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Postler T[1], Schulz T[1], Oberhoffer R[1]

Skipping Hearts Goes to School: Short-Term Effects

Skipping Hearts macht Schule: Kurzzeiteffekte des Projekts

1. TECHNICAL UNIVERSITY OF MUNICH, *Department of Sport and Health Sciences, Chair of Preventive Pediatric, Munich, Germany*

Summary

› **Background:** To counteract cardiovascular risk factors in childhood, the German Heart Foundation developed "Skipping Hearts" for schools: Aim of this rope skipping project is to promote physical activity by providing pleasure in exercise, which, in turn would improve physical performance. The current evaluation study investigated the effectiveness of this preventive measure.

› **Methods:** Using a pre-post-design, anthropometric characteristics, health parameters and motor skills of 1,493 elementary school children (9.03±0.65 years) were tested. 1,161 children received a one-stage (SH_{Basic}: n=721) or two-stage training ($SH_{Champion}$: n=440), 332 children served as controls. To score the project, all children and the coordinating teachers of the examined schools (n=24) were surveyed by means of questionnaires. Additionally, physical activity was measured by accelerometry (sub-sample: n=89).

› **Results:** Endurance, strength, coordination and shoulder mobility showed improvements in the students participating in Skipping Hearts compared to the control group ($p<0.001$). Also, an increased activity level ($p=0.027$) and a lower rise in body fat ($p<0.001$) were ascertained after the project. Children in $SH_{Champion}$ showed greater developmental leaps and changes towards health attitude/behavior than the SH_{Basic}.

› **Discussion:** Skipping Hearts elicited great enthusiasm among the children and received high acceptance/satisfaction ratings from the teachers. Positive effects were observed on motor skills, body composition and exercise behavior in the 5-month study period. Thus the measure is successful in the short term. Further conclusions about sustainable improvements in health are not yet possible.

KEY WORDS:
Health Promotion, Physical Activity, Children, Elementary School, Rope Skipping

Zusammenfassung

› **Problemstellung:** Um kardiovaskulären Risikofaktoren im Kindesalter entgegenzuwirken, hat die Deutsche Herzstiftung das Projekt „Skipping Hearts" für Schulen konzipiert: Über die Sportart Rope Skipping sollen Kinder Spaß an Bewegung finden und zu mehr Aktivität motiviert werden, was wiederum eine Steigerung der körperlichen Leistungsfähigkeit bewirken soll. Die vorliegende Evaluationsstudie untersucht die Effektivität dieser Präventionsmaßnahme.

› **Methoden:** In einem Prä-Post-Design wurden anthropometrische Eigenschaften, Gesundheitsparameter und sportmotorische Fähigkeiten von 1493 Grundschulkindern getestet (9,03±0,65 Jahre). 1.161 Kinder erhielten ein einstufiges (SH_{Basic}: n=721) oder zweistufiges Training ($SH_{Champion}$: n=440), 332 Kinder dienten als Kontrolle. Zur Bewertung des Projekts erfolgten Befragungen aller Kinder und der koordinierenden Lehrer der untersuchten Schulen (n=24). Bei einer Teilstichprobe wurde zusätzlich mittels Akzelerometrie die körperliche Aktivität erhoben (n=89).

› **Ergebnisse:** An Skipping Hearts teilnehmende Kinder zeigten Verbesserungen in Ausdauer, Kraft, Koordination und Schulterbeweglichkeit gegenüber der Kontrollgruppe ($p<0,001$). Zudem wurde bei ihnen eine Erhöhung des Aktivitätsgrades ($p=0,027$) und ein geringerer Anstieg des Körperfettanteils ($p<0,001$) festgestellt. Sämtliche Entwicklungssprünge sowie Einstellungs-/Verhaltensänderungen waren bei Kindern der $SH_{Champion}$ stärker ausgeprägt als in der SH_{Basic}.

› **Diskussion:** Skipping Hearts hat bei den Kindern große Begeisterung ausgelöst, bei den Lehrkräften erfuhr es sehr hohe Akzeptanz und Zufriedenheit. Im fünfmonatigen Untersuchungszeitraum konnten positive Effekte auf die motorischen Fähigkeiten, die Körperzusammensetzung und das Bewegungsverhalten beobachtet werden. Kurzfristig ist die Maßnahme demnach erfolgreich. Weitere Schlussfolgerungen über nachhaltige gesundheitliche Verbesserungen sind noch nicht möglich.

