



Intervention effects of a kindergarten-based health promotion programme on obesity related behavioural outcomes and BMI percentiles

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ABSTRACT

In recent decades, prevalence of childhood overweight has increased worldwide and became a public health concern. One reason is children's insufficient engagement in physical activity (PA) which may lead to deficient motor skills, which are interdependent. Therefore, early health promotion such as the kindergarten-based health promotion programme "Join the Healthy Boat" is necessary.

In order to evaluate the programme's effectiveness on children's BMI percentiles (BMIPCT), PA and endurance capacity, a randomised controlled trial including intervention (IG) and control group (CG) was conducted. 973 kindergarten children (3.6 ± 0.6 years; 47.1% male) in 57 kindergartens were assessed at baseline and 558 of them at follow-up. Anthropometrics and endurance capability (3-minute-run) were assessed on site. PA behaviour and socio-economic data were assessed using parental report. Linear regression models were used to determine intervention effects for all health outcomes, adjusting for baseline values, age, gender, BMIPCT and socio-economic variables.

After one year, a significant positive intervention effect on children's BMIPCT was found ($p \leq 0.04$). Children in the IG spent significantly more days in sufficient PA than children in the CG (3.1 ± 2.1 days vs. 2.5 ± 1.9 days; $p \leq 0.005$). Children in the IG performed significantly better in the three minute endurance run than their counterparts in the CG (305.8 ± 46.2 m vs. 286.9 ± 43.2 m; $p \leq 0.001$).

This teacher-centred health promotion using a low-dose bottom-up approach with action alternatives achieved significant positive effects in the reduction of BMIPCT and significant increases in endurance capacity and daily PA. The programme is therefore ideal for integrating health promotion more intensively into the everyday life of children.

1. Introduction

In recent decades, the prevalence of childhood overweight and obesity has increased worldwide and became a public health concern. Over the last four decades, the number of overweight children and adolescents (aged five to 18) worldwide has increased tenfold from 11 million in 1975 to 124 million in 2016. Among the children under the age of 5, in 2016, 41 million children worldwide were overweight and obese (NCD Risk Factor Collaboration, 2017). For children, the worldwide prevalence of overweight and obesity is expected to rise up to 60 million in the next years (de Onis et al., 2010).

Physical inactivity may predispose children to developing obesity (Marcus et al., 2000; Sturm and Datar, 2005) as well as preventable chronic diseases (Hinkley et al., 2008) such as type 2 diabetes,

cardiovascular disease, hypertension, gastrointestinal problems, and depression (Daniels, 2006; Reilly, 2005; Strong et al., 2005). Children should therefore engage in sufficient physical activity, because even at a young age, physical activity is associated with a number of positive mental and physical health outcomes (Timmons et al., 2012; Timmons et al., 2007) and has also been shown to track throughout childhood (Kelder et al., 1994; Reilly et al., 2004; Jones et al., 2013).

Therefore, the World Health Organization (WHO) propagates at least 60 min of moderate to vigorous physical activity (MVPA) on all days of the week for children from the age of three years (WHO, 2019). However, few children are sufficiently active throughout the day (Kettner et al., 2013), even at kindergarten age as a small number of children at this age comply with the current physical activity guidelines (Hinkley et al., 2012).

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This is the case although it has been suggested that regular physical activity improves movement skills in kindergarten children (Reilly et al., 2006). Especially the time between three and six years is an essential period for children's motor development, since children then improve their basic motor abilities, such as speed, endurance, strength, coordination and balance (Sentderdi, 2008), which are bases for many physical activities (Gallahue et al., 2006) and may even influence their later physical activity behaviours (Barnett et al., 2009; Stodden et al., 2009). It has been shown that children with better motor abilities are more physically active than those with less well developed skills (Fisher et al., 2005; Laukkanen et al., 2014; Williams et al., 2008; Wrotniak et al., 2006). This leads to the assumption that physical activity and motor abilities have to be promoted simultaneously and from a very early age in order to engage children in an active and healthy lifestyle.

