Aus der Kinderklinik und Kinderpoliklinik im Dr. von Haunerschen Kinderspital
Klinik der Ludwig-Maximilians-Universität München
Direktor: Prof. Dr. Dr. Christoph Klein

Motor abilities in early childhood and the effectiveness of a multi-component, kindergarten-based intervention: The ToyBox-study

Dissertation
zum Erwerb des Doktorgrades der Humanbiologie
an der Medizinischen Fakultät der
Ludwig-Maximilians-Universität zu München

vorgelegt von
Julia Birnbaum
aus
Berlin
2019

Mit Genehmigung der Medizinischen Fakultät

der Universität München

Berichterstatter:	Prof. Dr. med. Dr. med. habil. Berthold Koletzko
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Inhaltsverzeichnis

1 ABKÜRZUNGSVERZEICHNIS

PA	physical activity
JSS	Jumping from Side to Side
SLJ	Standing long jump
BMI	Body Mass Index
PE	physical education

2 PUBLIKATIONSLISTE

Diese Dissertation basiert auf folgenden Veröffentlichungen:

Publication I:

Effects of a kindergarten-based, family-involved intervention on motor performance ability in 3- to 6-year-old children: the ToyBox-study. Birnbaum J, Geyer C, Kirchberg F, Manios Y, Koletzko B; ToyBox-study Group.J Sports Sci. 2017 Feb;35(4):377-384.

Publication II:

Concepts and strategies on how to train and motivate teachers to implement a kindergarten-based, family-involved intervention to prevent obesity in early childhood. The ToyBox-study. Payr A, Birnbaum J, Wildgruber A, Kreichauf S, Androutsos O, Lateva M, De Decker E, De Craemer M, Iotova V, Manios Y, Koletzko B; ToyBox-study group. Obes Rev. 2014 Aug;15 Suppl 3:40-7.

Publication III:

Designing and implementing teachers' training sessions in a kindergarten-based, family-involved intervention to prevent obesity in early childhood. The ToyBox-study. Androutsos O, Katsarou C, Payr A, Birnbaum J, Geyer C, Wildgruber A, Kreichauf S, Lateva M, De Decker E, De Craemer M, Socha P, Moreno L, Iotova V, Koletzko BV, Manios Y; ToyBox-study group. Obes Rev. 2014 Aug;15 Suppl 3:48-52.

3 SUMMARY

Background: Well-developed motor abilities in early childhood form the basis for an active life and contribute to the prevention of health disease. Kindergarten settings offer ideal conditions to support the motor development process of each individual child. The aim of the present thesis is to investigate the effects of a one-year, kindergarten-based intervention program on motor abilities in children three to six years old, to assess the influence of anthropometric, social and behavioural factors on these effects and further to define key strategies and components of effective teacher training sessions.

Methods: A multi-component, kindergarten based and family involved intervention, the ToyBox-study, was elaborated, applied and evaluated in six countries of the European Unit. Following the cluster-randomized study design with pre and post measurements, anthropometric data (height, weight) and motor performance tests (Jumping from Side to Side (JSS), Standing long jump (SLJ)) of the children were measured in 58 German kindergartens. Pre and post data from a total of 1293 children were incorporated in the analyses of intervention effects.

Results: The intervention of the ToyBox-study is an effective program to improve motor abilities of children aged 3 to 6. The children taking part in the intervention revealed a higher increase in JSS and there was a trend for them to improve better in SLJ. Teachers´ training sessions provide information for practical implementation and integrate components enhancing self-efficacy.

Conclusion: The results underline the essentialness of well-designed and applied programs to promote motor abilities in kindergarten. The findings can help to create effective promotion strategies with the aim to give each child the best opportunity to development a high motor potential and thus the prerequisite for a healthy long life.

4 ZUSAMMENFASSUNG

Ziele: Sportmotorische Fähigkeiten, die im Kindesalter ausgebildet werden, bilden die Basis für ein aktives Leben und tragen zur Prävention von Krankheiten bei. Kindergärten bieten optimale Rahmenbedingungen um den motorischen Entwicklungsprozess jedes einzelnen Kindes positiv zu lenken. Ziel der vorliegenden Arbeit ist es die Auswirkungen eines einjährigen Kindergartenprogramms auf die sportmotorischen Fähigkeiten von 3- bis 6-jährigen Kindern und den Einfluss von anthropometrischer, sozialer und verhaltensbezogener Faktoren auf diese Effekte zu untersuchen, sowie wichtige Strategien und Inhalte zur Durchführung von effektiven Schulungen für Erzieherinnen zu definieren.

Methoden: ToyBox ist eine europäische Studie zur Entwicklung, Durchführung und Untersuchung eines innovativen, evidenzbasierten Interventionsprogramms im Kindergarten. Gemäß cluster-randomisiertem Studiendesign mit Vor- und Nachmessungen wurden anthropometrische Messungen (Größe und Gewicht), sowie sportmotorische Tests (seitliches Hin- und Herspringen, Standweitsprung) in 58 deutschen Kindergärten in Oberbayern durchgeführt. Prä- und Post-Daten von 1293 Kindern wurden in die Analyse der Interventionseffekte einbezogen.

Ergebnisse: Die ToyBox-Intervention ist ein effektives Programm zur Verbesserung der sportmotorischen Fähigkeiten von 3-6-jährigen Kindern. Schulungen im Vorfeld sollten Informationen zur praktischen Umsetzung der Intervention geben, sowie Strategien zur Verbesserung der Selbstwirksamkeit integrieren.

Schlussfolgerungen: Die Ergebnisse dieser Arbeit unterstreichen die Bedeutung gut konzipierter und umgesetzter Programme zur Förderung der motorischen Fähigkeiten im Kindergarten. Darüber hinaus können die gewonnen Erkenntnisse dazu beitragen, weitere wirksame Strategien zu entwickeln, damit jedes Kind sein höchstes Maß an motorischem Potential entwickeln und damit die Grundvoraussetzung für ein gesundes Leben schaffen kann.

5 EINLEITUNG

Changes in our society have a major impact on children's movement conditions. Increasing technologization, urbanization and mediatization lead to a more inactive daily lifestyle for children. Although there is agreement that physical activity (PA) is indispensable for a healthy development [1, 2], Reilly et al. showed that PA levels are lower than expected [3]. It was shown in several studies that children at the preschool age achieve less than the recommended 60 minutes of moderate to vigorous PA a day [4-6].
The level of physical activity of children is closely linked to existing motor abilities. Children with lower-skilled abilities may find it difficult to succeed in advanced movements, which may lead to avoiding these activities. Studies confirm that less developed abilities are linked with lower levels of physical activity [7, 8]. On the other hand, motor abilities can only be appropriately developed if they are correctly and frequently trained through PA and sports. In this way, participating in physical activity will lead to an improvement in motor abilities and skills [8-10]. Hence, children who perform PA at an elevated level are more likely to develop higher levels of motor abilities compared to their counterparts.

Motor abilities are considered as the foundational basic requisites underlying the visible movements like running and hopping. Bös et al. established the most well-known theoretical and systematical model of motor abilities in Germany (Fig. 1). He clustered motor abilities, at the first level, into conditional (energetically determined) and coordinative (information-oriented) abilities. The second level categorizes the main basic abilities of strength, speed, endurance, coordination and flexibility. The latter is assigned to the passive systems (joints and skeletal system) of energy transfer. A further detailed subdivision shows specifically motor sub-dimensions [11].

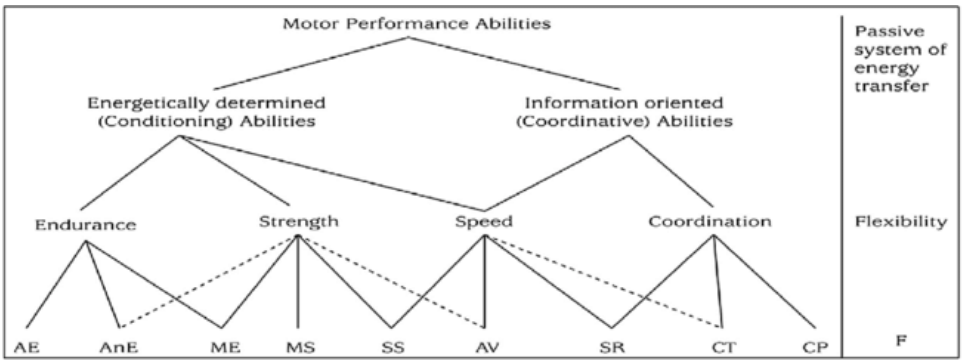

Fig. 1 : Differentiation of motor abilities [12]. AE = aerobic endurance; AnE = anaerobic endurance; ME = muscular endurance; MS = maximum strength; SS = speed strength; AV = action velocity; SR = speed of response; CT = coordination under time pressure; CP = coordination with precision requirement; F = flexibility.

If motor abilities are well trained and developed, they remain permanently available and form a basis for an active lifestyle [13]. It is difficult to generate and modify these abilities in adulthood [14]. The essential time period for developing fundamental motor abilities and skills is three to six years [15-17]. During this period children go through different stages of development, where they change in shape, body size, weight and maturity [18]. In addition, the social environment in which the child is located also has a big impact on their physical activity behaviour and motor competence. Hence, the acquisition of motor abilities is the product of growth and maturation (morphological, physiological and neuromuscular) and the social and physical environment [18]. Gabbard at al. define this "reciprocal interaction between the biological characteristics and the environment" as a "dynamic developmental system of perception to action" [19].

Researchers have focused on a wide array of potential correlations in motor skills and abilities in recent decades, but results are inconsistent and differ according to the investigated types of motor skills. A recent review and meta-analyses identified age, gender and weight status as the most commonly investigated biological correlations in motor competence in children and adolescence [20]. Age seems to be the most important biological factor, as numerous studies confirm an increasing improvement along with age [7]. Controversial findings exist regarding gender. Some researchers found differences in specific motor tasks, like boys outperforming girls in tasks with power and strength and

girls being better performers in balance skills [21]. Other researchers failed to find gender differences [22, 23]. Similarly, controversial results have been detected according to weight status. While some [22, 24] found no differences, others found poor motor abilities in overweight or obese children [10, 25]. Inconsistent findings have been explained by the fact that differences may appear with increasing age [22].

Research on environmental impacts includes various circumstances and conditions surrounding a child. Socio-economic status (SES) [26] , migration status [27], living-area, parents- and family related variables [28], participation in organized sports [29] as examples have been shown as factors affecting motor abilities. A review of Venetsanou et al. focusing on the main environmental factors detected that family context, for examples socio-economic status, level of mother's education and siblings can influence motor development of the preschoolers [30].

Kindergarten settings, in particular, can strongly influence the process of developing children's motor abilities, as they offer existing structural conditions, as well as professionally trained teachers. Two important reviews indicated that school-based interventions have been successful in improving motor skills and abilities [31, 32]. Moreover a recent systematic review and meta-analyses about fundamental movement sills, locomotion skills (e.g. jumping, hopping) and object controlled skills (e.g. catching, kicking) showed positive effects of childcare or kindergarten settings interventions [33].

One of the most important key elements for a successful implementation of school-based intervention programs are the school teachers. Their knowledge and awareness of teaching physical education (PE) is essential, as positive influence on motor abilities can only be achieved through high quality guided and instructed activities [34, 35]. Every teacher should have the confidence, competence, skill, knowledge and motivation to contribute to an adequate teaching and implementation process. A recent review showed that teachers' training is effective at improving movement skills and/or physical activity in school-based PA Intervention [36]. This underlines the results of a review indicating that many effective interventions focusing on energy balance-related behaviours have included teachers` training as part of their intervention [37]. Unfortunately there is some evidence that preschool teachers` lack the confidence and knowledge to teach effective PE [38, 39].

Given the importance of teachers training it is necessary to conduct systematically developed training sessions, based on principles of teachers´ education and strategies for successful program implementation. Unfortunately details on general characteristics of training sessions are still lacking as this research field is still under-studied and under-reported [36].