SCHLÜSSELWÖRTER:
Gesundheitsförderung, Bewegung, Kinder, Grundschule, Seilspringen

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CORRESPONDING ADDRESS:
Dipl.-Sportwiss. Tanja Postler
Technical University of Munich, Department of Sport and Health Sciences, Chair of Preventive Pediatric, Uptown München, Campus D, Georg-Brauchle-Ring 60/62
80992 München
✉: tanja.postler@tum.de

Introduction

The prevalence of pre-existing cardiovascular (risk) diseases in childhood has increased steadily in recent years (5, 28). One of the main causes is the altered exercise behavior of children leading to decreasing physical activity (16, 21). The related motor performance of children has also diminished (6, 39). However, motor skills are an essential factor in the overall development of childrens' personality – both in the biological-physical as well as in the social, psychological and cognitive sense (5, 6, 12, 24). Furthermore, physical fitness is already considered one of the most important cardio-protective factors in children (1, 4). Therefore, early effective, sustainable measures to increase physical activity or physical fitness in children and adolescents are absolutely essential (23, 24, 25). These prevention and health

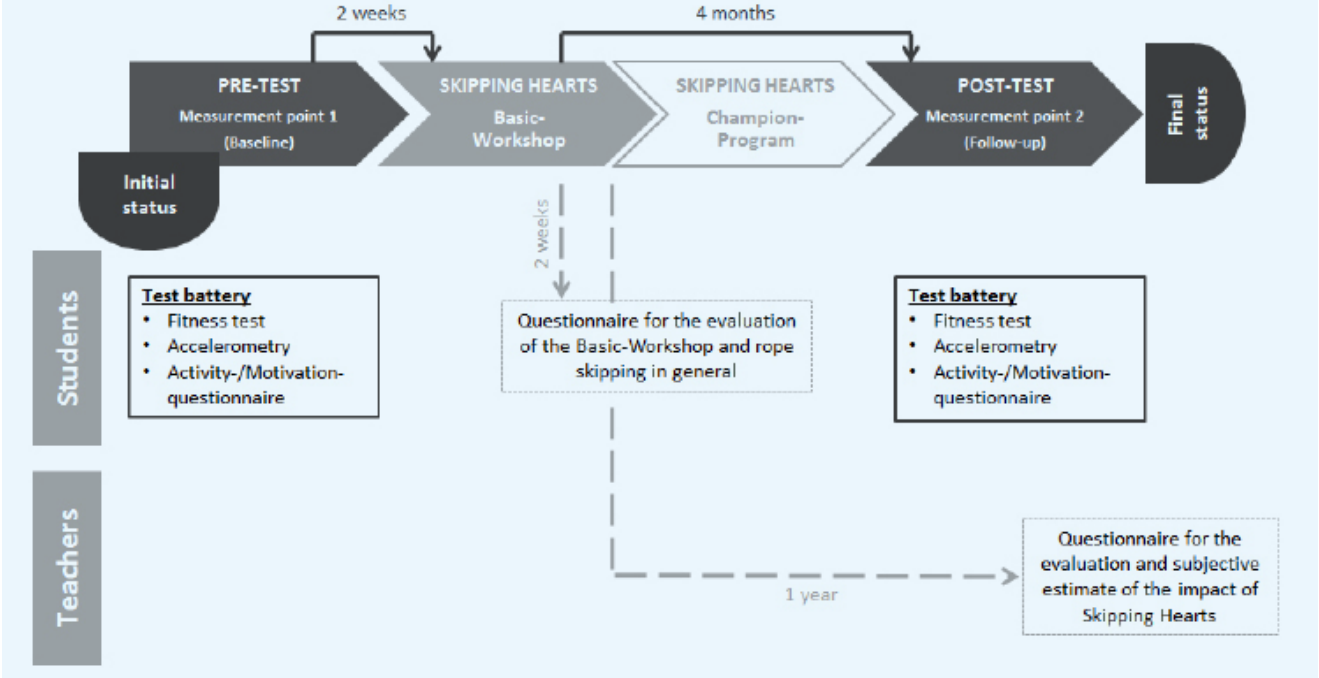

Figure 1

Design of the Evaluation Study.

promotion programs are intended to help prevent lifestyle- and environment-related diseases, reduce their prevalence, or mitigate their development.