Health promotion, which encourages physical activity and provides children with means for a healthy lifestyle, is therefore needed and should start early (Møller et al., 2017). Hence, the kindergarten-based health promotion programme "Join the Healthy Boat" focuses on the key risk factors: increased physical activity and higher fruit and vegetable intake as well as reduced screen media use and sugar-sweetened beverages (Kobel et al., 2017). By means of a health-psychological approach based on Bandura's socio-cognitive theory (Bandura, 2001) and the socio-ecological approach of Bronfenbrenner (2012) and ready-prepared active action alternatives, the children (and parents) are taught the importance and practical implementation of a healthy lifestyle. In order to investigate the programme's effectiveness on children's health behaviours and BMI percentiles a large-scale evaluation had to be carried out. Findings of those outcomes after a one-year intervention are reported in this study.

2. Methods

2.1. Intervention

"Join the Healthy Boat" is a health promotion programme which aims at a healthy lifestyle of kindergarten children and supports among others the prevention of overweight and obese children. The development of the programme (described elsewhere (Wartha et al., 2016)), guided by the intervention mapping approach (Bartholomew et al., 2006), resulted in a kindergarten-based, teacher-centred intervention based on the health-psychological background of Bandura's socio-cognitive theory (Bandura, 2001) and the socio-ecological approach of Bronfenbrenner (2012). It is implemented state-wide by a bottom-up train-the-trainer approach by nearly 2000 kindergarten teachers in over 850 kindergartens throughout south-west Germany.

The three key topics of the programme are the promotion of physical activity, the reduction of screen media consumption, and a more healthy diet including the reduction of sweetened drinks and an increased fruit and vegetable intake. All intervention materials are integrated into the everyday life of kindergartens so no external staff or extra time is required. The intervention materials consist of 20 exercise and games lessons and 30 ready to use ideas, action alternatives and lessons in order to get children to be more physically active, gain fundamental motor skills and knowledge about their body and health as well as eat more healthily (e.g., games, exercise breaks, cooking). In addition, short activity games (exercises of 5–7 min each, which also promote children's motor skills) are part of the materials and are to be used twice daily. In order to not only reach children but also their parents, family homework, materials for parents' nights and parental letters were included in three languages. The intervention materials also include instructional and behavioural educational resources for kindergarten teachers, who were trained twice in 16 h of peer-to-peer training courses before receiving all materials for free. This enabled a guided instruction paired with some background information and ideas how to implement health-promoting aspects into the kindergarten life.

2.2. Study design

For the evaluation of this multilevel multicomponent programme, a prospective, stratified, cluster randomised and longitudinal study was performed with an intervention group and a control group. After completion of the baseline measurements (autumn 2016), the programme "Join the Healthy Boat" was carried out in the intervention group, while the control group followed the regular kindergarten life with no contact during that year. Follow-up measurements took place after one year (autumn 2017). Details on kindergarten and children recruitment, materials and organisation of randomisation and data collection have already been published elsewhere (Kobel et al., 2017). Approval for the study was obtained from the Ethics Committee of the University and the Ministry of Education and carried out according to the Helsinki Declaration. In addition, the study is registered in the German Register of Clinical Trials (DRKS-ID: DRKS00010089). Primary and secondary outcomes were defined as change in BMI percentiles and physical activity. Desired sample size was calculated as four possible numbers of kindergartens per study group (11, 12, 13 or 14 kindergartens per study group with 40 children each). The minimum assumed number was therefore 880 children, the maximum 1120 children. The overall significance level is set to 0.05 (two-sided). Depending on the number of kindergartens, a small effect size of 0.288 to 0.325 could be achieved for a power of 0.80 for the metric targets.

