classes with 1071 children, 53.8% male in the IG; 74 classes with 872 children, 46.2 % in the CG), who participated in the evaluation study were assessed.

A sub-sample of 525 (27%) children (7.1 ± 0.7 years; 48.6% male) with migration background was considered for these analyses and took part in baseline motor skills testing (T1) as well as follow-up testing (T2).

Children's migration background is defined as at least one parent being born abroad or the child was spoken to in another language than German in the first three years of life. Further, parental education was assigned to the particular level according to the CASMIN classification [24]. Family education level was determined as the highest level of two parents or the level of a single parent who cared for the child.

2.3. Instruments

Anthropometric measurements such as children's height (cm) and body mass (kg) were taken by trained staff according to ISAK Standards [25] using a stadiometer and calibrated electronic scales (Seca 213 and Seca 826, resp., Seca Weighing and Measuring Systems, Hamburg, Germany). Height was measured to the nearest 0.1 cm and weight to the nearest 0.05 kg. BMI was calculated as weight di-

vided by height squared. To define children's weight status BMI was converted to BMI percentiles (BMIPCT) using German reference data [26]. Cut-off points for overweight children were determined above the 90th percentile and for obese children above the 97th percentile [27].

2.4. Motor Ability Test

Children's motor abilities were assessed with the standardized and validated Dordel-Koch-Test battery (DKT) [28]. Skilled examiners carried out the tests in small groups. The DKT is a validated test battery to assess the main types of a child's motor abilities. It assesses flexibility, conditional and coordinative skills with the following exercises, which are shown in **Table 1** [27].

2.5. Data Analysis

Statistics were performed using SPSS Statistics 21 (SPSS Inc., Chicago, IL, USA) with a significance level set to $\alpha < 0.05$. Descriptive statistics were calculated (mean values and standard deviations) [27].

For better interpretation of the motor test battery, an exploratory factor analysis (principal components analysis, varimax rotation) was performed in order to reduce dimensions [27].

Table 1. Motor ability exercises.

	Conditional skills
Standing long jump	• Determines jumping power of the legs • Participants had two tries to jump with both legs as far as possible and land on both feet • Highest value was used for data analysis [27] [28]
Sit-ups	• Assess strength and endurance of the abdominal muscles and hip-flexors • Participants had 40 seconds to do as many sit-ups as possible [27] [28]
Push-ups	• Examine muscular strength and endurance of arms and trunk • Participant had 40 seconds to conduct push-ups • Only correctly performed push-ups were noted [27] [28]
6-min run	• Measures aerobic endurance • Participants ran as far as they could for 6 min • Exact distance in meters was recorded [27] [28]
	Coordinative skills
Lateral jumps	• Assess whole body co-ordination under time pressure • Participants jumped back and forth over a line as often as possible in 15 seconds • Two trials were executed • Number of correctly performed jumps of both runs were noted [27] [28]
One-leg stand	• Used to observe co-ordination for precision and balance on standing • Participants stood barefooted on a small rope on the floor on one leg for 1 minute • Ground contacts of the free leg were counted [27] [28]
	Flexibility
Sit and reach	• Flexibility of the lower back and hamstring muscles were assessed • Participants legs were fully stretched against a standardized sit and reach box when reaching along the top of the box with both hands as far forward as possible • Distance reached by the fingertips (cm) was noted [27] [28]

Therefore, based on the definition of motor abilities of Bös and Mechling [29], two factors were determined (coordination and condition) and included in an exploratory factor analysis. Since flexibility is not defined as a separate motor skill, but an important prerequisite for performance [29], it was considered separately [27].

The appropriateness of the model is supported by Bartlett's test (χ^2 = 2081.62, p ≤ 0.000), the Kaiser-Meyer-Olkin criterion (KMO 0.814) and measure of sampling adequacy (MSA 0.795 [lowest]) [27].

Differences in the three sub-groups of motor abilities (flexibility, conditional and coordinative skills) between IG and CG were examined using Analysis of covariance (ANCOVA) adjusting for age, gender, BMIPCT, parental level of education and baseline data. Similarly, gender differences in IG and CG were analyzed, adjusting for age, BMIPCT, parental level of education and baseline [27].

3. Results

Baseline socio-demographic and anthropometric characteristics of the participants are shown in Table 2. No significant gender differences were found for height, weight, or BMIPCT. Group comparing to check if randomization was successful revealed no differences between IG and CG for any relevant variables.

3.1. Performances during Each Motor Test at Baseline

Performances during each motor test at baseline are shown in Table 3. At baseline, only significant differences between IG and CG were found for the 6-min run and push-ups. Children in the CG ran for a significantly longer distance (p ≤ 0.002) and completed more push-up repetitions (p ≤ 0.001) than their counterparts in the IG.