The school setting was identified early as a starting point for health promotion measures (5, 29, 32), since targeted health promotion – e.g. through exercise – can be offered to a large number of children with minimal effort and expense (7, 20). Regardless of their socio-cultural backgrounds, all children can be reached at school and their health thus promoted over a long period of time (14, 25, 42). It should be remembered that the physical activity of children decreases after school entrance, the proportion of overweight children doubles from the first to the fourth grade, and societal diseases or symptoms such as obesity, hypertension and hypercholesterolemia increase (2, 5, 22, 28). Elementary school age is also described as a sensitive phase in motor development (12, 41). The motivation for motor activities and the willingness to learn are high at this age. If the sports experiences of young people are positively assessed and rewarded through enjoyment, the limbic system will integrate them with good connotations into the memory of experiences, and they can lay the foundation for an active lifestyle in adulthood (32, 36, 37). The early sensitization to health awareness behavior is also important, since behavioral patterns which can lead to serious health risks in later life are tested, learned and stabilized especially during childhood and adolescence (2, 6, 23, 25).

The "German Heart Foundation" also addresses the "lack of exercise" issue among children and adolescents and is therefore providing the "Skipping Hearts" prevention project in (elementary) schools (10). Through rope skipping – a fun and motivational approach – children will be encouraged to engage in more exercise in the short and long term. The protective influence of physical activity in childhood has been demonstrated in various studies: active children will become active adults and inactive children will become inactive adults, who in turn become the parents of inactive children (21, 36, 37).

Rope skipping expands traditional exercise experiences and unites aspects of physical fitness and coordination abilities to full body training. This can counteract impairments in coordination and organ functions in all grades. It brings rapid learning success, promotes creativity and can make an important contribution to the development of social skills by working in groups. Through the wide variety of jumping variations, it is a sport for everyone, which can be done anytime and anywhere, together or alone, regardless of age, height, gender, performance level and motor capability (33).

Skipping Hearts has been offered free of charge to schools since 2006. It is implemented in a two-stage concept (Tab. 1): an introductory, one-time Basic-Workshop conducted by an exercise instructor from the "German Heart Foundation" and, built on this, the subsequent Champion-Program with 10 ready-to-use rope skipping units (standardized curricula) for independent implementation by the teacher. For this purpose, a package of materials, including a teacher's manual, is provided to the school, which also allows the expansion of the project within the school (9, 10).

By the end of the year 2016, a total of 11,028 school classes had completed a Basic-Workshop and 2,700 schools had received the Champion package, whereby Skipping Hearts has already reached more than 500,000 children. So it is one of the largest actions in the exercise promotion field in Germany and has established itself in nine of the federal states. However, with regard to the effectiveness of the project – as with many prevention programs – there is no scientifically based proof (25, 42).

Therefore the aim of the present study was to evaluate the effectiveness of the health promotion program "Skipping Hearts", designed, implemented and funded by the "German Heart Foundation". The objective was to assess its effectiveness on increasing the students' physical activity and motor performance with long-term effects on health parameters. Another central objective was to assess the subjective evaluation of the project by the students and the teachers involved. Not only acceptance of, and satisfaction with the program, but also its success in promoting health awareness among the students was inquired. ›

Table 1

The Skipping Hearts Project.

	SKIPPING HEARTS BASIC (BASED ON EACH OTHER, BUT CAN ALSO BE DONE SEPARATELY)	SKIPPING HEARTS CHAMPION
Setting	Elementary school	Elementary & secondary schools
Target group	3rd&4th grade	3rd–6th grade
Implementation	One-time rope skipping workshop (2 school hours)	10 units of rope skipping of 45 minutes each
	Conducted by a certified Skipping Hearts instructor	Independently conducted by teachers at the school Concept, extensive teaching materials, children's workbooks and skipping ropes are provided by the „German Heart Foundation" (9)
	Implementation during class	Implementation during class
	Designed for 1 school class	Participation of several classes possible
	Maximum of 1 workshop per school and school year	Package of materials remains for ongoing implementation at school
Content	Teaching of the basic techniques of rope skipping	Expansion of the rope skipping skills through continued training
	Presentation of a choreography developed in the workshop performed in front of students, parents, teachers as well as open jumping for other students as a follow-up (participating students as experts)	"Skipping Hearts Day" as project completion (Internal school team competition)
Objectives	Sustainable increase in physical activity by conveying enjoyment of exercise	
	Training and improvement of physical fitness and coordination skills	
	Conveying of various exercise experiences with feelings of quick success	
	Promotion of social components	

Material and Methods

The evaluation was carried out during the 2011-2012 school year using a non-randomised, controlled longitudinal study with two measurement points five months apart (Fig. 1).