2.3. Participants and instruments

973 kindergarten children (3.6 ± 0.6 years; 47.1% male) in 57 kindergartens (30 kindergartens in the intervention group; 27 kindergartens in the control group), who participated in the evaluation study of the programme were assessed at baseline and 558 (57%) of them at follow-up. Prior to data collection, parents provided written and informed consent and children their assent to taking part in the study.

Anthropometric measurements such as children's height (cm) and body mass (kg) were taken by trained technicians to ISAK-standards (Stewart et al., 2011) using a stadiometer and calibrated electronic scales (Seca 213 and Seca 862, respectively, Seca Weighing and Measuring Systems, Hamburg, Germany). Children's BMI was calculated as weight divided by height squared, and converted to BMI percentiles (BMIPCT) using German reference data (Kromeyer-Hauschild et al., 2001). Cut-off points for overweight children were determined above the 90th percentile; for obese children above the 97th percentile.

Endurance capability was assessed using a 3-minute-run (Oja and Jürimäe, 1997) which the children performed during a visit at their kindergarten, supervised and instructed by trained staff. Completed meters in 3 min were recorded.

Physical activity and other health behaviours such as screen media use and dietary patterns as well as migration background were assessed using a parental questionnaire. The included questions were based on the German Health Interview and Examination Survey for Children and Adolescents (KiGGS), which previously assessed health behaviour in 18,000 German children and adolescents (Kurth and Schaffrath, 2010). Since for kindergarten children sufficient physical activity is defined as at least 60 min of MVPA per day (WHO, 2019), this was used as the cut-off. Recent guidelines for screen media use suggest no > 60 min/day for this age group (WHO, 2019), which lead to using 1 h as the cut-off for screen media use, including television, game console, computer, tablet, and smartphone use. Migration background was defined as at having least one parent who was born abroad or if the child was spoken to in another language than German in the first three years of their life.

2.4. Data analysis

Statistics were performed using SPSS Statistics 25 (SPSS Inc., Chicago, IL, US) with a significance level set to $\alpha < 0.05$. Descriptive statistics were calculated (mean values and standard deviations). For

Table 1
Participant's characteristics at baseline, split into control and intervention group.

	Missing values	Intervention (n = 318)	Control (n = 240)	Total (n = 558)
Age, years [m (sd)]		3.6 (0.6)	3.6 (0.5)	3.6 (0.6)
Boys, n (%) [*]		179 (56.3)	113 (47.1)	292 (52.3)
Anthropometry				
BMIPCT, m (sd)	77	51.9 (25.9)	47.9 (25.9)	50.3 (25.9)
Overweight and obesity, n (%)	77	18 (6.3)	10 (5.1)	28 (5.8)
Socio-economic characteristics				
Migration background, n (%)	106	77 (30.6)	74 (37.0)	151 (33.4)

m (sd), mean (standard deviation); BMIPCT = BMI percentiles; migration background = at least one parent was born abroad or the child was spoken to in another language than German for the first three years of their life.

^{*} $p \leq 0.05$.

categorical data, Fisher's exact test was used for the detection of group differences at baseline. Linear regression models were used to determine intervention effects for all health outcomes, adjusting for baseline values as well as controlling for age, gender, BMI percentiles and migration background.

3. Results

Participant's baseline socio-demographic, anthropometric and health characteristics are summarised in Table 1. Gender differences were found for days on which children spent 60 min in MVPA and covered distance during the three minute run. 5.8% of children were classified as overweight (including obesity) and 2.5% of children were classified as obese.

Checks comparing control and intervention group to see if randomisation was successful revealed no differences for any relevant variables except for gender, showing significantly more boys in the intervention group ($p \leq 0.03$).

3.1. Weight status

Average BMIPCT of participating children at baseline were 50.3 (± 25.9) with no significant differences between gender or migration background. 5.8% of children were classified as overweight (including obesity) and 2.5% as obese.