The ToyBox-study

Developing and evaluating a multi-component intervention program for 4-6 year old children in six countries (Belgium, Bulgaria, Germany, Greece, Poland and Spain) was the aim of the EU-funded ToyBox-study ("Multifactorial evidence based approach using behavioural models in understanding and promoting fun, healthy food, play and policy for the prevention of obesity in early childhood", www.toybox-study.eu). The promotion of four healthy energy balance-related behaviours (drinking, eating and snacking, physical activity and sedentary behavior) is the focus of this preschool-based, family-involved intervention.

The development process started with detecting these key behaviors and their determinants [40-42] and exploring existing behavioral models and educational strategies [43-46]. Based on these findings the content was developed using an intervention mapping protocol and PRECEDE-PROCEED model [47, 48]. Consequently the practical implementation of the intervention comprised strategies on four different scopes for each behavior, which are demonstrated by examples of the PA behavior:

Level 1: Changing the environmental classroom setting

Aiming to increase the activity of all participant children across the day, teachers were asked to change the environment in the classroom, e.g. creating space for movement by rearrangements of the furniture. This component is based on the concept of "unstructured physical activity". These activities are self-directed by the children and not instructed by the teacher. Because children discover their environment by themselves, it is often called "free time" or "self-selected free play".

Level 2: Children implementing the actual behaviour in the kindergarten

Educators were asked to teach physical activity on a regular basis. Therefore 26 physical education sessions have been developed. Each session has duration of 45-60 min and is

feasible with equipment that is available in the setting. All sessions aimed to improve different predefined motor abilities by implementing playful games with different levels of intensity, e.g. “Newspapers and clothes pegs” focused on endurance and strength [49].

Level 3: Teachers implementing fun classroom activities

In order to improve a child´s knowledge and understanding of the importance of PA in life, interactive classroom activities were implemented for at least one hour per day. These activities include fun and interaction, e.g. Kangaroo stories to read to the children or suggestions for excursions.

Level 4: Involving parents

Parents were actively involved in the program by receiving newsletters und tipcards. These materials include practical advice and ideas to perform healthy lifestyle behaviours at home together with the family, e.g. ideas to take the children to kindergarten by an active way.

Throughout the academic year 2012/2013, the Intervention was implemented in six European countries following a predetermined timetable (Fig. 2). In each country kindergartens were recruited from different socio-economic background based on a list of municipalities sorted by information of annual household income (low SES, medium SES, high SES). After acceptance of participation, parental consent forms were collected and baseline measurements performed (May-June 2012). Then kindergartens were randomly allocated to intervention and control groups (ratio 2:1) based on municipality. Kindergartens taking part in the intervention received the Toy-Box Materials, participated in two training sessions and started with the program, whereas kindergartens of the control group continued with the standard kindergarten curriculum. At the beginning of the intervention teachers had to change the classroom environment (level 1), which was retained until the end. Each behavior was implemented sequentially for four weeks and repeated afterwards. Following the timetable the PA-part took place in weeks 5 to 8, and repeated in weeks 19 and 20. During this period teachers weekly had to implement 2-3 sessions of PE lasting 45-60 minutes (level 2) and additional activities for a minimum of one hour (level 3). Activities of level 2 retained until the end of the school year. Nine newsletters, eight tip-cards and four posters were handed out to involve the parents.

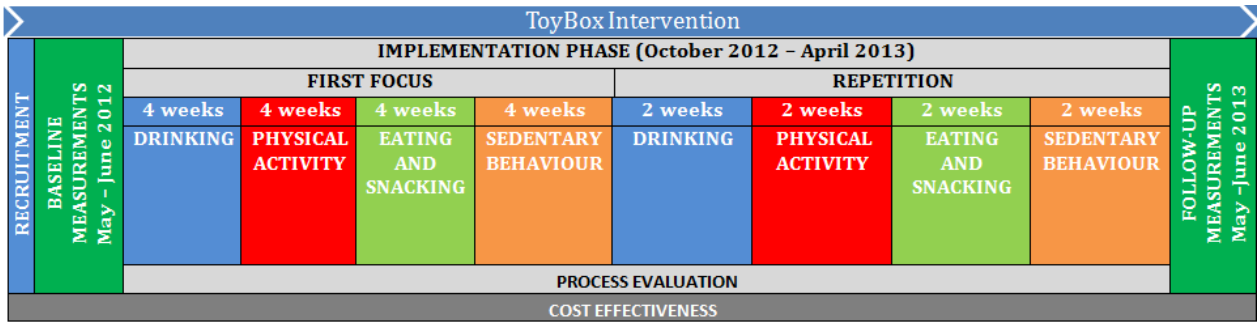

Fig. 2 : Timetable of the ToyBox Intervention.

After the first focus on each behavior, the classroom teachers received a third teachers´ training, aiming to refresh motivation and engagement.

After the one year intervention follow up measurements were performed with all children of the intervention and control group. To evaluate the process, impact and outcome standardized materials, protocols and methods were used.

Outline of the doctoral thesis:

The aim of the present thesis is to analyze the effectiveness of a one-year, multi-component, kindergarten-based intervention program on the development of motor performance abilities in preschool children. The results provide important aspects for future intervention programs. In this context three different scientific articles were written, which are all based on a European multicenter study, The ToyBox-study.

Publication 1:

In a longitudinal study we evaluated the effect of the multi-component ToyBox-intervention program on selected motor abilities in children aged 3-6 years. The intervention included a physical activity component composed of unstructured free-time PA and structured physical education sessions as well as classroom activities. Besides analyzing the effectiveness, we also investigated the role of different anthropometric, social and behavior parameters on the intervention effect. These results are helpful for developing most effective programs in the future, based on information as to who and what should be focused on. This is particularly important as it is assumed that highly developed motor abilities in the preschool years may result in increasing physical activity which, in turn, contributes to health benefits.

Publication 2:

As directed learning experiences as well as time for free-play takes a crucial role in developing motor abilities in preschool years, highly educated teachers with extensive knowledge are an essential prerequisite to perform PE sessions like the ones integrated in the ToyBox-intervention. Considering the importance of teachers´ training, the aim of the third publication was to illustrate the systematic developmental process of the training sessions implemented in front of and during the ToyBox-intervention. Identified concepts and strategies as well as didactical methods on how to train teachers makes an important contribution to the current under-studied research situation.

Publication 3:

Publication 3 aimed to describe details of the protocol and methodical approach of the three teachers´ training sessions carried out as part of the ToyBox-intervention. These specific representations may help to improve the approaches of effective kindergarten-based interventions in the future.

Conclusion:

The results of this doctoral thesis are of high importance for creating future promotion and teaching strategies, which may include gender and age separate exercises. We highlighted the need for qualified and trained teachers to provide structured and free time activities with the aim to give every child the opportunity to reach their full motor potential. The findings underline the investments in school-based programs, such as the ToyBox-program, because building up a repertoire of motor abilities in early life is essential as it will stimulate an individual's physical activity behaviour across their lifespan and thus contribute to a healthy lifestyle. From this public health point of view, early childhood teachers need to stress the importance of promoting motor abilities and its role in healthy growing and prevention of chronic diseases.

6 VERÖFFENTLICHUNG I

Journal of Sports Sciences

Routledge
Taylor & Francis Group

ISSN: 0264-0414 (Print) 1466-447X (Online) Journal homepage: http://www.tandfonline.com/loi/rjsp20

Effects of a kindergarten-based, family-involved intervention on motor performance ability in 3- to 6-year-old children: the ToyBox-study

Julia Birnbaum, Christine Geyer, Franca Kirchberg, Yannis Manios, Berthold Koletzko & on behalf of the ToyBox-study Group

To cite this article: Julia Birnbaum, Christine Geyer, Franca Kirchberg, Yannis Manios, Berthold Koletzko & on behalf of the ToyBox-study Group (2016): Effects of a kindergarten-based, family-involved intervention on motor performance ability in 3- to 6-year-old children: the ToyBox-study, Journal of Sports Sciences, DOI: 10.1080/02640414.2016.1166390

To link to this article: http://dx.doi.org/10.1080/02640414.2016.1166390

JOURNAL OF SPORTS SCIENCES, 2016
http://dx.doi.org/10.1080/02640414.2016.1166390

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Effects of a kindergarten-based, family-involved intervention on motor performance ability in 3- to 6-year-old children: the ToyBox-study

Julia Birnbaum[a], Christine Geyer[a], Franca Kirchberg[a], Yannis Manios[b] and Berthold Koletzko[a], on behalf of the ToyBox-study Group

[a]Division of Metabolic Diseases and Nutritional Medicine, Dr. von Hauner Children's Hospital, Ludwig-Maximilians-University of Munich, Munich, Germany; [b]Department of Nutrition and Dietetics, School of Health Science and Education, Harokopio University, Athens, Greece

ABSTRACT

This study targeted to examine the effect of the ToyBox-intervention, a kindergarten-based, family-involved intervention, aiming to improve preschooler's energy-related behaviours (e.g., physical activity) on motor performance ability. Physical activity sessions, classroom activities, environmental changes and tools for parents were the components of the 1-year intervention. The intervention and control were cluster-randomised, and children's anthropometry and two motor test items (jumping from side to side, JSS and standing long jump, SLJ) were assessed. A total of 1293 (4.6 ± 0.69 years; 52% boys) from 45 kindergartens in Germany were included (intervention, $n = 863$; control, $n = 430$). The effect was assessed using generalised estimating equation. The intervention group showed a better improvement in JSS (Estimate 2.19 jumps, $P = 0.01$) and tended to improve better in SLJ (Estimate 2.73 cm, $P = 0.08$). The intervention was more effective in boys with respect to SLJ (P of interaction effect = 0.01). Children aged <4.5 years did not show a significant benefit while older children improved (JSS, Estimate 3.38 jumps, $P = 0.004$; SLJ, Estimate 4.18 cm, $P = 0.04$). Children with low socio-economic status improved in JSS (Estimate 5.98 jumps, $P = 0.0001$). The ToyBox-intervention offers an effective strategy to improve specific components of motor performance ability in early childhood. Future programmes should consider additional strategies specifically targeting girls and younger aged children.

Abbreviations: BMI: body mass index; SES: socio-economic status; JSS: jumping from side to side; SLJ: standing long jump; SD: standard deviation; GEE: generalised estimating equation

ARTICLE HISTORY
Accepted 10 March 2016

KEYWORDS
Intervention; kindergarten; motor performance ability

Introduction

The age of about 3-6 years is a critical period for a child's motor development. During these years, children learn the basic types of motor skills like running and hopping which promotes the process of development of their basic motor abilities, such as speed, strength, coordination and balance (Sentderdi, 2008). These skills and abilities are the foundations of a variety of physical activities (Gallahue, Ozmun, & Goodway, 2006) and may influence later physical activity levels in adolescence and adulthood (Barnett, van Beurden, Morgan, Brooks, & Beard, 2009; Stodden, Langendorfer, & Roberton, 2009). Children with higher levels of motor performance are more physically active than those with less well-developed skills (Fisher et al., 2005; Laukkanen, Pesola, Havu, Sääkslahti, & Finni, 2014; Williams et al., 2008; Wrotniak, Epstein, Dorn, Jones, & Kondilis, 2006). Reilly et al. (2006) suggested that physical activity improves movement skills in preschoolers.

However, physical activity among children is believed to be insufficient and has worsened (Dollman, Norton, & Norton, 2005; Tucker, 2008). Similarly, some motor abilities have declined in recent decades (Hardy, Barnett, Espinel, & Okely, 2013; Roth et al., 2010). The development and evaluation of interventions to promote physical activity and motor performance abilities is therefore a priority. Kindergartens are ideal settings where opportunities for being physically active can be provided through existing personnel, equipment and facilities (Lubans et al., 2012) and where a large number of children at the best age for stimulation of motor abilities and their parents can be reached. Goodway et al. stressed that the process of acquisition needs a variety of active play experiences and structured programmes (Goodway, Crowe, & Ward, 2003).