3.2. Factor Analysis

The principal components analysis confirmed the two previously appointed factors and explained 59.8% of the variation. The first factor (conditional skills)

Table 2. Baseline characteristics of participants with migration background on the "Join the Healthy Boat" study.

	Missing values	Intervention (n = 318)	Control (n = 207)	Total (n = 525)
Age, years [m (sd)]		7.2 (0.7)	7.1 (0.7)	7.1 (0.7)
Boys [n (%)]		149 (46.9)	106 (51.2)	255 (48.6)
First grade [n (%)]		152 (47.8)	108 (52.2)	207 (39.4)
Weight, kg [m (sd)]	18	25.6 (5.7)	24 (4.7)	25.3 (5.3)
Height, cm [m (sd)]	18	123.9 (6.5)	124.1 (6.0)	124.0 (6.3)
BMI, kg/m^2 [m (sd)]	18	16.5 (2.5)	16.1 (2.1)	16.3 (2.4)
BMIPCT [m (sd)]	18	54.7 (29.1)	50.9 (27.6)	53.20 (28.5)
Overweight and obesity [n (%)]	18	42 (13.8)	18 (8.9)	60 (11.8)

m (sd): mean (standard deviation); BMI: body mass index, BMIPCT: BMI percentiles.

Table 3. Performances during each motor test at baseline.

	Conditional skills							
	Intervention Group				Control Group			
	Missing Values	Boys (n = 149)	Girls (n = 169)	Total (n = 318)	Missing Values	Boys (n = 106)	Girls (n = 101)	Total (n = 207)
Standing long jump, cm [m (sd)]	8	114.4 (±20.2)	105.9 (±20.8)	109.8 (±20.9)	-	117.2 (±23.2)	119.4 (±23.0)	113.5 (±23.4)
Sit-ups, n [m (sd)]	4	12.2 (±5.8)	10.3 (±5.8)	11.2 (±5.8)	1	12.6 (±6.2)	11.7 (±6.9)	12.2 (±6.5)
Push-ups, n [m (sd)]	6	4.9 (±3.9)	4.2 (±3.7)	4.5[1] (±3.8)	2	6.3 (±4.1)	5.1 (±4.2)	5.7[1] (±4.2)
6-min run, m [m (sd)]	1	842.5 (±122.5)	792.1 (±117.0)	815.9[2] (±122.1)	-	885.2 (±129.1)	810.4 (±93.9)	849.4[2] (±119.4)
	Coordinative skills							
One-leg stand, n [m (sd)]	2	5.7 (±7.0)	4.2 (±3.7)	4.9 (±5.9)	1	4.4 (±4.2)	4.1 (±5.6)	4.3 (±4.9)
Lateral jumps, n [m (sd)]	-	42.0 (±11.4)	41.9 (±13.9)	41.9 (±12.7)	1	40.8 (±12.5)	40.8 (±12.5)	41.0 (±13.0)
	Flexibility							
Sit and reach, cm [m (sd)]	-	1.8 (±5.3)	2.1 (±6.5)	1.9 (±5.9)	-	0.88 (±5.7)	1.9 (±5.1)	1.3 (±5.5)

m (sd): mean (standard deviation); n: number; m: meter; cm: centimeter. [1]Significant difference between children in the intervention and control group $p \leq 0.001$; [2]Significant difference between children in the intervention and control group $p \leq 0.002$.

included standing long jump, sit-ups, push-ups and 6-min run; the second factor (coordinative skills) included one-leg stand and lateral jump.

3.3. Intervention Effects on Children's Motor Performance

Significant intervention effects were found for conditional skills and flexibility. For the boys in the IG, a significant improvement of conditional skills ($F(1, 201) = 8.02$, $p \leq 0.005$) was ascertained by comparison to boys in the CG. Girls in the IG showed no significant improvement in conditional skills, but a tendency towards better results than their counterparts in the CG. Additionally, girls showed a significant improvement in the flexibility tests ($F(1, 226) = 10.72$, $p \leq 0.01$).

The model explains 61.1% of variance in flexibility (adjusted $R^2 = 0.611$, $F(4, 226) = 91.50$, $p \leq 0.000$) and 29.3% of variance (adjusted $R^2 = 0.293$, $F(7, 209) = 13.31$, $p \leq 0.000$) for conditional skills both adjusted for age, BMIPCT, parental education level and baseline data. Results are shown in Table 4.