At follow-up, this changed marginally to 6.5% of children being overweight (including obesity) and 2.4% of children being obese. Although, children in the intervention group displayed slightly higher BMIPCT values at baseline, compared to the children in the control group (51.9 ± 25.9 and 47.9 ± 25.9 , respectively), after one year, BMIPCT values of children in the intervention group decreased to 48.7 (± 26.3) whereas BMIPCT values of children in the control group increased to 48.4 (± 26.2). Taking into account age, gender and baseline values, this shows a significant positive intervention effect ($p \leq 0.04$), however, once controlled for migration background, this effect was lost (Table 3).

3.2. Nutrition

3.2.1. Fruit and vegetable intake

As shown in Table 2, at baseline, children ate 2.27 (± 1.73) portions of fruit and vegetables daily with 16.7% of children eating no fruit or vegetables and 9.9% of children eating five or more portions per day. At follow-up, children ate 2.39 (± 1.81) portions of fruit and vegetables per day with 17.9% of children eating no fruit or vegetables and

10.9% of children eating five or more portions daily. There was no significant difference between control and intervention group at baseline or follow-up.

3.2.2. Consumption of sugar-sweetened beverages

Before intervention, 24.6% of children never drank any sugar-sweetened beverages, 9.5% drank bespoke drinks at least once per day with no significant difference between control and intervention group but with a slight tendency towards greater daily sugar-sweetened beverage consumption in the intervention group (10.7% vs. 7.9% for intervention and control group, respectively).

After one year, 21.2% of children never consumed and sugar-sweetened beverages, 6.2% of children drank those beverages at least once daily with no significant difference between control and intervention group. However, children in the intervention group displayed higher values of daily consumption of sweetened beverage at baseline, compared to the children in the control group; after one year, the percentage of children in the intervention group who consumed sugar-sweetened beverages at least daily reduced to 5.9% whereas the percentage of children in the control group whose parents reported to consume sugar-sweetened beverages at least daily remained the same (7.9%, Table 2).

3.3. Screen media use

At baseline, 49.5% of children used screen media (television, game console, computer, tablet, smartphone) for 1 h or more per day. At follow-up this increased to 54.2% with no significant difference between control and intervention group (Table 2).

3.4. Physical activity

At baseline, children spent on 2.7 (± 2.0) days/week 1 h or more in MVPA. 7.2% of children reached 60 min of MVPA on seven days per week. There was a significant gender difference in days being sufficiently physically active ($p \leq 0.001$) with boys spending on average 2.9 (± 2.1) days/week with at least 60 min of MVPA, whereas girls spent on 2.3 (± 1.8) days/week 1 h in that intensity. Also, 9.1% of boys reached the bespoke amount of physical activity on all days per week, while 4.9% girls achieved that goal.

One year later, at follow-up, children engaged in 60 min of MVPA on 2.8 (± 2.0) days/week and reached that hour of MVPA on 7 days/week significantly more often than the year before ($p \leq 0.001$; Table 2). Further, a significant difference could be observed between control and intervention group with children in the intervention group spending significantly more days engaging in 60 min of MVPA than children in the control group ($p \leq 0.005$; Table 2), which stayed significant even when controlling for baseline values, age, gender, weight status and migration status. Also, there were proportionally nearly twice as many children in the intervention group who were physically active on every day of the week, compared to the control group ($p \leq 0.03$; Table 2). This was the case although at baseline, less children in the intervention group engaged in 60 min of MVPA on seven days per week than in the control group.

3.5. Endurance capacity

At baseline, children ran between 98 and 435 m in 3 min (251.5 ± 45.7 m), largely depending on age ($p \leq 0.001$) and gender ($p \leq 0.03$). Boys ran on average 255.9 (± 48.5) m whereas girls completed 246.9 (± 46.2) m in 3 min. Also, three-year-olds managed 224.5 (± 37.9) m, four-year-olds 266.6 (± 43.7) m, and five-year-olds 290.3 (± 57.2) m during the 3-minute-run.