Increasing physical activity and motor performance abilities in preschool children has been the aim of several projects. A recent review and meta-analysis reported effects for ≥1 fundamental movement skill in all of 19 evaluated interventions. Although the findings are positive for motor performance improvements, the authors stressed the need for future research on high-quality trials with long-term follow-up. They recommended school-based programmes with physical activity lessons delivered by specialists or highly trained classroom teachers (Morgan et al., 2013). Riethmuller et al. also underlined parental involvement when creating interventions (Riethmuller, Jones, & Okely, 2009). Taking into account these

CONTACT Julia Birnbaum j.birnbaum@med.uni-muenchen.de Division of Metabolic Diseases and Nutritional Medicine, Dr. von Hauner Children's Hospital, Ludwig-Maximilians-University of Munich, Lindwurmstr. 4, Munich, 80337, Germany

Supplemental data for this article can be accessed here.

recommendations, the ToyBox-intervention was established, a multicomponent, kindergarten-based, family-involved intervention aiming to improve energy-balanced related behaviours, among them physical activity. Twenty-six physical activity sessions, interactive classroom activities, environmental changes in the classroom and tools for involving parents were components of the intervention.

The aim of the current study was to evaluate the effectiveness of the ToyBox-intervention on motor performance abilities, namely strength and coordination measured by the test items standing long jump (SLJ) and jumping from side to side (JSS) in 3- to 6-year-old children in Germany. The children included in this study represent a subgroup of the ToyBox-intervention performed in six European countries, but motor tests were only regularly performed in Germany.

Methods

Study design

The ToyBox-study developed a multicomponent, kindergarten-based, family-involved intervention at the kindergarten setting for use in different European countries with the focus on healthy snacking, water consumption, physical activity and sedentary behaviour (Manios et al., 2014) (www. toybox-study.eu). The development of the programme was based on a systematic approach that combines the use of the PRECEDE-PROCEED model and intervention mapping protocol performed by a multidisciplinary team of 15 partners across the EU (De Craemer et al., 2014; Duvinage et al., 2014; Manios et al., 2012). Kindergartens were recruited from nine municipalities with different socio-economic status (SES) in the region of Upper Bavaria in Germany. The selection followed a list of municipalities classified into tertiles (low, middle and high) based on annual income. At baseline, 58 kindergartens agreed to participate in the project (11 low SES, 17 middle SES and 30 high SES). The kindergartens were randomly assigned in a 1:2 ratio to the control (19) or to the intervention group (39) on the level of municipalities to avoid contamination between kindergartens in the same area. Three intervention kindergartens withdrew during the implementation due to teachers shortages. Written informed consent forms were obtained from 1952 German parents/caregivers. Prior to the intervention during May to June 2012 pretest measurements was preformed, followed by post-test assessment at respective same time period 1 year later (De Miguel-Etayo et al., 2014; Manios et al., 2014; Mouratidou et al., 2014). Children's anthropometry and motor test were measured in 1293 children, latter were only regularly performed in Germany. Dropouts occurred because children were unable to participate to the respective tests because of family-holiday, diseases, injury or other refusals. Also, children below age of 3 years were excluded from the analyses. The programme was applied to all children of intervention kindergartens starting with teachers' training sessions and distribution of the related educational material. The kindergartens in the control group continued their usual routine based on their kindergarten curriculum (Bavarian Ministry of Labour and Social Affaires & State Institute of Early Childhood Research, 2012).

The study protocol was accepted by the Ethical Committee of the Medical Faculty, Ludwigs-Maximilians-University of Munich. The ToyBox-study is registered with the clinical trials registry clinicaltrials.gov ID: NCT02116296 (Manios et al., 2014).

Physical activity component of the ToyBox-intervention

The ToyBox-intervention focused on four energy balance-related behaviours: healthy snacking, water consumption, physical activity and sedentary behaviour. Each behaviour was implemented on four different levels (Manios et al., 2014).

The main focus in the physical activity component was the increase in the children's physical activity level. In order to achieve this objective: (i) the kindergarten was rearranged to be more attractive and provide more free space for being physically (level 1); (ii) 2 structured physical activity sessions with duration of 45 min each were scheduled per week and were divided into different levels of difficulty. These sessions contained playful exercises to promote children's motor skills and motor abilities (level 2) (iii) additional activities, for example, reading interactive kangaroo stories and excursions were scheduled for at least 1 h per week to provide an increase of the children's knowledge, skills and self-efficacy about physical activity (level 3) and (iv) the distribution of two newsletters, two tip-cards and one poster on physical activity to the parents (level 4). Level 1 was applied before the start of the academic year 2012–2013 and continued until the end, Level 2 started in week 5 of the ToyBox-Intervention and continued until the end of the academic year. Level 3 of the physical activity component was conducted in weeks 5–8 with a repetition period in weeks 19 and 20. During the other weeks, the behaviours snacking, water consumption and sedentary behaviour were implemented. Level 4 was applied on predefined time points. The detailed content of this module and its development are described elsewhere (De Craemer et al., 2014; Duvinage et al., 2014). To ensure an appropriate implementation, three different training sessions were conducted by project staff; at least one teacher per class was encouraged to attend each training session. In the first and second session, which took place before the start of the intervention and 4 weeks thereafter, respectively, the teachers were informed about the background, objective and details of the intervention and about the importance of being a role model in establishing a healthy and active life style. The third training session was scheduled before the start of the repetition period, with the aim of sharing experience and preserving motivation and enthusiasm. Detailed information about the development and implementation of the training sessions are described elsewhere (Androutsos et al., 2014; Payr et al., 2014).

Data collection

Measurements of the main outcomes were conducted in the morning among small groups in the movement rooms of the kindergarten. Exercises were explained and demonstrated by trained research assistant. Two to three children were arranged in groups for measurements of weight, height and two different motor tests.

Data characteristics

Height was measured using the Seca® type 214 stadiometer, weight with an electronic scale Seca® type 861 and waist circumference with Seca® type 201. While being measured, children were allowed to wear underwear and socks only. The average of two measurements was used for both weight and height. The body mass index (BMI) was calculated as weight in kilos divided to height in square metres and classified according to the percentile graphs of Kromeyer-Hauschild et al. (2001). Children with a BMI < 10th percentile were classified as underweight, ≥10 to <90th percentile as normal, ≥90th to <97th percentile as overweight and ≥97th percentile as obese.

Motor performance tests

Motor performance ability for children is defined in this study referring to the theoretical model of Bös (1987), namely endurance, strength, speed, coordination and flexibility. In this study, two different motor assessments were chosen to test children's motor performance and to get insights in the basic motor abilities coordination and strength: JSS (coordination, i.e., total body coordination under time pressure, speed and muscular endurance capabilities of the lower extremities) and SLJ (strength, i.e., jumping power and speed strength) (Lämmle, Tittlbach, Oberger, Worth, & Bös, 2010). Both assessments are part of the "Kinderturntest" (Bös, 2006) and valid for children aged 3–10 years. The test was established for use in schools and day care settings and was shown to be feasible and sensitive (Bappert, Karger, Seidel, Bös, & Oberger, 2006). The test–retest reliability coefficient is 0.84 for JSS and 0.91 for the SLJ (Karger & Bös, 2009). Both tests were carried out in shoes.

Jumping from side to side. The children were asked to jump from side to side over a marked line with both feet together for 15 s, as quickly as possible. Jumps with mistakes, that is, child touched the line, jump was not done with both feet, child was not jumping sideways, were not counted. There were two attempts; the results of both series of jumps were added together (Bös, 2006).

Standing long jump. The child was positioned with both feet behind a marking and asked to jump as far as possible forwards and land on both legs without falling back. The distance from heel of the back feet to the standing marking was measured in centimetres. The best jump of two attempts was rated (Bös, 2006).

Demographic, anthropometric, social and behavioural factors

Data on child age, parental height and weight, parental school education and child's membership in sports clubs were obtained using parent-completed questionnaires at baseline (Gonzalez-Gil et al., 2014). The child's age was calculated by date of baseline measurement. The parents' BMI were classified according the WHO criteria (Obesity: Preventing and managing, 2000) as underweight with BMI < 18,5 kg/m^2, normal with BMI ≥ 18.5 and <25 kg/m^2, overweight with BMI ≥ 25 and <30 kg/m^2 and obese with BMI ≥ 30 kg/m^2. Parental school education was classified into four categories: 12 years or less, 13–14 years, 15–16 years and more than 16 years.

Statistical analyses

Baseline characteristics between the intervention and control group were compared using mean and standard deviation (SD) or percentages. To analyse the main outcomes, namely the improvements in both motor tests, the difference between the results of the first and second measurements were calculated. We calculated mean and design effect corrected confidence intervals for graphical representation of the main outcomes. In order to test for a difference in improvements between intervention and control group, we used generalised estimating equation (GEE) accounting for clustering of children within kindergartens. The role of other anthropometric, social and behavioural factors of interest was assessed by successively incorporating them into the models and testing for an interaction effect with the intervention group variable using an ANOVA. In case of ambiguous results, stratified analyses were used to explore the effect of the intervention on improvements in the motor tests.

For all analyses, statistical significance level was set at $P < 0.05$. All analyses were performed using R (version 3.0.1).

Results

Both baseline and final examination measurements of the main outcomes were available for 1293 children (4.6 ± 0.69 years; 52% boys, intervention, $n = 863$; control, $n = 430$). Table 1 shows the baseline characteristics for the intervention and control group. These data show an equal distribution of the anthropometric, biological and social parameters between the two groups, except for a difference in SES. In the control group, only 22% were of medium SES, compared to 42% in the intervention group. In contrast, 61% of the control group were of high SES, compared to 39% in the intervention group.

Children in both groups improved their coordination and strength along with the increase in age by 1 year, but the children in the intervention group had a greater increased in JSS (Estimate 2.19 jumps, $P = 0.01$) and tended to a greater increase of SLJ (Estimate 2.73 cm, $P = 0.08$), suggesting a beneficial effect of the intervention on motor performance. This effect is dependent of any demographic or social parameter. The results of motor tests at baseline (pre) and at follow-up examination (post) are shown in Figure 1.

Boys achieved a greater improvement in JSS than girls (Estimate 2.3 jumps, $P = 0.007$; Table 2). The intervention, however, had similar positive effects in both sex (P of interaction effect = 0.69), as the interaction effect sex × intervention shows. Regarding SLJ, we found no sex effect ($P = 0.158$), but for this outcome, the intervention was more effective in boys than girls (P of interaction effect = 0.01). There was a borderline significant interaction effect between the intervention × age regarding JSS (P of interaction effect = 0.08). Stratified analyses showed that the intervention yielded better results

Table 1. Anthropometric, demographic, social and behavioural characteristics of the intervention and control group at baseline:

Characteristics		Intervention (n = 863)	Control (n = 430)
Anthropometric data			
Age (years)	Mean ± SD	4.6 ± 0.71	4.6 ± 0.65
Weight (kg)	Mean ± SD	18.3 ± 2.97	18.6 ± 3.13
Height (cm)	Mean ± SD	107.6 ± 6.28	108.2 ± 6.65
BMI	Mean ± SD	15.7 ± 1.52	15.8 ± 1.37
Demographic parameters			
Sex	Male	434 (50%)	234 (54%)
	Female	429 (50%)	196 (46%)
Child BMI[a]	Underweight	43 (5%)	16 (4%)
	Normal	741 (87%)	381 (89%)
	Overweight	44 (5%)	17 (4%)
	Obese	26 (3%)	14 (3%)
	(Missing)	9	2
Mother BMI[b]	Underweight	30 (4%)	13 (3%)
	Normal	469 (64%)	256 (66%)
	Overweight	166 (23%)	86 (22%)
	Obese	64 (9%)	33 (9%)
	(missing)	134	42
Father BMI[b]	Underweight	2 (0%)	2 (1%)
	Normal	271 (40%)	142 (38%)
	Overweight	332 (49%)	182 (49%)
	Obese	68 (10%)	43 (12%)
	(missing)	190	61
Social and behavioural parameters			
Socio-economic status[c]	Low tertile	175 (20%)	72 (17%)
	Medium tertile	351 (41%)	94 (22%)
	High tertile	337 (39%)	264 (61%)
Member in sports club	No	368 (50%)	203 (51%)
	Yes	372 (50%)	196 (49%)
	(Missing)	123	31
Years of education mother	≤12 years	172 (24%)	92 (23%)
	13–14 years	213 (30%)	117 (30%)
	15–16 years	110 (15%)	79 (20%)
	≥16 years	221 (31%)	108 (27%)
	(Missing)	147	34
Years of education father	≤12 years	153 (23%)	75 (20%)
	13–14 years	161 (24%)	97 (26%)
	15–16 years	116 (17%)	64 (17%)
	≥16 years	242 (36%)	138 (37%)
	(Missing)	191	56