The sample was comprised of children in the 3rd and 4th grade in Upper Bavarian elementary schools. A total of 31 schools in different regional areas with 86 classes participated in the study. 24 schools participated in Skipping Hearts after the pre-test. Depending on the project stage, the children were divided into two independent project groups (SH). The assignment was based on the classes' decision, after completing the required Skipping Hearts Basic-Workshop, either to end this one-time action (Skipping Hearts Basic Group SH_{Basic}: 42 classes) or to implement the Skipping Hearts Champion-Program ($SH_{Champion}$: 26 classes). Students from comparable classes without Skipping Hearts prevention (7 schools with 18 classes) served as the control group (CG).

The measurements were performed in classes during the regular instruction period in the local schools and were conducted by a specially-trained test team. Children participated voluntarily in all parts of the study, and parental consent was obtained in advance.

1,493 children attended the test at both times (dropout: 6.2%; not group-dependent; reason: illness- or injury-related absence on the day of the post-test). At the baseline test the students were 7 to 11 years old (9.03±0.65y). The gender ratio was balanced both as a whole as well as within the groups. The composition of the sample is shown in table 2.

The study methods in the field were pre-standardized and were identical in all groups at both measurement times. The contents of the screening were a "Fitness test", in which anthropometric properties, health parameters and motor skills were ascertained (see online supplementary table 1), and physical activity measurements.

A questionnaire for children was used to determine the physical activity level: consisting for the most part of standardized questions from "German Health Interview and Examination Survey for Children and Adolescents" (KiGGs, Motorik-Modul, 6) supplemented by child-related questions on the attitude towards rope skipping and sports in general (n=1,231). Besides the subjective assessment of exercise behavior, a physical activity measurement using accelerometry (38) was performed in a subsample (n=125 children from 12 schools). The scope and the intensity of the physical activity were recorded twice, before and after participating in Skipping Hearts, using three-dimensional accelerometers (Actigraph GT3X, GT3X+) with the children wearing the device on their right hip for one week. The main parameter for the analysis was the physical activity intensity of the children in the moderate to vigorous range (moderate-to-vigorous physical activity=MVPA). For reasons of comparability between the groups and also individually between the measurement times, the relatively measured values were used depending on the wearing time (%). The classification of the exercise intensity took place according to the cut points of Freedson et al. (15). The period length was 60 seconds. Periods with "consecutive zeros" for a duration of 20 minutes or more were defined as nonwear time. 4 days (3 workdays and 1 weekend day) were determined to be the minimum wearing time, with a daily wearing time of at least 7 hours. In order to keep time impacts low, only identical pre- and post-test weekdays of each subject were included in the statistical evaluation. The analysis of the physical activity measurement is based on 89 children; 36 datasets had to be excluded due to a lack of compliance with the wearing specifications (Tab. 2).

Table 2

Sample description; differentiated according to overall sample and accelerometry subsample; distribution of the subjects into 3 groups; SH_{Basic}=Skipping Hearts Basic Group, $SH_{Champion}$=Skipping Hearts Champion Group, CG=Control Group; age and wearing time (accelerometer) in mean±SD.

	FITNESS TEST				ACCELEROMETRY				WEARTIME (H/DAY)	
	N	AGE	BOYS	GIRLS	N	AGE	BOYS	GIRLS	PRE-TEST	POST-TEST
SH_{Basic}	721	9.07±0.66	362 50.2%	359 49.8%	35	8.20±0.47	18 51.4%	17 48.6%	12.74±1.3	12.44±1.3
$SH_{Champion}$	440	9.04±0.68	218 49.5%	222 50.5%	28	8.36±0.49	14 50.0%	14 50.0%	12.66±1.1	12.39±1.1
CG	332	8.94±0.55	163 49.1%	169 50.9%	26	8.12±0.43	11 42.3%	15 57.7%	12.41±0.9	12.69±1.5
Total	1,493	9.03±0.65	743 49.8%	750 50.2%	89	8.22±0.47	43 48.3%	46 51.7%	12.62±1.1	12.50±1.3

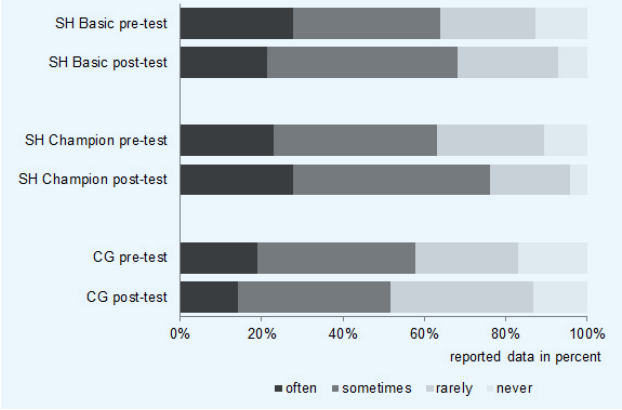

Figure 2

Results of the student survey; frequency of rope skipping before and after the Skipping Hearts (SH) project; differentiated presentation of the groups depending on the completed project stage; n=1,200 (SH_{Basic}: n=508, $SH_{Champion}$: n=444, CG: n=248).