After the one-year intervention, the distance children covered in their three minute run ranged from 151 to 486 m (297.8 ± 45.9 m), still predominantly depending on age ($p \leq 0.001$) and gender

Table 2
Participant's nutrition, screen media and physical activity behaviours at baseline and follow-up, split into control and intervention group.

	Missing values	Intervention (n = 318)	Control (n = 240)	Total (n = 558)
<i>Nutrition</i>				
Baseline				
Portions of fruit and vegetables/day, m (sd)	102	2.2 (1.8)	2.3 (1.6)	2.3 (1.7)
Sugar-sweetened beverages \geq daily, n (%)	94	28 (10.7)	16 (7.9)	44 (9.5)
Follow-up				
Portions of fruit and vegetables/day, m (sd)	166	2.3 (1.8)	2.4 (1.8)	2.4 (1.8)
Sugar-sweetened beverages \geq daily, n (%)	161	13 (5.9)	14 (7.9)	27 (6.8)
<i>Screen media use</i>				
Baseline				
Screen media use \geq 60 min/day, n (%)	152	117 (50.2)	84 (48.6)	201 (49.5)
Follow-up				
Screen media use \geq 60 min/day, n (%)	185	120 (56.3)	82 (51.2)	202 (54.2)
<i>Physical activity</i>				
Baseline				
Days of MVPA \geq 60 min/day, m (sd)	112	2.7 (2.0)	2.6 (2.0)	2.7 (2.0)
7 days of MVPA \geq 60 min/day, n (%)	112	17 (6.7)	15 (7.9)	32 (7.2)
Follow-up				
Days of MVPA \geq 60 min/day, m (sd) ^a	168	3.1 (2.1)	2.5 (1.9)	2.8 (2.0)
7 days of MVPA \geq 60 min/day, n (%) ^a	168	31 (14)	12 (7.1)	43 (11)
<i>Endurance</i>				
Baseline				
Completed meters in 3 min, m (sd)	86	250.7 (48.9)	252.8 (45.7)	251.5 (47.6)
Follow-up				
Completed meters in 3 min, m (sd) ^a	20	305.8 (46.2)	286.9 (43.2)	297.8 (45.9)

m (sd), mean (standard deviation); MVPA = moderate to vigorous physical activity.

^a Significant difference between control and intervention group.

Table 3

Results from the final regression model for health outcomes at follow up for the intervention group.

	n ^a	Coefficient ^b	p	95% CI
<i>Physical activity</i>				
60 min MVPA/day (days/week)	279	0.102	0.049	[0.01; 0.81]
<i>Fruit and vegetable intake</i>				
Portions of fruit and vegetables/day	286	0.006	0.907	[-0.34; 0.39]
<i>Sugar-sweetened beverages</i>				
Daily consumption of sugar-sweetened beverages	295	-0.098	0.070	[-0.10; 0.01]
<i>Screen media use</i>				
Screen media use \geq 60 min/day	256	-0.002	0.964	[-0.27; 0.26]
<i>Endurance capacity</i>				
Meters completed in 3 min	466	0.201	0.001	[10.31; 27.80]
<i>Weight status</i>				
BMI percentiles	480	-0.032	0.153	[-3.98; 0.62]

CI = confidence interval, MVPA = moderate to vigorous physical activity;

Bold = significant difference between control and intervention group.

^a Only cases with baseline and follow-up data.

^b Adjusted for baseline values, gender, age, BMI percentiles (except weight status), and migration status.

($p \leq 0.01$), with girls running on average 10 m less in 3 min than boys (302.6 ± 46.9 m and 292.4 ± 44.1 m, respectively). There was also a significant intervention effect (see Table 3) with children in the intervention group reaching 305.8 (± 46.2) m in 3 min and those in the control group covering 286.9 (± 43.2) m, although baseline values were slightly higher in the control group compared to the intervention group (252.8 ± 45.7 m and 250.7 ± 48.9 m, respectively). Therefore, children in the intervention group performed significantly better in the three minute endurance run than their counterparts in the control group, even if adjusted for baseline values, age, gender, weight status, and migration status ($p \leq 0.001$).