P values were assessed using χ^2 test for categorical variables (except for father BMI where we used Fisher's exact test) and t-test for normally distributed variables. Significance levels were as follows: *P < 0.05; **P < 0.01; ***P < 0.001; Missing, not available data; [a]BMI according to classification by Kromeyer-Hausschild et al; [b]Parental BMI according to WHO classification; [c]Socio-economic status classified according to annual income.

with increasing age (Table 3) in both tests. There is a greater improvement in JSS in children aged 4.3–5 years (Estimate 2.45 jumps, P = 0.035) and in those aged >5 years (Estimate 3.38 jumps, P = 0.004). Regarding the SLJ, the intervention was effective only in children aged >5 years (Estimate 4.18 cm, P = 0.038). Stratified analyses by SES revealed a significant effect of the intervention on JSS in children of low SES (Estimate 5.98 jumps, P = 0.0001). In the subgroups of children with medium and high SES this was not significant, although the intervention group tended to improve compared to the control group (Table 4). Regarding SLJ, a significant and positive intervention effect was seen in children of medium (Estimate 6.06 cm, P = 0.02) and high SES (Estimate 4.61 cm, P = 0.021). In children of low SES, the intervention showed a significant negative effect (Estimate −5.48 cm, P = 0.036).

None of the other demographic, anthropometric, social or behavioural parameters, namely BMI, parental BMI, years of education of the mother and father, nor membership in sports clubs significantly influenced the effect of the intervention. However, we observed significantly worse scores in JSS for (i) overweight/obese and underweight compared to normal weight children, (ii) children with obese mothers compared to normal weight mothers and (iii) children who were not a member of a sports club. The improvement in the SLJ test of the children did depend on their parents` years of education. Children whose parents had a higher education improved (significantly) less than children of parents that went to school for less than 13 years (Table 5 in supplementary section).

Discussion

This study aimed to examine the effect of the ToyBox-intervention on some components of motor performance ability, namely coordination and strength in German 3- to 6-year-old children. We hypothesised that the intervention increases children's motor performance abilities more than the abilities from children of the control group.

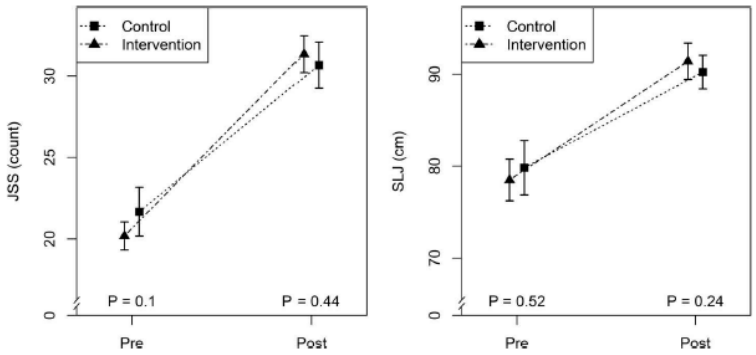

Figure 1. Mean and 95% confidence interval of the motor tests, jumping from side to side (JSS) and standing long jump (SLJ), at baseline (pre) and follow-up (post) by group (intervention, n = 863; control, n = 430).

Table 2. Regression coefficients from GEE models for the effect of the intervention on jumping from side to side (JSS) and standing long jump (SLJ) on sex with and without interaction effect.

		JSS			SLJ		
	Independent variable	Estimate	*P*	Significance	Estimate	*P*	Significance
Sex							
Without interaction	Intervention	2.3	0.0074	**	2.79	0.08	
	Female	−2.69	0.0003	***	−1.4	0.20	
With interaction	Testgroup intervention	2.61	0.06		5.13	0.0049	**
	Female	−2.26	0.10		1.89	0.15	
	Female × intervention	−0.65	0.69		−4.94	0.0110	*

*$P < 0.05$;**$P < 0.01$; ***$P < 0.001$.

Table 3. Regression coefficients from GEE models for the effect of the intervention on jumping from side to side (JSS) and standing long jump (SLJ) stratified by age.

Stratification variable		JSS			SLJ		
Age	Independent variable	Estimate	*P*	Significance	Estimate	*P*	Significance
Low tertile	Testgroup intervention	0.79	0.44		−0.02	0.99	
Medium tertile	Testgroup intervention	2.45	0.035	*	2.66	0.19	
High tertile	Testgroup intervention	3.38	0.0044	**	4.18	0.038	*

*$P < 0.05$;**$P < 0.01$; ***$P < 0.001$; Age: low tertile (3.03–4.26 years), medium tertile (4.27–4.98 years) and high tertile (4.98–6.51 years).

Table 4. Regression coefficients from GEE models for the effect of the intervention on jumping from side to side (JSS) and standing long jump (SLJ) stratified by SES.

Stratification variable		JSS			SLJ		
SES	Independent variable	Estimate	*P*	Significance	Estimate	*P*	Significance
Low tertile	Testgroup intervention	5.98	0.0001	***	−5.48	0.036	*
Medium tertile	Testgroup intervention	1.74	0.43		6.06	0.020	*
High tertile	Testgroup intervention	0.81	0.47		4.61	0.021	*

*$P < 0.05$;**$P < 0.01$; ***$P < 0.001$; Socio-economic status (SES) classified according to annual income.

We found that children participating in this intervention had significantly improvement in JSS and a trend towards improvement in SLJ. This observation is in line with a Swiss study, which confirmed relevant intervention effects after 7 months for side-to-side jumping in preschool children (Donath, Imhof, Roth, & Zahner, 2014). The Children's Health Interventional Trial study found significant improvement in motor abilities, assessing lateral jumps and endurance performance in primary school children (Graf et al., 2005). A review of interventions in children younger than 5 years found that more than half of 17 studies significantly improved children's motor performance (Riethmuller et al., 2009). Thus, our results can be attributed to the physical activity component of the intervention, which included (i) the rearrangement of the classroom in order to assist the children to be more active, (ii) the performance of two structured physical education sessions per week, (iii) children's active participation in classroom activities of a minimum of 1 h per week and (iv) distribution of intervention material to parents/caregivers. As children do not learn motor skills and abilities naturally (Hardy, Reinten-Reynolds, Espinel, Zask, & Okely, 2012), it is important to differentiate the implementation of guided physical education sessions. Children need to be instructed and practice through a varied range of active play experiences and multifaceted structured programmes (Hardy et al., 2012). In this context, an impact of the ToyBox programme is the focus on training sessions for teachers who implemented the intervention. This importance is supported by Martin et al. suggesting that early childhood teachers may have limited knowledge about the individual components of motor performance (Martin & Hands, 2003). Many teachers lack the skill to teach physical education efficiently (Morgan & Hansen, 2008). It is necessary for teachers to understand the process of developing motor skills and abilities, their importance and ways of teaching.

Another important finding is the sex difference in the effectiveness of the intervention. Boys improved more in SLJ than girls. In contrast, the intervention had similar positive effects regarding JSS in both sexes. In general, boys are more physically active than girls (Hinkley, Crawford, Salmon, Okely, & Hesketh, 2008; Pate, Pfeiffer, Trost, Ziegler, & Dowda, 2004; Williams et al., 2008) and girls tend to skip and hop more and do activities such as dancing and gymnastics (Okely & Booth, 2004). Although the ToyBox-intervention addresses all children, there may be a gender-specific lack of attention and different preferences in physical activities. Girls may need to be addressed with gender-specific opportunities. Thus, gender should be taken into consideration when designing appropriate physical activity sessions in education setting. We found different intervention effects in relation to the children's age. The intervention was mostly effective on motor ability outcomes in children older than 5 years and had no effect on children aged 3–4.3 years. This is in line with a study of Williams et al. detecting that 4-year-old children had higher scores in motor performance and stronger relationship between level of motor skill performance and physical activity than 3-year-old children (Williams et al., 2008). At this age, motor skills are still emerging and the acquisition is determined by appropriation and elaboration of movements (Scheid, 1994; Williams et al., 2008). Thus, to also address younger children, future interventions in setting kindergarten need to include more age-specific games and exercises.

Intervention of children with low SES showed significantly greater improvement in JSS. In contrast, children with high SES revealed the smallest amelioration in both tests. In general, children with lower SES background are less physically active (Federico, Falese, & Capelli, 2009) and have lower levels of physical fitness (Lammle, Worth, & Bos, 2012) and motor skills (Sprague, Kile, Lipscomb, McClelland, & MacDonald, 2013) compared to children with higher SES background. This can be attributed to socio-environmental factors, for example, lack of physical activity opportunities and unsafe playgrounds in low SES and home environments (de Vet, de Ridder, & de Wit, 2011; Evans & Kantrowitz, 2002). Children from lower SES have greater media access, but lower access to portable play equipment (Tandon et al., 2012). In this context, our data suggest that the programme is more activating children and their families with low SES and illustrates the importance of designing school-based approaches to promote physical activity and motor performance.

In this context, we had expected similar results in SLJ. In contrast to the positive intervention effect for children in low SES regarding JSS, we found controversial results in SLJ. While children of medium and high SES increased their strength significantly more compared to control children, we found a negative intervention effect for children of low SES. This finding is caused by the fact that the children of two control kindergartens increased their SLJ scores by 23.1 and 17.7 on average – compared to the mean amelioration of 10.4 among the control group. These two kindergartens, however, showed no abnormalities with respect to biological or socio-economic characteristics. Therefore, we are not able to give comprehensive explanation about this observation.

Strength and limitations

The strength of this study was the large sample of children with different SES. Furthermore, the intervention followed a standardised and evidence-based protocol and assessments were done by trained field workers. The main limitation of the study was the low assessment of motor characteristics. As we only conducted two different tests measuring coordination and strength, we are not able to give any statement regarding the basic abilities flexibility and endurance. To capture a full description of motor performance ability status, it is necessary to measure all motor abilities as research implies that motor performance ability is a complex multidimensional construct and cannot be described by using only one parameter (Lämmle et al., 2010).

Our study provides support for the importance of a well-designed and implemented intervention to improve motor performance abilities in kindergarten settings, such as the ToyBox programme. Planned and structured physical activity sessions, as well as active play experiences should be pivotal components in education settings delivered by trained and instructed teachers. The ToyBox programme appeared to be an effective programme to activate children from low SES, boys and older children. As it is important that all children develop proficiency in motor abilities at a young age, we propose more research to generate activity offerings, instructional methods and teaching strategies to girls and younger children.