4. Discussion

This work investigated the effects of the school-based health promotion program "Join the Healthy Boat" on motor abilities of children with migration background. The program focuses on a healthy lifestyle with three main priority areas:

Table 4. Intervention effects on children's motor performance after one year intervention-T2-T1 Differences.

	Missing Values	Intervention Group			Missing Values	Control Group		
		Boys (n = 149)	Girls (n = 169)	Total (n = 318)		Boys (n = 106)	Girls (n = 101)	Total (n = 207)
Conditional skills[1]								
Standing long jump, cm	48	13.6 (21.5)	9.5 (18.6)	1.4 (20.1)	28	9.1 (18.8)	8.1 (17.0)	8.6 (18)
Sit-ups, n	36	3.5 (6.5)	2.7 (6.0)	3.1 (6.2)	28	2.7 (5.8)	2.3 (5.9)	2.5 (5.8)
Push-ups, n	48	3.2 (4.6)	1.4 (4.8)	2.3 (4.8)	29	0.9 (5.4)	1.4 (5.1)	1.2 (5.2)
6-min run, m	42	91.0 (127.9)	60.6 (103.3)	75.0 (116.4)	26	59.8 (116.6)	44.8 (92.3)	52.7 (105.7)
Coordinative skills								
One-leg stand, n	44	−2.7 (6.8)	−2.1 (4.4)	−2.4 (5.7)	28	−2.1 (4.4)	−1.6 (4.8)	−1.9 (4.6)
Lateral jumps, n	43	11.0 (9.1)	9.9 (10.2)	10.4 (9.7)	28	11.7 (9.1)	10.3 (9.0)	11.0 (9.1)
Flexibility[2]					27			
Sit and reach, cm	41	−0.6 (4.4)	1.0 (4.2)	0.2 (4.4)	36	−0.6 (5.0)	−0.7 (4.6)	−0.64 (4.8)

Values are displayed in mean (standard deviation); cm: centimeter; n: number; m: meter; [1]Significant difference between boys in the intervention and control group $p \leq 0.001$; [2]Significant difference between girls in the intervention and control group $p \leq 0.05$.

sufficient physical activity, leisure time activity without screen media and a healthy diet. The materials have been developed for one school year, including one teaching unit per week and various instructions for short daily exercises, lasting 10 to 15 minutes. The mediating effect of the intervention on three relevant motor skills was assessed, namely on coordination, conditional and flexibility.

After a one-year intervention period, significant intervention effects were found for boys in conditional skills and for girls on flexibility in the IG compared to the CG.

Migrant boys of the IG showed a significant improvement of their conditional skills compared to their counterparts in the CG. The conditional skills were assessed using standing long jump, push-ups, sit-ups and a 6-minute run. These tests were also used in other large school-based interventions measuring motor skills in primary school children [30] [31] [32]. However, most of these studies did not focus on migrant children; hence, to our knowledge, no comparable data for our study group are available. Only data of the current status of motor abilities of children with migration background are available [33]. The German Health Interview and Examination Survey for Children and Adolescents (KiGGS) collected representative data of motor performance of migrant children who live in Germany [33]. KiGGS ascertained among other motor abilities, conditional skills of 6 to 10 years old children with and without migration background in endurance

and strength. The study group used three tests for measuring conditional skills: a bicycle-ergometer test for endurance, push-ups and standing long jump test for strength [33]. Compared to the boys without migration background, migrant boys showed only differences in the endurance test. At the push-up and standing long jump exercises the results were similar to their counterparts [33].

On the KiGGS endurance ability test, migrant boys showed an average capability deficit of 9% of endurance competence compared to boys without migration background [33], which deteriorated with increased age. Presently, 11 to 13 years old boys with migration background showed a further decline in endurance performance [33]. Therefore, early promotion of motor performance of children with migration background is all the more important. At this developmental stage, the intervention "Join the Healthy Boat" could contribute to children's endurance ability, considering that the program achieved an improvement in conditional skills of migrant boys.

This intervention could play a part in contributing to enhance the current situation of motor abilities of boys with migration background, through a widespread usage of this program.

However, no significant improvement of conditional skills of girls with migration background in the IG could be found compared to the girls in the CG. Nevertheless, a tendency towards better results in motor ability tests for girls in the IG could be shown. These results indicate that the intervention should be adapted to the special needs of girls, to get a significant improvement in their conditional skills.

Coordinative skills were measured via children's performance on lateral jumping and a one-leg stand. The current analyses revealed no intervention effects on coordinative skills, which might be due to the low-threshold of the "Join the Healthy Boat" intervention, which mainly focuses on behavior change on the basis of a provision of action alternatives. Unfortunately, to our knowledge, there are no other school-based intervention studies available which focused on migrant children and used the same or comparable motor tests. Due to the lack of comparative data, it is difficult to appraise these results.