4. Discussion

In this study effects of the intervention of the health promotion programme “Join the Healthy Boat”, on body composition, daily physical activity, nutrition and screen media behaviours as well as endurance performance of > 550 kindergarten children in south-west Germany were analysed in a cluster-randomised, controlled study. The positive intervention effects on all three outcomes display the effectiveness of the presented measure.

Especially, the significant decrease of BMIPCT in the intervention group compared to a slight increase in BMIPCT in the control group within one year shows promising effects on an objective measure. Although at baseline, the children in the intervention group displayed higher BMIPCT than their counterparts in the control group, at follow-up, children in both groups showed very similar BMIPCT, suggesting the often reported age-related upwards trend of body weight (Schienkiewitz et al., 2018) might have been slowed down due to the here described intervention. However, the intervention effect was lost once the children's migration status was taken into account, which still seems to be a large determinant for children's weight status (Kuepper-Nybelen et al., 2005). A recent study assessing 648 kindergarten children in China (Hu et al., 2017) also showed small intervention effects on children's weight status. Their primary aim laid on the increase of (knowledge of) healthy nutrition delivered by trained kindergarten staff and the increase of parental awareness of their children's weight (Hu et al., 2017). “Join the Healthy Boat” actively avoided a focus on children's weight but concentrated on delivering action alternatives for a healthy diet and an active lifestyle. Nevertheless, parents were actively incorporated in the intervention and regularly informed about all three aspects of the programme (nutrition, physical activity and screen media use).

That those are relevant in preventing childhood obesity shows a large systematic review of 15 different studies aiming at preventing overweight and obesity in kindergarten children investigated exactly those three topics: nutrition, physical activity and sedentary behaviour (all of which assessed sedentary time via screen media use) (te Velde et al., 2012). Their results showed an insufficient evidence for an

association between diet and overweight, however moderate evidence for a positive association between sedentary behaviour and overweight and strong evidence for an inverse association between physical activity and overweight (te Velde et al., 2012).

German research comparing effects of three low-threshold health promotion programmes in kindergartens in Cologne including 1510 children has shown inconsistent results regarding BMI changes (Klein et al., 2014). Whereas two programmes (Klein et al., 2010; Klein et al., 2014) showed positive intervention effects on children's BMI after six months; in one intervention (Graf and Dordel, 2010) the BMI increased parallel to the control group (Klein et al., 2014). Although all three interventions focused on different aspects (one was primarily educating parents and kindergarten staff on health behaviours with no active involvement in the kindergartens (Klein et al., 2010); one incorporated 60 min of physical education once a week for six months (Graf and Dordel, 2010), and one combined both (Klein et al., 2014)), it could be shown that parental involvement seems to be key for a change in children's nutrition and physical activity habits possibly leading to a favourable change in body composition.

An increase in children's daily physical activity was also an aspired aim of "Join the Healthy Boat" and was therefore assessed at baseline and follow-up. According to recent recommendations, children from the age of three years should achieve 60 min of MVPA per day (WHO, 2019). At baseline, 7.2% of children spent a minimum of 60 min/day in MVPA, with boys – as reported many times before (e.g. Schmutz et al., 2018; De Craemer et al., 2014) – achieving this nearly twice as often than girls but no significant difference between control and intervention group (apart from a slight tendency towards more physical activity in the control group). After one year, however, there was a significant positive intervention effect whereby 14% of children in the intervention group engaged in 1 h of MVPA daily, compared to 7.1% of children in the control group. This is in contrast to previous research showing no effect on physical activity after significantly shorter (six weeks) and more intense school- and kindergarten-based programmes (O'Dwyer et al., 2013). However, a meta-analysis showed that physical activity interventions lasting four weeks and less had the largest effect on MVPA in kindergarten children, compared to interventions with a duration of three to six months, which showed only very small effects on MVPA (Gordon et al., 2013).