Acknowledgements

The ToyBox-study is funded by the Seventh Framework Programme (CORDIS FP7) of the European Commission under grant agreement n° 245200. The content of this article reflects only the authors' views, and the European Community is not liable for any use that may be made of the information contained therein. We would like to thank all children and their parents, as well as the kindergarten directors and teachers for their participation in the project. Special thanks to all field workers that helped with the assessment. The ToyBox study group consist of:

Co-ordinator: Yannis Manios
Steering Committee: Yannis Manios, Berthold Koletzko, Ilse De Bourdeaudhuij, Mai Chin A Paw, Luis Moreno, Carolyn Summerbell, Tim Lobstein, Lieven Annemans and Goof Buijs
External Advisors: John Reilly, Boyd Swinburn, and Dianne Ward
Harokopio University (Greece)
Yannis Manios, Odysseas Androutsos, Eva Grammatikaki, Christina Katsarou, Eftychia Apostolidou and Eirini Efstathopoulou
Ludwig Maximilians Universitaet Muenchen (Germany)
Berthold Koletzko, Kristin Duvinage, Sabine Ibrügger, Angelika Strauß, Birgit Herbert, Julia Birnbaum, Annette Payr and Christine Geyer
Ghent University (Belgium)
Department of Movement and Sports Sciences: Ilse De Bourdeaudhuij and Greet Cardon, Marieke De Craemer, Ellen De Decker
Department of Public Health: Lieven Annemans, Stefaan De Henauw, Lea Maes, Carine Vereecken, Jo Van Assche and Lore Pil
VU University Medical Center EMGO Institute for Health and Care Research (the Netherlands)
EMGO Institute for Health and Care Research: Mai Chin A Paw and Saskia te Velde
University of Zaragoza (Spain)
Luis Moreno, Theodora Mouratidou, Juan Fernandez, Maribel Mesana, Pilar De Miguel-Etayo, Esther M. González-Gil, Luis Gracia-Marco and Beatriz Oves
Oslo and Akershus University College of Applied Sciences (Norway)
Agneta Yngve, Susanna Kugelberg, Christel Lynch, Annhild Mosdøl and Bente Nilsen
University of Durham (UK)
Carolyn Summerbell, Helen Moore, Wayne Douthwaite and Catherine Nixon
State Institute of Early Childhood Research (Germany)
Susanne Kreichauf and Andreas Wildgruber
Children's Memorial Health Institute (Poland)
Piotr Socha, Zbigniew Kulaga, Kamila Zych, Magdalena Góźdź, and Beata Gurzkowska and Katarzyna Szott
Medical University of Varna (Bulgaria)
Violeta Iotova, Mina Lateva, Natalya Usheva, Sonya Galcheva, Vanya Marinova, Zhaneta Radkova and Nevyana Feschieva
World Obesity Federation (UK)
Tim Lobstein
CBO B.V. (the Netherlands)
Goof Buijs, Annemiek Dorgelo, Aviva Nethe and Jan Jansen
AOK- Verlag (Germany)
Otto Gmeiner, Jutta Retterath, Julia Wildeis and Axel Günthersberger
Roehampton University (UK)
Leigh Gibson
University of Luxembourg (Luxembourg)
Claus Voegele

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

The ToyBox-study is funded by the Seventh Framework Programme (CORDIS FP7) of the European Commission under grant agreement n° 245200.

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7 VERÖFFENTLICHUNG II

obesity reviews doi: 10.1111/obr.12177

Obesity Prevention

Concepts and strategies on how to train and motivate teachers to implement a kindergarten-based, family-involved intervention to prevent obesity in early childhood. The ToyBox-study

A. Payr[1], J. Birnbaum[1], A. Wildgruber[2], S. Kreichauf[2], O. Androutsos[3], M. Lateva[4], E. De Decker[5], M. De Craemer[5], V. Iotova[4], Y. Manios[3] and B. Koletzko[1] on behalf of the ToyBox-study group

[1]Dr. von Hauner Children's Hospital, University of Munich Medical Centre, Munich, Germany; [2]State Institute of Early Childhood Research, Munich, Germany; [3]Department of Nutrition and Dietetics, Harokopio University, Athens, Greece; [4]Department of Pediatrics, Medical University Varna, Varna, Bulgaria; [5]Department of Movement and Sports Sciences, Ghent University, Ghent, Belgium

Received 7 April 2014; accepted 8 April 2014

Address for correspondence: B Koletzko, Division of Metabolic and Nutritional Medicine Dr. von Hauner Children's Hospital Ludwig-Maximilians-University of Munich, Mnchen, Germany.
E-mail: office.koletzko@med.lmu.de

Summary

The key person for the implementation of kindergarten-based behavioural interventions is the kindergarten teacher. When conducting intervention studies in kindergartens, training sessions are needed to train and motivate kindergarten teachers for programme implementation. This paper presents the systematic development of the teachers' trainings executed in the ToyBox-intervention – a kindergarten-based and family-involved obesity prevention programme for children aged 4–6. Based on concepts for the education of kindergarten teachers, on general strategies for successful programme implementation and on the ToyBox programme-specific requirements, the aims of the teachers' trainings were defined and an overall concept was deduced. Regarding the concept for the ToyBox teachers' training sessions, it is concluded that the training modules should focus on presenting information on the practical implementation of the intervention. Furthermore, these modules should also include self-efficacy enhancing components and should give kindergarten teachers opportunities to share experiences. Regarding the didactic methods applied in the ToyBox teachers' training sessions, constructivist learning approaches that facilitate active participation, reflective thinking and personal involvement were implemented. Emphasis was put not only on the content but especially on the didactic methods of teachers' trainings in order to enhance devotion to, and quality and sustainability of the ToyBox-intervention.

Keywords: Children, kindergarten, obesity prevention, teacher training.

obesity reviews (2014) **15** (Suppl. 3), 40–47

ToyBox-study group: **Coordinator:** Yannis Manios; **Steering committee:** Yannis Manios, Berthold Koletzko, Ilse De Bourdeaudhuij, Mai Chin A Paw, Luis Moreno, Carolyn Summerbell, Tim Lobstein, Lieven Annemans, Goof Buijs; **External advisors:** John Reilly, Boyd Swinburn, Dianne Ward; **Harokopio University (Greece):** Yannis Manios, Odysseas Androutsos, Eva Grammatikaki, Christina Katsarou, Eftychia Apostolidou, Eirini Efstathopoulou; **Ludwig Maximilians Universitaet Muenchen (Germany):** Berthold Koletzko, Kristin Duvinage, Sabine Ibrügger, Angelika Strauß, Birgit Herbert, Julia Birnbaum, Annette Payr, Christine Geyer; **Ghent University (Belgium):** *Department of Movement and Sports Sciences:* Ilse De Bourdeaudhuij, Greet Cardon, Marieke De Craemer, Ellen De Decker; *Department of Public Health:* Lieven Annemans, Stefaan De Henauw, Lea Maes, Carine Vereecken, Jo Van Assche, Lore Pil; **VU University Medical Center EMGO Institute for Health and Care Research (the Netherlands):** EMGO Institute for Health and Care Research: Mai Chin A Paw, Saskia te Velde; **University of Zaragoza (Spain):** Luis Moreno, Theodora Mouratidou, Juan Fernandez, Maribel Mesana, Pilar De Miguel-Etayo, Esther M. González-Gil, Luis Gracia-Marco, Beatriz Oves; **Oslo and Akershus University College of Applied Sciences (Norway):** Agneta Yngve, Susanna Kugelberg, Christel Lynch, Annhild Mosdøl, Bente B Nilsen; **University of Durham (UK):** Carolyn Summerbell, Helen Moore, Wayne Douthwaite, Catherine Nixon; **State Institute of Early Childhood Research (Germany):** Susanne Kreichauf, Andreas Wildgruber; **Children's Memorial Health Institute (Poland):** Piotr Socha, Zbigniew Kulaga, Kamila Zych, Magdalena Gózdz, Beata Gurzkowska, Katarzyna Szott; **Medical University of Varna (Bulgaria):** Violeta Iotova, Mina Lateva, Natalya Usheva, Sonya Galcheva, Vanya Marinova, Zhaneta Radkova, Nevyana Feschieva; **International Association for the Study of Obesity (UK):** Tim Lobstein, Andrea Alkenhead; **CBO B.V. Prevention (the Netherlands):** Goof Buijs, Annemiek Dorgelo, Aviva Nethe, Jan Jansen; **AOK-Verlag (Germany):** Otto Gmelner, Jutta Retterath, Julia Wildels, Axel Günthersberger; **Roehampton University (UK):** Leigh Gibson; **University of Luxembourg (Luxembourg):** Claus Voegele.

Introduction

Previously established school-based behavioural interventions targeting health promotion and obesity prevention used teachers' training as one element of multifactorial intervention strategies (1–4). However, only few of them evaluated and reported the effects of teachers' training separately from the overall intervention outcomes. One study with more than 1,200 kindergarten children investigated the effect of teachers' education on the prevalence of overweight and obesity in Thailand (5). The prevalence of overweight decreased significantly over a period of 3 years in the schools that received teachers' education (5). A study in Australian primary schools reported that adoption of a fruit and vegetable break was 2.2 times higher for children in schools that had teachers trained in programme implementation compared with those that tried to implement vegetable and fruit breaks without teachers' training (6). Another intervention with kindergarten and first-grade teachers showed that teachers' training positively changed classroom food practices and food-related beliefs (7). Regarding physical activity, a German study compared one group of kindergartens that received activity-enhancing material with one group that received teachers' training and one group that received both, training and material, as well as one control group (8). The greatest effects on motor abilities in children were found for the combination of training and material followed by the group that only received teachers' training, whereas providing activity-enhancing materials without dedicated teachers' training showed little effect (8).

The review and meta-analysis by Waters *et al.* (9) indicates that support for teachers to implement health promotion strategies is a promising strategy to maximize intervention effectiveness. Similarly, the review on educational strategies promoting physical activity in pre-schools prepared within the ToyBox-study concluded that teachers' training may be a key element for successful interventions (10).

Given the importance of teachers' training for the implementation of school-based interventions, it is necessary to explore how the training should be designed. Mechanisms that can be integrated into the training process in order to enhance devotion to and quality and sustainability of obesity prevention programmes that are implemented by teachers should be considered (11), while general principles for the education of teachers should be incorporated as well. Hence, it is important to develop the teachers' training systematically and to put attention both to the content and to the didactic methods of the trainings.

The ToyBox-intervention (http://www.toybox-study.eu) aims to promote healthy food, fun and active play for children aged 4–6 across six European countries, namely, Belgium, Bulgaria, Germany, Greece, Poland and Spain (12,13). As this intervention is conducted in kindergartens, there are three main target groups: children, their parents/caregivers and their teachers. Considering that the ToyBox-intervention reaches children and parents/caregivers mainly through the implementation of the intervention by kindergarten teachers, the key persons for the implementation of the intervention are the teachers. Hence, an important goal of the ToyBox-intervention is to inform the teachers about the importance of establishing energy balance-related behaviours and to motivate them to implement the ToyBox-intervention in their kindergartens following a specific time plan and using the materials provided. Three teachers' training sessions were developed and implemented as part of the ToyBox-intervention (14). In this paper we illustrate the systematic development and describe the concepts and strategies followed in the design of the three teachers' training sessions conducted as part of the ToyBox-intervention.

Methods

Material from the evaluated TigerKids programme (4) and experience gathered from its practical implementation (www.tigerkids.de) was used for the development of the ToyBox-intervention. Additional concepts and ideas were adopted from other previous intervention programmes of the current consortium such as the ENERGY project (47,48), the POP study (49,50) and the Cretan Health and Nutrition Intervention (51–53). For the design of the ToyBox teachers' training sessions, the content and didactic methods of the training modules were embedded into an overall training concept (Fig. 1). This concept is developed based on the defined aims of teachers' trainings. The aims of the teachers' trainings in the ToyBox-intervention deduced from concepts for the education of kindergarten teachers, from general strategies for successful programme implementation described in the literature and from the ToyBox-intervention-specific requirements (Fig. 1). The ToyBox-specific requirements refer to preceding work in the ToyBox-study that included systematic and narrative reviews of the literature, comprised focus groups, addressed behavioural models and educational strategies, and investigated policy and regulations in different countries. ToyBox-specific requirements, which had to be taken into account, include the overall aims of ToyBox (i.e. [i] increase physical activity; [ii] decrease sedentary behaviour; [iii] increase the intake of water; [iv] promote the consumption of healthy snacks) and the detailed aims that have been deduced using the intervention mapping protocol (12).