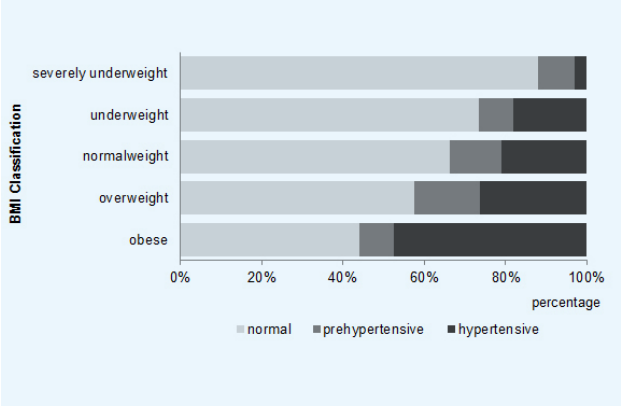

Figure 3

Classification of the systolic blood pressure values differentiated by weight class; classification of blood pressure by RKI 2013 (34); assignment of weight classes according to Kromeyer-Hauschild 2001 (27); n=1,486.

In addition, the project was evaluated in a cross-section by means of questionnaires from the participating children (n=1,311) as well as assessed by an anonymous online survey of the Skipping Hearts coordinators of the 24 schools (n=24). All survey instruments were designed in accordance with the recommendations of the relevant literature (8) and were based on specific features of the target groups (elementary school children and teachers) in terms of language, scope and layout. The distinctive features of the online survey were taken into account.

The statistical data analysis was performed using SPSS Statistics 20.0 (IBM Corp., Armonk, NY, USA). The significance level was α=5% ($p \leq 0.05$). Using two-factorial analyses of variance with repeated measures, the group-time interaction was tested to express possible program-dependent changes over time. In the event of significant interaction effects, post-hoc analyses according to Bonferroni ($\alpha^* = \alpha/3$; $p^* \leq 0.0167$) were used for the exact identification of group differences. Furthermore, to examine the cross-sectional data on group-, gender- and age-specific differences, Kruskal-Wallis tests, t-tests, Mann-Whitney-U tests and chi-square tests were carried out and correlations calculated according to Spearman and Pearson. The normal distribution was checked using the Kolmogorov-Smirnov test.

Results

Table 3 shows a descriptive presentation of the known measurement parameters of the pre- and post-test for each of the three groups as well as the results of the comparison testing between the groups (further data see online supplementary table 2). With the exception of the parameters for the body mass index (BMI) – trunk flexibility (Sit and Reach) and frequency speed (Tapping), significant interaction effects between the groups can be determined for all items. The interactions related to the motor data are based in particular on the great performance increase in the $SH_{Champion}$, which is significantly different from the CG and for the most part also from the SH_{Basic}. Some parameters also showed differences between the SH_{Basic} and the CG. Compared to the CG, children participating in Skipping Hearts (Basic and Champion) showed a smaller increase in body fat ($p<0.001$). Interaction effects concerning the accelerometry data reflect an increase in the time spent in MVPA in both project groups, while children in the CG showed no difference in their physical activity ($p=0.027$). All interaction effects occurred independent of gender, age and weight status.

85% of the children rated the Skipping Hearts Basic-Workshop on a six-point school number scale with the grade "1=very good" or "2=good" (girls: 89%, boys: 81%; $p<0.001$). The appeal of rope skipping (rating based on a 4-level ordinal scale: 1="totally cool", 2="cool", 3="just okay", 4="boring") increased significantly in both project groups ($p<0.001$) and differed significantly ($p<0.001$) from the control group after the project (score 1 or 2: $SH_{Champion}$: 73%>SH_{Basic}: 67%>CG: 51%). In the questionnaire two weeks after the Basic-Workshop, a total of 72% of the children reported that they were currently jumping rope more frequently than before. During the course of the project until the post-test, this percentage of SH_{Basic} fell to 62%, while in $SH_{Champion}$ it continued to climb (78%). The proportion of children who "often" or "sometimes" jump rope in the $SH_{Champion}$ was 13% higher after the end of the project than during the pre-survey ($p<0.001$); in the SH_{Basic} it rose by 4%. In the CG, the frequency of rope skipping decreased minimally (Fig. 2).