Nevertheless, a large Belgium study investigating a teacher-centred intervention which was designed for at least 1 h per week and included physical activity, changes to the environment and parental involvement (De Craemer et al., 2014), which is very similar to "Join the Healthy Boat". Physical activity behaviours of nearly 500 kindergarten children were objectively assessed after one year showing positive intervention effects for boys and children from a high socio-economic background (De Craemer et al., 2014). Here, gender and migration background was controlled for as well, with no significant differences in intervention effects regarding daily physical activity.

On the topic of the – not only here – notable gender difference in physical activity behaviour and especially in achieving a minimum of 60 min of MVPA per day, it is believed that apart from physiological and developmental factors as well as environmental factors, also psychological and social factors contribute to this repeatedly showing phenomena (Kohl and Hobbs, 1998). Especially since this study shows such an evident difference at a very early age already, social factors are to be investigated further. Yet, there seems to be no research studying this at that particular age-group, which only derives assumptions such as different parental concerns about their child's safety as well as greater socialisation towards sports and physical activity in boys (Haywood and Getchell, 2014). Since gender norms and possibly resulting behaviours such as different physical activity patterns, are developed at home as well as kindergartens or other institutions, interventions should look at targeting physical activity behaviours of boys and girls separately and with a strong parental component, in order to reverse this tendency. "Join the Healthy Boat" had no aspects of gender

specific exercises or lessons, which could in future be considered. It is however, mentioned in the teacher training given prior to the intervention but only as background information. Literature shows that girls are attracted by different aspects on a playground compared to boys (Möhrle et al., 2015) and that physical activity interventions affect boys and girls differently (Bergh et al., 2012). Therefore, a more intense focus could be laid on sensitising teachers but also parents and communities to this issue in order to give confidence as well as create opportunities and spaces to enable girls to be more physically active.

With regards to children's endurance capacity, even when adjusted for migration background, significant intervention effects were found using a three minute run. Similar effects were found after a 14-week, far more intense intervention (six times per week of 45 min of physical activity in kindergarten) in five- to six-year-olds (Eliakim et al., 2007) as well as a 10-week training programme (90 minute exercise per week) in three- to six-year-olds (Latorre-Román et al., 2018). Yet, the three German interventions previously mentioned (Klein et al., 2010; Graf and Dordel, 2010; Klein et al., 2014), which focused on parental and teacher education as well as one physical activity session per week, showed no improvement with regards to endurance capacity in kindergarten children (Klein et al., 2014).

"Join the Healthy Boat" uses action alternatives, weekly physical activity sessions (lasting 15–45 min) as well as two daily exercise breaks (lasting 5–7 min each) delivered by the kindergarten teachers in order to engage children in more physical activity and therefore increase their motor abilities. The latter is of particular importance as declining motor skills are an increased health risk since motor skills (especially endurance capacity) are a strong predictor of adult mortality and life expectancy (Myers et al., 2002). In addition, decreased cardiovascular fitness is associated with an increased incidence of cardiovascular risk factors in adults (Myers et al., 2002) as well as in children and adolescents (Tomkinson, 2011). Yet, secular trends of a decline have been shown for most of the basic motor abilities (Tomkinson, 2007; Roth et al., 2010).