Nevertheless, comparable studies ascertained the status quo of children's coordinative skills with and without migration background [33]. Here also, the same tests as in the current study, one-leg stand and lateral jump test, were used. The analysis has shown that boys and girls with migration background perform significantly worse at the one-leg stand than children without migration background [34]. For the lateral jump test, no significant results for migrant children were found compared to their counterparts without migration background [34].

The KiGGS data are representative for German children [33]. Considering these results and the findings from the current analysis the necessity of target-group-specific promotion of coordinative skills becomes apparent. The intervention described in this paper, could not improve children's coordinative skills, which might be due to the low-threshold concept. Therefore, future interventions should target on the specific needs of children with migration background to improve

their coordinative skills successfully.

Besides the comprehensive conditional and coordinative skills, also flexibility was assessed as an important prerequisite for motor performance [29]. Significant effects were found for flexibility of girls in the study population, which was measured by a standardized sit and reach test. After one year, girls of the IG showed a significant improvement in their flexibility compared to their counterparts in the CG.

Considering comprehensive studies, flexibility ability of girls with migration background is less pronounced compared to girls without migration background [34]. Due to the poor performance of migrant girls, it is even more important to promote their flexibility as early as possible. That seems feasible through the intervention "Join the Healthy Boat". The intervention study could achieve an improvement in flexibility of girls in the IG. Considering the results of Kobel *et al.* [23] they showed that the PA levels of migrant children in the CG tended to be decreasing more than the PA levels of the migrant children in the IG after one year intervention. It is known that the motoric competence is associated with children's PA levels [35].

Migrant boys showed no significant improvement in their flexibility. One reason might be, that girls and boys differ in their preferences for PA. This could have led to different intervention effects on children's motor performance, like in flexibility or conditional skills. Therefore, it is even more important to consider gender aspects in future interventions to promote motor skills of boys and girls equally.

To summarize, well-pronounced motor competence is essential to the development of skills which are positively related to PA participation in childhood and youth and further required for sports activities [8] [16] [36]. Consequently, well-pronounced motor abilities are the foundation for an active lifestyle [8].

Considering the findings of existing intervention studies for general health promotion, they have shown little or no success for socially disadvantaged children or children with migration background [23] [37] [38] [39]. Besides, there is a gap of effective intervention studies which aim to improve motor proficiency of children with migration background.

Therefore, it is necessary to investigate children's motor abilities and their correlates as well as target group specific intervention opportunities. Early childhood is seen as the optimal stage of life to develop motor skills and establish motor competence [40]. Thus, school is an appropriate setting for the promotion of children's PA including their motor abilities.

Hence, the results of the current study are all the more important. The health promotion program "Join the Healthy Boat" could obtain an improvement of some motor abilities of children with migration background. Nevertheless, the results should be considered critically, because significant positive results were found predominantly in boy's motor improvement.

Consequently, future intervention studies should aim at a target-group-specific health promotion of motor abilities of children with migration background with

a special focus on girls.

However, there are some limitations to consider when interpreting these results. The length of the intervention of one year might be insufficient to get significant changes in children's motor performance, because behavioral changes in children appear mostly in long-term interventions [41]. Furthermore, there is a gap of comparable motor data of primary school children with migration background who took part in intervention studies. To our knowledge, only data of the momentary motor status of children with migration background is available. Matters are complicated further by the fact that other studies often used different testing methods.

The strength of this study is that it has started to fill the gap of missing studies in this research area. To our knowledge, this is the first partly successful intervention study, which examined the motor performance and development of primary school children with migration background in Germany. Furthermore, the large sample size and the randomised controlled design with an intervention and control group are major strengths of this study.

5. Conclusion

The early promotion of children's motor abilities is important to lay a foundation for an active and healthy lifestyle. Here, a particular attention on children with migration background is required. This is due to the fact that children with migration background show deficits in their motor performance in general compared with children without migration background. The school-based health promotion program "Join the Healthy Boat" could achieve an improvement of motor abilities of children with migration background after one-year of intervention. However, boys obtained better results than girls in the motor tests. Hence, future interventions should aim at a target-group-specific promotion to get a holistic improvement in motor abilities of boys and girls with migration background.

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Compliance with Ethical Standards

Ethical approval: The study was approved by the Ministry of Culture and Education as well as the university's ethics committee and was in accordance with the declaration of Helsinki.

Informed consent: Informed consent was obtained from all individual participants included in the study.

Conflict of interest: The authors declare that they have no conflict of interest.

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