Teachers gave the Basic-Workshop a good rating (46% "very good", 50% "good", 4% "average") and assigned it a high fun factor for the children - both girls (100% "high" or "very high") and boys (91% "high" or "very high", 9% "average"). With the exception of one single Basic school, increased rope skipping activity among the children could be observed in the short term following the Basic-Workshop in all project schools. One year later there was still an increase in rope skipping activity in 10 of 19 schools, with the percentage among the Champion schools (72%) significantly higher than in the Basic schools (40%). The general exercise activity of the children was greatly increased one year after Skipping Hearts in 33% of the Champion schools and slightly increased in 44%. In the Basic schools, 73% detected a slightly more active exercise behavior. At a total of 25% of the schools, increased physical activity was no longer observed.

All twelve surveyed teachers who carried out the Champion-Program with their students, detected an increase in the motor skills during the course of the project. Every second child of $SH_{Champion}$ and 40% of SH_{Basic} believed that they had improved "a lot" in their fitness parameters compared to the preliminary examinations; 24% were of this opinion ($p<0.001$) in the CG.

The blood pressure values were significantly increased (>40% hypertensive) during the initial diagnostics according to the z-score (34) and were measured significantly lower in all groups during the post-test. On the cross-section, a correlation of ›

the blood pressure with body fat percentage (r=0.219; p<0.001) and a rising hypertension percentage in the higher weight classes (p<0.001) were determined independently (Fig. 3). Furthermore, there was a correlation between blood pressure and recovery ability after the endurance exercise (r=0.190; p<0.001). Overweight children showed an overall weaker performance on all tested parameters.

Discussion

The aim of this study was to evaluate a pre-existing and independently-designed health promotion project of the "German Heart Foundation" called "Skipping Hearts". The evaluation revealed that Skipping Hearts experienced a very high level of acceptance and satisfaction among the students as well as the teachers. Especially the impression of the implementing teachers is important for the success of preventive school programs, as also noticed in large-scale effective intervention measures like „Join the Healthy Boat" (41). For the teachers, Skipping Hearts is easy to integrate into the school day and provides a great fun factor for the children. In the case of the participating children, there was a positive influence on the duration and intensity of physical activity due to a changed attitude towards rope skipping and with respect to the fitness parameters, an effect was determined on all of the tested coordination skills, the condition characteristics of endurance and strength as well as the mobility of the shoulder.

As expected, the children in all groups were able to improve their motor skills with few exceptions (trunk flexibility, CG: endurance) between the initial and follow-up examinations based on their age development and a learning effect, which could not be ruled out. Nevertheless, significant differences are evident in the amount of the performance increase in favor of the children participating in Skipping Hearts, which is documented in the short-term success of the project and has also been shown in other intervention studies (17, 26, 29, 35, 41). No differences could be determined only with respect to trunk flexibility (35) and speed parameters.

During the test, the children in both project groups were able to make significant increases compared to the control group in tasks involving a high degree of coordination (jumping sideways, Match 4 Point, standing long jump). The Champion-Program participants were also able to improve their vertical jumping ability (standing high jump), static balancing ability or stability (One-leg stand), whole-body coordination as well as the complex eye-hand-leg coordination abilities (jumping sideways, Match 4 Point), anaerobic endurance performance (step test) and shoulder mobility (shoulder stretch) significantly more than the CG and SH_{Basic}. Especially coordination parameters and also mobility in particular can be improved quickly with sports training (5, 12, 17). Consequently, due to the regular, targeted rope skipping training in the Champion-Program, enhanced fitness progress and even a changed body composition are possible. Even if the BMI increased in an age-appropriate manner in all groups of the present study, the development-related increase in body fat content in $SH_{Champion}$ is significantly lower (7, 31). The reduced increase in body fat as well as the improvement of the recovery ability assessed after the step test could be attributable to the altered exercise behavior induced by Skipping Hearts. This can be seen in the increased physical activity (11, 14, 17, 18, 30) shown by the accelerometry data, especially in $SH_{Champion}$. However, a positive influence on the health parameter blood pressure could not be determined.