Concepts for the education of kindergarten teachers

The training of educational staff requires the consideration of two educational levels: the direct learning of the kinder-

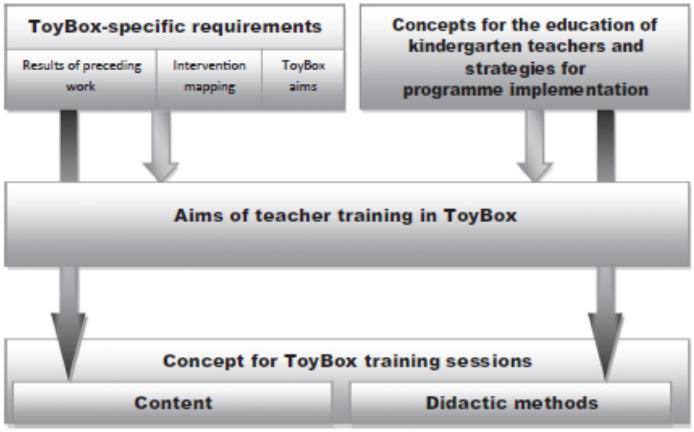

Figure 1 Development of training sessions for teachers in the ToyBox-intervention.

garten teachers and the indirect learning of the children. This applies not only to the content but also to the didactic methods. The main idea of contemporary didactic concepts for the learning of kindergarten teachers is that kindergarten teachers should experience in training the same didactic principles as the children experience in their learning processes (15). Contemporary pre-school pedagogies consider that children are active, competent and able to educate themselves from early life stages onwards (16); therefore, kindergarten teachers should also be supported in these self-education processes (15). Principles of problem and action-based learning such as solving complex problems in authentic contexts, self-monitoring, reflective thinking and taking responsibility within the learning process (17,18) are important when planning educational processes for kindergarten teachers. According to these principles, it is crucial for the kindergarten teachers to be actively engaged in learning within the educational process instead of merely consuming the education, being proactive rather than reactive, being involved rather than passive and providing sensual–emotional learning in addition to rational–analytic learning (19,20). Learning as an individual active process always refers to the personality and the professional and private background of the person who is learning (21). Thus, the individual background of learners, here kindergarten teachers, regarding the learning subject and personal resources as well as individual barriers have to be considered in the learning processes. Diverse persons, questions and behaviours should not be excluded, but habits, experiences, values and norms should be picked up with reference to learning subjects (21). The atmosphere should be positive and encouraging, and all involved should feel welcomed because learning occurs in social contexts (22).

From a constructivist perspective learners are actively engaged in developing the meaning of a learning subject (23). Trainers who teach kindergarten teachers should always look for what teachers can analyse, investigate, collaborate, share and build based on what the teachers already know (23). Therefore, trainers need to be moderators, learners and researchers in order to adjust their actions to the environment and to the participants in every teaching situation (20,23).

When designing the ToyBox teachers' training sessions, we considered the knowledge and experiences of kindergarten teachers regarding the content and aims of ToyBox-intervention. On the other hand, the training sessions were sufficiently flexible to be adapted to the individual knowledge and experiences of the teachers and the trainers present in every single training session. The atmosphere of the teachers' trainings was open minded for diverse personalities and biographies. Besides presenting information, a lot of room for active engagement, self-monitoring, self-experiences and reflective thinking was provided.

Strategies for successful programme implementation

Multiple factors support or inhibit teachers' efforts regarding programme implementation. These factors include school system-specific factors, school-specific factors, teacher-specific factors and programme-specific factors (11). School system-specific factors mainly depend on the policies of the administration that concern school curricula, evaluation and promotion strategies. At this level, it is important to try to integrate an intervention programme into the existing school improvement efforts and to build consensus and support among key stakeholders (24). In the ToyBox-intervention, the researchers in the six participating countries informed the relevant stakeholders of their

country and asked for their support. Within the training sessions, existing support of key stakeholders was communicated to the teachers.

School-specific factors depend on the school context that defines the conditions encouraging efforts by teachers regarding implementation of the intervention, such as the level of support from the school principal or the provision of enough space and time for the implementation of the intervention (11). During the recruitment of the kindergartens for the ToyBox-intervention, the local researchers informed the school principals on the ToyBox-intervention (13). Only schools whose principals had an active interest to support the ToyBox-intervention accepted to participate. Regarding environmental factors for programme implementation, it was made clear to the kindergarten teachers that the ToyBox-intervention was designed to be easily implemented in every kindergarten and no special equipment or special spaces/infrastructures would be needed.

The compatibility of an intervention with teachers' own beliefs and their familiarity with the intervention's principles are some of the teacher-specific factors (11). Therefore, information about teachers' pre-implementation attributions (11) regarding the objectives of the ToyBox-intervention and the compatibility with their beliefs, teaching style and previous knowledge and experiences were considered when planning ToyBox teachers' training sessions. Teachers' self-efficacy beliefs are another factor that may influence teachers' motivation to implement an intervention. A study on health education workshops showed effects of well-designed workshops on teachers' self-efficacy beliefs (25). Participating teachers scored significantly higher than control teachers on efficacy expectations and outcome expectations and they reported spending significantly more hours per week teaching health education (25). Therefore, methods that increase teachers' self-efficacy beliefs were included in the ToyBox teachers' training sessions. In addition, there was a relation between the anticipated effectiveness of an intervention and the acceptability (26). Hence, providing programme effectiveness information may increase teachers' intention to implement the intervention (11).

One programme-specific factor that enhances intervention implementation is the fitting of the programme with the individual setting. In the ToyBox teachers' training sessions researchers communicated to the teachers that the ToyBox-intervention was designed for kindergarten settings in different European countries. All the aforementioned school-specific factors, teacher-specific factors and programme-specific factors were drawn upon when designing the ToyBox teachers' training sessions because one of the most important programme-specific factors to facilitate programme implementation is the quality and amount of teacher training (11).

Regarding sustainability of the implementation of an intervention programme, it is necessary that teachers are able to continue programme implementation without external support (11). In this context, an intervention needs to be flexible and teachers need to be motivated and skilled to modify the intervention to meet changing requirements and to experience further success in changing children's behaviours (11). Hence, the ToyBox teachers' trainings aimed to help teachers discover their skills and show them how to adapt the programme according to the intervention principles. This was performed to ensure that the implementation of the intervention continued after the supported implementation phase.

ToyBox programme-specific requirements

The development of the ToyBox programme used a combination of the PRECEDE-PROCEED model and the intervention mapping protocol to systematically build a kindergarten-based, family-involved intervention (12). The recommendations from the PRECEDE phase and from the intervention mapping matrices that provided information about strategies to teach and motivate kindergarten teachers to implement the ToyBox-intervention are presented below.

To learn more about parents'/caregivers' and teachers' opinions on kindergarten children's physical activity, dietary and sedentary behaviours, focus groups were carried out in six different European countries (Belgium, Bulgaria, Germany, Greece, Spain and Poland). Regarding the development of the ToyBox training sessions, kindergarten teachers' knowledge, perceptions and views regarding energy balance-related behaviours are of special interest because the training sessions are based on these existing experiences. The focus groups indicated that the majority of the teachers perceived kindergarten children as sufficiently active (27), although quantitative studies based on objectively measured data indicate that young children are physically inactive during most of their time in the kindergarten (28–31). Furthermore, most kindergarten teachers had the opinion that physical activity is healthy and beneficial for children in general (27) and they are aware of the physical and socioemotional benefits of physical activity (32). However, kindergarten teachers also mentioned some barriers for increasing physical activity such as their own personal attitude and preferences to avoid the playground situation (weather, dirt, chaos) (32). Barriers that have been mentioned in the focus group study also referred to the weather but also to missing facilities, lack of space, staff shortage and the issue of safety on the playground (27). In addition, observations in kindergartens indicate that many teachers are relatively passive with respect to encouragement and participation in children's

physical activities (33). Regarding the ToyBox teachers' training, it was aimed that teachers become aware of the fact that children spend much of their time in the kindergarten in sedentary activities; therefore, teachers were given strategies to overcome barriers and were qualified to increase physical activity during kindergarten time (34). The training sessions aimed to help teachers for example to reconsider their views of free-play as risky, which may lead to increases in physical activity and a decrease in sedentary time as shown by Engelen *et al.* (35).

The information collected during the preceding phases of ToyBox indicated that especially children's drinking habits in kindergartens differed a lot between the participating countries (unpublished data). In some countries children were provided with beverages only during the meals while in other countries children had free access to beverages all day long, some countries offered tea, some sugar-sweetened drinks or water. When planning the ToyBox training sessions, the policies, regulations and practices of the particular countries were considered.

Regarding nutrition, focus groups indicated a discrepancy between the nutrition and drinking situation at kindergarten and the perceived needs to change these behaviours, as well as a discrepancy between knowledge and habits (36). Most of the kindergarten teachers know that drinking water is healthy and that drinking water regularly is important for children (36). Another study also showed that kindergarten students' knowledge of the dietary guidelines was quite good but their own nutrition practices were inconsistent with their knowledge (37). Results from the focus groups indicated that teachers know that they are one of the main role models for children's drinking behaviour (36). Hence, one goal of the ToyBox training sessions was to help kindergarten teachers to become good role models. Therefore, it is crucial to include health promotion strategies for the teachers as well. Evidence-based recommendations for the development of obesity prevention programmes that have been deduced from previous ToyBox reviews also indicate that using teachers and parents as role models is a key element of successful approaches (38). The teachers' trainings also addressed the topic of working together with parents/caregivers because reviews and meta-analyses suggest that the interventions with the largest effect in this age range included a parental involvement component (38–41). Therefore, the ToyBox training sessions involved information about communication strategies between teachers and parents/caregivers (42) and included strategies about how parents/caregivers could be involved in programme implementation such as organizing parent–child events or active parents/caregivers evenings.

Another feature of successful approaches identified by reviews and meta-analyses is to keep the messages of obesity prevention interventions short and simple (38,39). This is consistent with findings from the ToyBox focus groups that teachers wish to receive ready-to-use material and do not need a lot of theoretical background because they believe they already know relevant theories (36). Regarding the training sessions this means that simple messages about the four targeted energy balance-related behaviours (i.e. physical activity, sedentary, drinking and snacking behaviours) were repeated, and ready-to-use material was presented from a practical point of view.

Guided by the information collected during the PRECEDE phase, the different steps from the intervention mapping protocol have been performed (12). Based on the intervention mapping matrices, practical methods and strategies for the ToyBox-intervention have been developed. Especially for the development of the teachers' trainings, the objectives with respect to teachers were relevant. Strategies to change objectives that are differentiated by determining factors, e.g. self-efficacy, knowledge, attitudes, habits or social influences of kindergarten teachers, have been described in detail (43). Some of the strategies refer to the handbooks for teachers that have been developed (44), and others refer to the practical training sessions. Methods to change attitudes are, for example, shifting perspectives, environmental re-evaluation and self-experience, and methods to change habits are showing good practice, role play or self-monitoring of behaviour (45,46).

Results

The aims of the teachers' trainings in ToyBox

Based on general concepts for the education of kindergarten teachers, on strategies for successful programme implementation, on information collected during the PRECEDE phase of the ToyBox-intervention and on objectives specified in the intervention mapping matrices, the aims of the teachers' trainings have been defined. The overall aim was to enable and motivate teachers to implement the ToyBox-intervention focusing on the following detailed objectives:

Knowledge

The teachers were provided with background information, information on the programme and about their tasks in programme implementation. Hence, the aims of the ToyBox teachers' training sessions were that teachers:

- Become aware of the importance of healthy diet/drinking/snacking and appropriate levels of physical activity and sedentary behaviour.
- Understand the aims, concept and design of the ToyBox-intervention.

• Understand that their active participation and enthusiasm is important for the successful implementation of the ToyBox-intervention.
• Were informed that their role in the intervention will focus on experiential learning and role modelling.
• Understand the structure and how to use the ToyBox material.

Self-efficacy and skill development

Self-efficacy is connected with the development of skills. When teachers have sufficient skills to implement the programme and to change children's behaviours, they experience self-efficacy in this area that will in turn motivate them to continue programme implementation. For these reasons, the aims of the ToyBox teachers' training sessions were that teachers:

• Are enabled to set environmental changes.
• Are enabled to model the children's drinking, snacking, physical activity and sedentary behaviour.
• Are enabled to implement classroom activities using the ToyBox material.
• Are enabled to adapt the programme to meet changing circumstances without sacrificing the programme principles.
• Enhance their self-efficacy.