In order to reverse this trend and to enable kindergarten children to be sufficiently physically active, a programme such as "Join the Healthy Boat" has the potential to engage children in a healthier lifestyle and to benefit from its outcomes. However, the intervention was not able to change children's dietary behaviours and their screen media use in one year. Whereas before intervention approximately half of the participating children used various screen media for 1 h or more per day, this amount increased in both groups within one year by on average almost 5%. Most children used screen media for one to one and one half hours per day. Although these amount seem low in comparison to international studies (e.g. Madigan et al., 2019), this also means children could spend 1 h per day more being physically active. Since parents play a major role in their children's screen media use (Frate et al., 2019), "Join the Healthy Boat" tried to tackle increased time with screen media informing parents about guidelines, the establishment of family media rules and action alternatives to reduce time in front of screens. However, maybe at kindergarten such an intervention is too late already, as screen media habits might have established already. A recent study in the US showed that if parents were informed about strategies to minimise screen media use as early as 3 weeks after birth (and regularly thereafter), children would be exposed less to screen media than children in the control group. However, this effect was lost at one year already (Adams et al., 2018).

Comparably to screen media use, no intervention effect on dietary behaviours could be observed after one year. Although there was a slight tendency towards an increased fruit and vegetable consumption at follow-up, this could be detected in both groups. Again, this aspect is very much reliant on parental participation, since the parents are responsible for their children's food (choices) (Frate et al., 2019). The intervention included 15 dietary lessons within the year, including cooking, healthy snacks and breakfast, which were all documented and transported home via either recipes booklets or posters in their

kindergartens. Additionally, parents were informed about healthy nutrition in parental letters and parents nights. However, this might have been too low-threshold. A very short (five weeks) but intense intervention trying to increase kindergarten children's fruit and vegetable intake succeeded by sending home weekly multipage hand-outs to educate, motivate, and provide ideas for packing healthy lunches as well as classroom activities for the children (Briley et al., 2012).

Apart from regular fruit and vegetable intake, "Join the Healthy Boat" also focuses on a reduction of sugar-sweetened beverages. While the percentage of children consuming sugar-sweetened beverages daily was relatively low to start off with (below 10%) and approximately two thirds of the children drinking no such beverages or no more than once per week, there was little room for improvement. And even though no significant intervention effect could be shown, the percentage of children consuming sugar-sweetened beverages on a daily basis nearly halved in the intervention group, whereas no change occurred in the control group. This might be due to the situational and structural prevention aspect of the programme, which educated kindergarten teachers about the health risks emanating from the consumption of sugar-sweetened beverages and gave them strategies how to implement rules in their kindergartens about what drinks are allowed.

Nonetheless, this study is not without limitations, which need to be considered when interpreting these results. Although this study has an acceptable sample size and body composition and endurance capacity were assessed objectively, the use of subjective measures (parental report) of physical activity and the associated recall biases is a limitation of this study. Furthermore, participating in this study may have led to an increased social desirability and potential over-reporting bias with regards to the measured variables as awareness was raised for the importance of physical activity and other health behaviours. Also, the present intervention was very low "dose" and delivered by kindergarten teachers rather than external staff which also may lower the likelihood of the "Hawthorne" or observer effect. Further, the intensity of the physical activity sessions of the interventions could not be recorded, which would have been helpful. Even though, a major strength of this study is its randomised controlled design with a control group, the kindergarten teachers in that group were also very health conscious and have not been "inactive", which might have led to a strong contamination with other efforts to promote children's health in the control group.

5. Conclusions

This kindergarten-based health promotion has shown positive effects on children's health development in several areas. Although, only using a low-dose teacher-centred approach, "Join the Healthy Boat" managed to achieve significant increases in endurance capacity and daily physical activity in the intervention group as well as positive tendencies in the reduction of sugar-sweetened beverage consumption and BMI percentiles. In order to be consistent, interventions such as the here described as health promotion should become an integral part of all kindergartens. The programme, which requires no extra time and is free for all kindergartens in the south-west of Germany, is therefore ideal for integrating health promotion more intensively into the everyday life of children and into the education of kindergarten teachers, so that they can intervene accordingly. Since improvements of motor skills of kindergarten children have the potential to influence physical activity positively beyond the early years (Lopes et al., 2011), measures such as these that are easy to implement and effective through the provision of action alternatives and the bottom-up approach offered.

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