In addition, the better fitness status and the greater exercise activity are demonstrated both by the self-assessment of the children as well as by the subjective impressions of the individual project coordinators at the 24 schools. To begin with, the challenge aspect of rope skipping can be confirmed by the sustained motivation, which is greatly dependent on which stage of Skipping Hearts was involved. The Basic-Workshop sparked a real wave of enthusiasm and thus caused short-term effects in self-perceived exercise behavior, shown in the self-assessment of the children and teachers, reporting increased exercise/rope skipping behavior. In order to maintain this over the long term, the subsequent implementation of the Champion-Program is absolutely required.

Regardless of the evaluation results, high blood pressure values were generally found during the study, classifying many children as hypertensive. This may be attributed to a test situation unfamiliar to the children and the associated nervousness during the initial testing. However, during the post-test 22% (systolic) respectively 15% (diastolic) of the children also showed increased blood pressure but there were no significant differences between the groups. The increased blood pressure in almost one of five children combined with overweight in almost 15% of the children (identical to the KiGGS population, 28), confirm the need for effective health promotion starting in elementary school (25) – especially since in this and in some other studies, showed a direct correlation between blood pressure and body constitution (19, 24, 41), as well as a negative effect of overweight on motor skills (2, 13, 19).

There are currently numerous projects in the field of prevention, but their evidence is low (11), which is often attributable to the lack of evaluation of the measures, as well as to structural and substantive deficits (14, 43, 42). However, well-evaluated data on the health-promoting effects over a longer period of time are available from the program "Join the Healthy Boat", which has been developed based on the positive experience of the previous research project URMEL-ICE (Ulm Research on Metabolism, Exercise and Lifestyle Intervention in Children; 7), and is continuously being supervised and monitored scientifically (41). According to current findings, Skipping Hearts can at least make a short-term contribution to increase the intention, the quality and the fun that the children have in exercising, thus contributing to a reduction of known health risk factors. Within the project, the Champion-Program has shown the greater effects on all pursued goals and should ultimately become the standard for all classes. The change in behavior necessary for sustainable health-promoting effects can only be achieved through regular, guided and systematic training (11, 25, 30, 42). However, due to its conception, Skipping Hearts is greatly dependent on the motivation of the teaching staff and the time available.

For interpreting the results, it is also important to consider that Skipping Hearts was carried out during regular physical education lessons and therefore does not represent an additional exercise period (41). It is therefore crucial to use the project to arouse the interest and self-motivation of the children, to integrate rope skipping increasingly into their daily lives (leisure, family). Here, Skipping Hearts offers good requisites: While the teachers considered the intensity and the complexity factor of rope skipping as high, the children reported less effort and difficulty. One explanation is that the children did not notice the greater effort because of the focus on the jumping exercises to be mastered and the great pleasure they got from it. Only when activities are perceived positively, they will be repeatedly used by children for exercise, enable to elicit long-term behavioral changes and have a lasting effect (12).

Table 3

Descriptive presentation of the results (mean ± SD) differentiated according to test time and group; presentation of the group/time interaction effects; significant results p≤0.05 or p*≤0.0167 (corrected according to Bonferroni) marked in bold type; SH_{Basic}=Skipping Hearts Basic Group, $SH_{Champion}$=Skipping Hearts Champion Group, CG=Control Group; MVPA=moderate-to-vigorous physical activity; weight class allocation according to Kromeyer-Hauschild 2001 (27); blood pressure classification according to RKI 2013 (34).