Attitude

Enthusiasm from the teachers for what is being taught is important in role modelling to children the desired behaviours. Information about how easily and how flexible they could implement the intervention, information about programme effectiveness and providing opportunities for self-experience may help to motivate teachers to do their best to implement the programme. Teachers should also be aware of their own attitudes and behaviours and should be given the chance to re-evaluate some of their opinions. For these reasons, the aims of the ToyBox teachers' training sessions were that teachers:

• Reflect about their attitudes towards drinking, snacking, physical activity and sedentary behaviour.
• Reflect about being a role model.
• Are motivated and enthusiastic about the ToyBox-intervention.

Habits

Teachers are assisted to change habits in their kindergartens and they become familiar with the implementation material. In addition, teachers reflect their own habits and are helped to become good role models. For these reasons, the aims of the ToyBox teachers' training sessions were that teachers:

• Reflect about the habits regarding drinking, snacking, physical activity and sedentary behaviour in kindergarten children in general and in their kindergartens.
• Reflect about their own habits regarding drinking, snacking, physical activity and sedentary behaviour.
• Set goals to implement and sustain changes.
• Become familiar with the ToyBox material.

Social influence and parental involvement

Social influence refers to the influence of trainers, colleagues, principals and stakeholders. It is important to share support and enthusiasm about the programme. As parents are mainly approached with the help of the teachers in the ToyBox-intervention (i.e. handing out newsletters, tip cards and posters, giving information on the programme, etc.), it is important to provide kindergarten teachers with communication strategies and to help them to develop parent-involving activities. For these reasons, the aims of the ToyBox teachers' training sessions were that teachers:

• Exchange experiences with each other.
• Share experiences of experiential learning and role modelling.
• Assist and motivate other teachers.
• Develop strategies on how to involve the parents/caregivers.

Conclusion

The extensive experience from the development and application of a preceding preschool intervention, the TigerKids programme (4), was of key importance in the successful building of the ToyBox-intervention. In addition, experience gained from other previous interventions implemented from the current consortium such as the ENERGY project (47,48), the POP study (49,50) and the Cretan Health and Nutrition Intervention (51–53) were proved very useful. This paper presented the systematic process followed for the design of the three teachers' training sessions that were conducted in the ToyBox-intervention.

The training modules that were developed were built based on the actual knowledge and experiences of the kindergarten teachers and were flexible to be adapted to individual conditions and to the country-specific regulations. These trainings aimed to increase teachers' awareness of healthy diet/drinking/snacking and physical activity/sedentary behaviour. Furthermore, these training sessions included instructions for the teachers to increase the consumption of healthy snacks/drinks, doing physical activity and reducing/interrupting sedentary time together with the children. The ready-to-use intervention materials were presented from a practical point of view, and simple key messages about the key aims were repeatedly communicated. As teachers' self-efficacy beliefs with regard to implementing the intervention were important for their initial and further intrinsic motivation for implementation of the intervention,

self-efficacy enhancing components were integrated into the ToyBox teachers' training sessions. In this context, positive feedback from colleagues was provided and experiences during programme implementation were shared between teachers during the training sessions. Teachers' trainings in ToyBox also aimed to help teachers to become good role models as observational learning is essential in children of this age group. Therefore, it is crucial to include health promotion strategies for the teachers as well and to stress the importance of parental involvement within the framework of the teachers' training sessions.

The ToyBox teachers' training sessions were proactive and the chosen methods facilitated active participation and personal involvement. Hence, principles of problem and action-based learning and methods such as self-experience, self-monitoring and reflective thinking were integrated into the training modules. Learning was designed as a co-constructive process with trainers having a moderating function and kindergarten teachers taking responsibility within the training process. Active participation and autonomous thinking were also applied, in order to achieve sustainability of programme implementation. A friendly and open-minded atmosphere at the teachers' training sessions was created to enhance motivation and enthusiasm of teachers about the ToyBox-intervention. Thereby, the ToyBox teachers' trainings may have become an essential tool for implementing this health promotion intervention.

Conflict of interest statement

None of the authors declares a conflict of interest.

Acknowledgements

The ToyBox-study is funded by the Seventh Framework Programme (CORDIS FP7) of the European Commission under grant agreement number 245200. The content of this article reflects only the authors' views, and the European Community is not liable for any use that may be made of the information contained therein.

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8 VERÖFFENTLICHUNG III

obesity reviews doi: 10.1111/obr.12182

Obesity Prevention

Designing and implementing teachers' training sessions in a kindergarten-based, family-involved intervention to prevent obesity in early childhood. The ToyBox-study

O. Androutsos[1], C. Katsarou[1], A. Payr[2], J. Birnbaum[2], C. Geyer[2], A. Wildgruber[3], S. Kreichauf[3], M. Lateva[4], E. De Decker[5], M. De Craemer[5], P. Socha[6], L. Moreno[7,8], V. Iotova[4], B. V. Koletzko[2] and Y. Manios[1] on behalf of the ToyBox-study group

[1]Department of Nutrition and Dietetics, Harokopio University, Athens, Greece; [2]Dr. von Hauner Children's Hospital, University of Munich Medical Centre, Munich, Germany; [3]State Institute of Early Childhood Research, Munich, Germany; [4]Department of Pediatrics, Medical University Varna, Varna, Bulgaria; [5]Department of Movement and Sports Sciences, Ghent University, Ghent, Belgium; [6]The Children's Memorial Health Institute, Warsaw, Poland; [7]GENUD (Growth, Exercise, Nutrition and Development) Research Group, University of Zaragoza, Zaragoza, Spain; [8]School of Health Science (EUCS), University of Zaragoza, Zaragoza, Spain

Received 3 April 2014; revised 8 April 2014; accepted 8 April 2014

Address for correspondence: Y Manios, Department of Nutrition and Dietetics, Harokopio University, 70 El Venizelou Ave, 176 71 Kallithea, Athens, Greece.
E-mail: manios@hua.gr

Summary

Since school-based interventions are mainly delivered by the school staff, they need to be well-trained and familiarized with the programme's aims, procedures and tools. Therefore, the institute, research group, governmental or non-governmental body in charge of the coordination and implementation of the programme needs to devote time and resources to train the school staff before programme's implementation. This is particularly crucial in multi-centre studies where more than one research teams are involved. Both research teams and school staff need to be trained, using standard protocols and procedures, to ensure that the intervention will be delivered in a standardized manner throughout the intervention centres. The ToyBox-intervention, a multi-component, kindergarten-based, family-involved intervention, focusing on water consumption, snacking, physical activity and sedentary behaviours in preschool children, was implemented over the academic year 2012–2013 in six European countries. As part of this intervention, three teachers' training sessions were delivered to motivate and train teachers in implementing the intervention. The local researchers were trained centrally before delivering the training sessions for the teachers and followed a common protocol using standardized presentations and procedures. The aim of the current paper is to describe the protocol and methodological issues related to the teachers' training sessions conducted within the ToyBox-intervention.

Keywords: Kindergarten, obesity prevention, preschool children, teacher training.

obesity reviews (2014) **15** (Suppl. 3), 48–52

ToyBox-study group: **Coordinator:** Yannis Manios; **Steering Committee:** Yannis Manios, Berthold Koletzko, Ilse De Bourdeaudhuij, Mai Chin A Paw, Luis Moreno, Carolyn Summerbell, Tim Lobstein, Lieven Annemans and Goof Buijs; **External advisors:** John Reilly, Boyd Swinburn and Dianne Ward; **Harokopio University (Greece):** Yannis Manios, Odysseas Androutsos, Eva Grammatikaki, Christina Katsarou, Effychia Apostolidou and Eirini Efstathopoulou; **Ludwig Maximilians Universitaet Muenchen (Germany):** Berthold Koletzko, Kristin Duvinage, Sabine Ibrügger, Angelika Strauß, Birgit Herbert, Julia Birnbaum, Annette Payr and Christine Geyer; **Ghent University (Belgium):** *Department of Movement and Sports Sciences:* Ilse De Bourdeaudhuij, Greet Cardon, Marieke De Craemer and Ellen De Decker; *Department of Public Health:* Lieven Annemans, Stefaan De Henauw, Lea Maes, Carine Vereecken, Jo Van Assche and Lore Pil; **VU University Medical Center EMGO Institute for Health and Care Research (the Netherlands):** EMGO Institute for Health and Care Research: Mai Chin A Paw and Saskia te Velde; **University of Zaragoza (Spain):** Luis Moreno, Theodora Mouratidou, Juan Fernandez, Maribel Mesana, Pilar De Miguel-Etayo, Esther M. González-Gil, Luis Gracia-Marco and Beatriz Oves; **Oslo and Akershus University College of Applied Sciences (Norway):** Agneta Yngve, Susanna Kugelberg, Christel Lynch, Annhild Mosdøl, Bente B Nilsen; **University of Durham (UK):** Carolyn Summerbell, Helen Moore, Wayne Douthwaite and Catherine Nixon; **State Institute of Early Childhood Research (Germany):** Susanne Kreichauf and Andreas Wildgruber; **Children's Memorial Health Institute (Poland):** Piotr Socha, Zbigniew Kulaga, Kamila Zych, Magdalena Góźdź, Beata Gurzkowska and Katarzyna Szott; **Medical University of Varna (Bulgaria):** Violeta Iotova, Mina Lateva, Natalya Usheva, Sonya Galcheva, Vanya Marinova, Zhaneta Radkova and Nevyana Feschieva; **International Association for the Study of Obesity (UK):** Tim Lobstein and Andrea Alkenhead; **CBO B.V. (the Netherlands):** Goof Buijs, Annemiek Dorgelo, Aviva Nethe and Jan Jansen; **AOK-Verlag (Germany):** Otto Gmelner, Jutta Retterath, Julia Wildels and Axel Günthersberger; **Roehampton University (UK):** Leigh Gibson; **University of Luxembourg (Luxembourg):** Claus Voegele.

Introduction

The rates of obesity have been found to be remarkably high among preschool children (1,2). Among the many attempts worldwide to tackle childhood obesity, most have been ineffective. One of the key elements that may increase their effectiveness is the quality of training provided to teachers who will be implementing the intervention and how well it is implemented.

Previous studies indicated that it is necessary to train the teachers who will deliver an intervention in the school setting. More specifically, a recent review focusing on interventions aiming to prevent childhood obesity showed that many effective interventions included teachers' trainings in their design (3). In line with this study, a recent review conducted within the ToyBox-study suggested that teachers' training may be an essential component of kindergarten-based obesity prevention programmes (4).

In this context, recent intervention programmes, focusing on childhood obesity and/or energy balance-related behaviours (EBRBs), have integrated teachers' training as an important component of their design. More specifically, in the UP4FUN intervention, which was conducted as part of the ENERGY project, and aimed to reduce and break up sedentary time in European 10–12-year-old children, a 1-h teacher training session was conducted prior to the implementation of the intervention (5). Similarly, in the Ballabeina study, a multi-component lifestyle intervention focusing on physical activity, sleep duration, nutrition and media use in preschool children in Switzerland, two teachers' training sessions were conducted prior to the intervention (6).

The ToyBox-intervention (http://www.toybox-study.eu) is a multi-component, kindergarten-based, family-involved intervention, aiming to prevent obesity and ensure preschool children's optimum growth and development. It was implemented in six European countries, namely Belgium, Bulgaria, Germany, Greece, Poland and Spain (7). Children, their families and their teachers were recruited mainly at kindergartens, but also at day-care centres or preschool settings, depending on the country regulations and legislation. Precisely, in Germany, Bulgaria, Spain and Poland, children/families were recruited from kindergartens, in Greece from kindergartens and day-care centres and in Belgium from preschool settings. In order to avoid confusion for the reader, all these settings (kindergartens, day-care centres, preschool settings) will be referred to as 'kindergartens' in this paper. As part of the ToyBox-intervention, teachers' training sessions were conducted in each country, to train the participating teachers on how to implement the intervention. The implementation of the training sessions was driven by a standardized protocol and procedures, across the six intervention countries.