VARIABLE	GROUP			INTERACTION GROUP/TIME	POST HOC ANALYSIS P*		
	SH_{BASIC} PRE-TEST POST-TEST	$SH_{CHAMPION}$ PRE-TEST POST-TEST	CG PRE-TEST POST-TEST	P-VALUE	$SH_{CHAMPION}$ VS. CG	SH_{BASIC} VS. CG	$SH_{CHAMPION}$ VS. SH_{BASIC}
Body mass index (BMI) (kg/m²)	17.24±2.79 17.30±2.84 (n=698)	17.13±2.55 17.23±2.65 (n=437)	17.24±2.98 17.29±3.05 (n=331)	0.479	-	-	-
BMI-SDS	0.113±1.046 0.051±1.059	0.109±0.971 0.056±0.994	0.115±1.098 0.051±1.104	0.796	-	-	-
Percentage overweight & obesity (>90th percentile)	14.5% 13.8%	13.7% 12.2%	16.1% 14.8%	0.962	-	-	-
Body fat (%)	15.53±3.52 16.04±3.68 (n=684)	15.54±3.41 15.93±3.57 (n=437)	15.35±3.29 16.25±3.41 (n=327)	**<0.001**	**<0.001**	**<0.001**	0.273
Blood pressure (mmHg) systolic	114.85±12.11 109.14±10.12 (n=669)	113.31±10.94 110.21±9.68 (n=421)	116.51±11.16 110.00±10.20 (n=323)	**<0.001**	**0.001**	1.000	**0.002**
Percentage systolic hypertension (>95th percentile)	43.8% 20.2%	35.6% 21.1%	52.0% 26.0%	0.053	-	-	-
Blood pressure (mmHg) diastolic	70.96±9.86 65.22±8.48 (n=669)	69.90±9.28 65.58±8.21 (n=421)	72.18±9.22 66.66±8.22 (n=323)	0.075	-	-	-
Percentage diastolic hypertension (>95th percentile)	40.7% 13.8%	37.1% 14.0%	44.9% 17.0%	0.221	-	-	-
Jumping sideways (jumps)	28.23±5.51 33.38±5.97 (n=713)	27.83±6.02 34.26±5.70 (n=432)	28.31±5.76 31.95±5.88 (n=331)	**<0.001**	**<0.001**	**<0.001**	**<0.001**
Standing long jump (cm)	121.19±18.80 129.73±19.93 (n=711)	119.30±19.85 129.92±21.57 (n=430)	123.10±18.97 128.87±19.77 (n=328)	**<0.001**	**<0.001**	**0.009**	0.046
20-meter sprint (seconds)	4.146±0.318 4.080±0.298 (n=706)	4.138±0.313 4.095±0.314 (n=429)	4.180±0.347 4.139±0.361 (n=329)	**0.020**	1.000	0.064	0.068
Sit and Reach (cm)	-1.29±8.00 -1.85±7.89 (n=712)	-1.74±7.51 -2.11±7.38 (n=426)	-1.12±7.24 -1.65±7.56 (n=331)	0.841	-	-	-
MVPA relative (% of weartime)	22.63±6.11 25.65±6.48	22.09±6.29 25.59±6.40	25.35±4.69 25.47±5.37	**0.027**	**0.012**	0.026	0.706
MVPA absolute (minutes/day)	172.18±45.18 191.44±49.93 (n=35)	168.20±51.75 190.16±53.45 (n=28)	188.13±34.45 195.61±50.53 (n=26)	0.337	-	-	-

Noteworthy and new to Skipping Hearts is that short-term success is achieved by a large number of children, without a lot of effort and cost. Boys and girls of all ages, performance levels and weight groups are reached with one and the same action. Because of its setting-oriented approach, Skipping Hearts also offers an opportunity to promote better health in all children – regardless of the social status of parents or a possible migrant background. The realization that the positive impression of the project as well as the positive effects on attitude and behavior for girls are somewhat higher than for boys, and that younger children are somewhat more sensitized, fades into the background because of the overall great enthusiasm – especially as these differences in the $SH_{Champion}$ were less pronounced than in the SH_{Basic}. A systematic preoccupation with rope skipping thus helps to overcome prejudices against classic rope jumping.

Limitations

The significance of the present research is limited by the non-randomised design of the study, according to which the sample was obtained by a two-stage positive pre-selection (freedom of choice of the schools/project coordinators about participation in the evaluation and group allocation, voluntary participation of the children with the condition that the parents gave consent) and the data clustered by schools and classes. Posing questions to the teachers who probably have a positive attitude for the project, also presents a bias – nevertheless, only people who are acquainted with the program can give feedback about its content, quality and practicability in every-day school practice (41). Skipping Hearts itself is not an intervention measure in the classical sense, but an exercise-oriented school project with the overriding goal of increasing physical activity. Therefore, other important criteria for the design and implementation of large-scale health programs were neglected. Aspects such as healthy eating, heart health, and health-promoting behavior are presented in the childrens' work book, but there is no focus on an actual transfer of information. The scientific findings obtained here can provide a basis for the modification of the project in order to meet the requirements of a health program in the future, e.g. following the "Intervention Mapping Approach" according to Bartholomew (3). ›

The results, i.e. the positive short-term effects through Skipping Hearts are still given. However, a valid statement of a long-term effect on health cannot be made on the basis of the present evaluation due to the relatively short period of investigation (14, 26). Therefore, in a study funded by the "German Federal Ministry of Education and Research", the sustainability of the measure is currently being performed, as well as further, intense investigations into behavioral and situational prevention in children, parents and schools by Skipping Hearts.

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Conflict of Interest

The authors have no conflict of interest.

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