The aim of the current paper is to describe the design of the teachers' training sessions, conducted within the ToyBox-intervention and to provide an overview of the protocol, content and procedures followed across the six intervention countries.

Methods

According to the findings of the PRECEDE phase of the ToyBox-study, teachers' training sessions have been identified as a component that could potentially increase the effectiveness of interventions aiming to improve preschool children's EBRBs (4,8). Furthermore, the findings of the focus groups with kindergarten teachers conducted in the six ToyBox-intervention countries indicated that teachers' training would improve their self-efficacy, help them to overcome any potential barriers and keep them motivated to deliver the ToyBox-intervention as planned (ToyBox-report; unpublished data) (Fig. 1). Based on these findings, teachers' training sessions were incorporated as an integral part of the ToyBox-intervention (9).

Aims and structure

The overall aims, pedagogical approach and strategies of the ToyBox teachers' trainings have been presented elsewhere (10). In brief, the teachers' trainings were conducted to inform, enable and motivate kindergarten teachers from

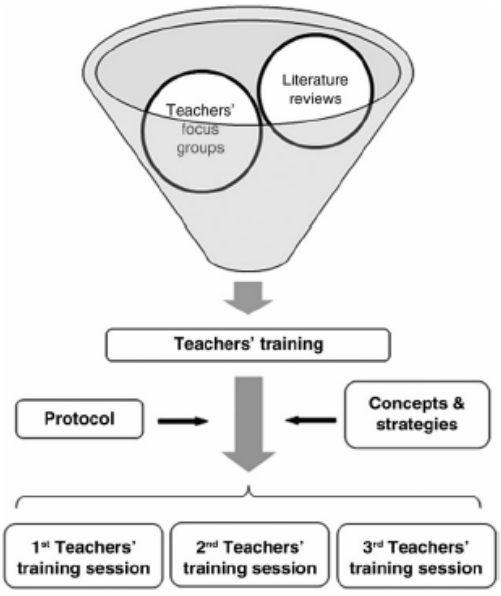

Figure 1 Conceptualization of the teachers' training sessions.

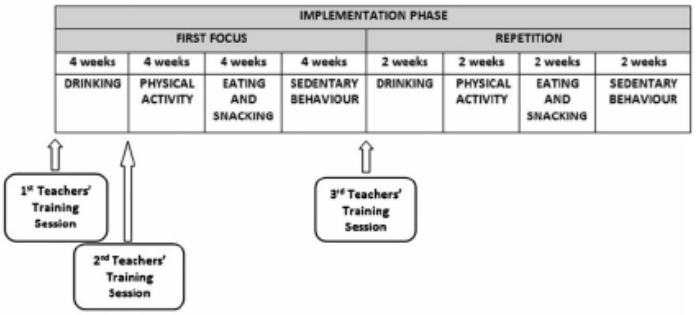

Figure 2 Time plan of the ToyBox-intervention and the teachers' training session implementation.

the intervention group to implement the ToyBox-intervention. The structure and timeplan of the teachers' trainings were designed in such way that it was in line with the timeplan of the ToyBox-intervention implementation. The teachers' trainings were conducted in three separate training sessions (Fig. 2). The first training session was planned to be delivered after the randomization of kindergartens to intervention and control groups and prior to the start of the intervention. The second training session was planned to be conducted immediately after the completion of the first four weeks of the intervention implementation, and the third training session before the start of the repetition phase.

Teachers' training protocol

All procedures regarding the organization and implementation of the teachers' training sessions were guided by a standardized protocol which was followed in the six intervention countries. All training sessions were organized and implemented locally by the ToyBox researchers who were trained centrally during the ToyBox consortium meeting that took place in Woerden, the Netherlands, in March 2012. The presentations and material used in the teachers' trainings were prepared jointly by the University of Munich, the University of Ghent and the Harokopio University of Athens. Standardized presentations were initially developed in English and then translated in the six local languages, allowing only for minor adaptations (i.e. presenting photos of ToyBox-intervention-related activities, taken from local kindergartens).

All teachers from the kindergartens assigned to the intervention group were invited via phone calls or personal meetings to participate in the three training sessions. The teachers' training sessions were conducted either in the local universities, in the kindergartens or in other settings, depending on what was most convenient in each country so as to maximize teachers' attendance. The trainings were conducted either on weekdays or weekends, in the morning or in the afternoon/evening. Additionally, each training session was repeated more than once in order to provide teachers with alternative options and increase their participation rate, whereas it was up to the local teams to provide incentives to the teachers (e.g. certificates of attendance). The participation of all intervention teachers was aimed; however, in cases where this was not possible and to ensure representation of all intervention classes, it was aimed that at least one teacher per class would attend each training session. In cases where none of the teachers of one class was able to attend a session, they were invited again in one of the following days when the session that they missed was repeated. Overall, the creation of a friendly and comfortable environment was intended in all teachers' training sessions, aiming to build team spirit, increase interactivity and exchange of ideas and thoughts among the participants, in order to boost teachers' enthusiasm, motivation and self-efficacy.

The first and the second training session had a duration of 2 h for the researchers' presentations, while additional time was allocated for questions and discussion with the teachers. The third training session had a duration of 75 min, followed by extra time for teachers' questions and discussion among the participants. The total time devoted to questions and discussion in all training sessions was determined by the number of teachers attending the session, ensuring that enough time will be given to all teachers to ask their questions and actively participate. It was aimed that researchers provide sufficient feedback to the teachers and contribute to the team-spirit development and brainstorming discussion with the group on how to achieve the optimum delivery of the programme, in order to increase teachers' self-efficacy, motivation and fidelity of the intervention implementation.

Results

The implementation of the teachers' training sessions across the six European countries was coordinated centrally by the Harokopio University of Athens. According to the study protocol (Fig. 2), the first training session was

conducted in September 2012 or earlier (i.e. before the start of the intervention). Hardcopies of a part of the ToyBox-intervention material (i.e. the 'Teachers' General Guide' describing the general principles and timeplan of the ToyBox-intervention and the 'Classroom Activities Guide' focusing on water consumption) were handed out to the teachers, during this session. Moreover, this session included presentations, which aimed to provide a general overview of the ToyBox-study to the teachers, explain the basic principles and timeplan of the ToyBox-intervention, discuss how the environmental changes for the four targeted EBRBs could be applied in the kindergarten setting and present the module of the 'Water consumption' so that teachers are familiarized with this component of the intervention (Table 1). The ToyBox researchers delivered these four presentations according to a predefined timeplan, so as to result in a total duration of 2 h.

The second session was conducted during September–October 2012 (i.e. immediately after the completion of the first four weeks of intervention implementation). This session included presentations aiming to provide a brief repetition of the intervention timeplan and the 'Water consumption' module and to present the modules of the 'Physical Activity behaviour', 'Snacking behaviour' and 'Sedentary behaviour' so that teachers are familiarized with these components of the intervention. The ToyBox researchers delivered these four presentations according to a predefined timeplan, so as to result in a total duration of 2 h.

The third session was conducted at the beginning of February 2013 (i.e. before the start of the repetition phase of the ToyBox-intervention). This session included presentations given by the researchers, aiming to provide a repetition of the basic principles of the ToyBox-intervention and to describe the timeplan for the remaining weeks of the intervention. Moreover, teachers were given the opportunity to present their progress and share their experiences regarding the implementation of the four targeted EBRBs to their colleagues. More specifically, four teachers from different kindergartens presented one behaviour each, so that all four behaviours were presented in every training.

Discussion

Three teachers' training sessions were conducted as part of the ToyBox-intervention. These sessions aimed to motivate and train teachers on how to implement the ToyBox-intervention. The implementation of the ToyBox teachers' training sessions was driven by a common protocol using standardized presentations/modules and procedures across the six intervention countries. All teachers from the kindergartens allocated in the intervention group were invited to participate.

Teachers' training sessions may comprise an important element to enhance the effectiveness of health promotion programmes (11–13). Hence, previous interventions addressing childhood obesity have integrated teachers'

Table 1 Content and duration of ToyBox teachers' training sessions

Training session	Content	Duration (min)
1st session	Introduction to the ToyBox-study	15
	Module 'Teacher's General Guide' (i.e. basic principles and timeplan of the ToyBox-intervention implementation)	45
	Module 'Environmental changes' (i.e. changes to be applied in the kindergarten setting)	30
	Module 'Water consumption'	30
	Discussion (throughout the whole session)	5–10 per teacher (indicative time per teacher throughout the whole session)
2nd session	Sharing experiences among the teachers' group (discussion)	15
	Repetition of the key messages from the 1st session	15
	Module 'Physical activity behaviour'	30
	Module 'Snacking behaviour'	30
	Module 'Sedentary behaviour'	30
	Discussion (throughout the whole session)	5–10 per teacher (indicative time per teacher throughout the whole session)
3rd training	Brief introduction and repetition of the timeplan of the ToyBox-intervention for the remaining months	15
	Teachers' presentation on 'Water consumption'	15
	Teachers' presentation on 'Physical activity behaviour'	15
	Teachers' presentation on 'Snacking behaviour'	15
	Teachers' presentation on 'Sedentary behaviour'	15
	Discussion (throughout the whole session)	5–10 per teacher (indicative time per teacher throughout the whole session)

training sessions in their design. For example, the UP4FUN intervention, a 6-week intervention aiming to reduce and break up sedentary time in 10- to 12-year-old children, included a 1-h training session for teachers participating in the intervention (5). Similarly, the Ballabeina study, a multicomponent lifestyle intervention focusing on preschool children implemented between August 2008 and June 2009, included two teachers' training sessions (6). Based on the findings of the PRECEDE phase of the ToyBox-study (narrative review and focus group research), three teachers' training sessions were conducted within the period of implementation of the ToyBox-intervention. The first and second sessions were focused on teachers' training regarding the content, timeplan and implementation of the ToyBox-intervention, whereas the third session aimed to reinforce teachers' motivation and fidelity of intervention implementation.

The actual delivery and the cost of the teachers' training sessions were recorded in the six intervention countries (14,15). More specifically, immediately after the completion of each training, the teachers reported the level of their satisfaction with the training. Similarly, the researchers who delivered the training sessions documented teachers' attendance and recorded any deviations from the teachers' training protocol (fidelity of implementation) (14). The information from the process evaluation and the cost-assessment will be used to assess the effectiveness and cost-effectiveness of the ToyBox-intervention and is expected to provide valuable insights for future interventions.

The use of a standardized protocol, presentation/modules, concepts, strategies and procedures for the design and implementation of the ToyBox teachers' training sessions should be considered as strengths of the current study. Moreover, the implementation of three training sessions which were conducted in different time points throughout the intervention, but following the timeplan of the intervention is expected to increase teachers' fidelity of implementation of the ToyBox-intervention.

In conclusion, three teachers' trainings were conducted as part of the ToyBox-intervention. These trainings may play a significant role in increasing teachers' self-efficacy, motivation and fidelity for the implementation of the intervention; however, this remains to be clarified by the process evaluation analyses.

Acknowledgements

The ToyBox-study is funded by the Seventh Framework Programme (CORDIS FP7) of the European Commission under Grant Agreement No. 245200. The content of this article reflects only the authors' views and the European Community is not liable for any use that may be made of the information contained therein.

Conflict of interest statement

The authors have no conflicts of interest to declare.

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10 DANKSAGUNG

An erster Stelle möchte ich Herrn Prof. Dr. med. Dr. h.c. Berthold Koletzko danken, für seine Unterstützung, sein Vertrauen in mich und meine Arbeit und für die großen Freiräume selbstgestalterisch arbeiten zu können.

Ich möchte mich bei meiner Familie bedanken: bei Alex, der sich immer wieder humorvoll beklagt nicht als Koautor genannt zu sein, und bei meinen Kindern, die während der Messphase auf so manchen Spielplatzbesuch verzichten mussten.

Mein größter Dank gilt aber meinem Vater, dem ich diese Arbeit widme. Papa, ich werde unsere morgendlichen Diskussionen auf Korsika und dein – manchmal auch zu großes - Engagement niemals vergessen. Danke!