UNIVERSITY OF GHENT
Faculty of Medicine and Health Sciences
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The effect of the ToyBox-intervention on water consumption in preschoolers from six European countries

Master's thesis submitted to obtain the degree of
Master of Health Education and Health Promotion

by Ann Vandendriessche

Promotor: Dr. Marieke De Craemer,
Mentor: Drs. Julie Latomme

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Abstract

Background: The ToyBox-intervention aimed to develop, implement and evaluate a preschool-based family-involved intervention to prevent overweight and obesity in early childhood, by promoting a healthy lifestyle in preschoolers. In this master thesis, the effects of the ToyBox-intervention on water consumption in preschoolers from six European countries (Belgium, Bulgaria, Germany, Greece, Poland and Spain) will be studied.

Method: A sample of 4574 preschoolers (51.6% boys; mean age: 4.7 ± 0.4 years) from six European countries was analyzed. To attain information about the water consumption of the participating preschoolers, the parents or caregivers completed a food frequency questionnaire. The effect of the intervention was analyzed through a Repeated Measures ANOVA, on the total sample and also according to country and climate.

Results: In the total sample, a positive intervention effect was found. The mean water consumption per day showed a higher increase in the intervention group (+43.3 ml/day) than in the control group (+28.3 ml/day) from baseline to follow-up measurements. Country-specific intervention effects were only found in Belgium (intervention group: +66.3 ml/day; control group: +25.8 ml/day) and Poland (intervention group: +88.1 ml/day; control group: +47.6 ml/day). In warm climates no intervention effects were found, but relatively cold/mild climates did show intervention effects (intervention group: +74.0 ml/day; control group: +38.0 ml/day).

Conclusion: The ToyBox-intervention was successful for water consumption in preschoolers. However, the increase in water consumption was small and not present in every country. Future interventions should actively involve parents trough sessions and customize their approach according to climate.

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Abstract

Inleiding: De ToyBox-interventie had als doel het ontwerpen, implementeren en evalueren van een interventie om overgewicht en obesitas bij kleuters te voorkomen, door een gezonde levensstijl te promoten. Deze interventie speelde zich af in kleuterscholen en betrok leerkrachten en ouders. In deze masterproef werden de effecten van de ToyBox-interventie voor waterinname bij kleuters uit zes Europese landen (België, Bulgarije, Duitsland, Griekenland, Polen, Spanje) bestudeerd.

Methode: Een sample van 4574 kleuters (51,6% jongens; gemiddelde leeftijd: 4,7 ± 0,4 jaar) uit zes Europese landen werd geanalyseerd. Om informatie over de waterinname van de deelnemende kleuters te verkrijgen, vulden de ouders of voogd een food frequency questionnaire in. Het interventie-effect werd geanalyseerd door middel van Repeated Measures ANOVA testen op de totale steekproef, alsook volgens land en volgens klimaat.

Resultaten: Er werd een positief interventie-effect gevonden in de totale steekproef. De gemiddelde waterinname per dag steeg sterker in de interventiegroep (+43,3 ml/dag) dan in de controlegroep (+28,3 ml/dag) van baseline naar follow-up metingen. Landspecifieke interventie effecten werden alleen gevonden in België (interventiegroep: +66,3 ml/dag; controlegroep: +25,8 ml/dag) en Polen (interventiegroep: +88,1 ml/dag; controlegroep: +47,6 ml/dag). In warme klimaten werd geen effect gevonden, maar in relatief koude / milde klimaten waren er wel interventie-effecten (interventiegroep: +74,0 ml/dag; controlegroep: +38,0 ml/dag).

Conclusie: De ToyBox-interventie was succesvol voor waterinname bij kleuters. De toename van waterinname was wel vrij klein en niet aanwezig in alle landen. Toekomstige interventies zouden ouders actief moeten betrekken door middel van sessies en hun aanpak aanpassen op basis van klimaat.

Aantal woorden: 14 645 (exclusief bijlagen en bibliografie)

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Preface

Writing this master thesis has been a very enriching experience for me. It gave me the opportunity to increase my knowledge on childhood obesity and nutritional habits in preschoolers. This master thesis could only be achieved thanks to the support and assistance of a number of people. Therefore, I would like to thank them.

First I want to thank my promotor and mentor. My promotor, Marieke De Craemer, doctor at the department of Movement and Sports Sciences of the University of Ghent, because she always gave me constructive suggestions and encouraging words to continue my master thesis. My mentor, Julie Latomme, doctoral student at the department of Movement and Sports Sciences of the University of Ghent, because her good monitoring and guidance were an important factor motivating me to see through this work successfully. I also want to thank Greet Cardon, professor doctor at the department of Movement and Sports Sciences of the University of Ghent, for the additional guidance when Dr. De Craemer was on maternity leave.

In addition, special thanks go to An-Sofie Pinket, doctoral student at the department of Movement and Sports Sciences of the University of Ghent, who provided me with some useful information to help me in my master thesis.

Furthermore, a sincere thank you goes out to all the members of the GENUD research group in Zaragoza (Spain). During my three months of Erasmus there, they did not only provide us with extra information relevant to our master thesis, but they also made Zaragoza feel like a home to us. In addition to this I also want to thank Benedicte Deforche, professor at the Department of Public Health of the University of Ghent, for giving us the opportunity to end our studies with an interesting foreign experience.

Finally, I would like to thank my partner Michiel and the members of my family, because they are always in every sense committed to support me in my studies. I am thankful to be surrounded with people like them.

Introduction

In this master thesis the effects of the ToyBox-intervention on water consumption of preschoolers from six European countries will be investigated. ToyBox (www.toybox-study.eu) is an EU-funded program that wanted to prevent overweight and obesity in preschoolers between the age of four and six years old. Since behaviors and psychological processes are mostly developed at this young age, it is the ideal time to acquire good habits towards nutrition and movement. Moreover, the last decennia the prevalence of overweight and obesity has reached alarming levels, even in preschoolers, which indicates the need for effective interventions in early childhood to reverse this trend (de Onis, Blössner, & Borghi, 2010; Maalouf-Manasseh, Metallinos-Katsaras, & Dewey, 2011).

The ToyBox-intervention targeted three energy-balance-related behaviors to prevent overweight and obesity in preschoolers: physical activity, sedentary behavior and dietary behavior (including snacking and water consumption). These behaviors were targeted through a preschool-based, family-involved intervention. The intervention was implemented in six European countries: Belgium, Bulgaria, Germany, Greece, Poland and Spain (Manios, 2012; "ToyBox- a European multi-country study"; 2015).

What is the effect of the ToyBox-intervention on water consumption in preschoolers? This question will be answered throughout this master thesis. Water consumption, one of the dietary behaviors targeted in the intervention, is an essential aspect of a healthy diet for preschoolers (Kind & Gezin, 2016). Furthermore, water is also important for the optimal functioning of the human body. Even a mild dehydration can cause fatigue, headaches and loss of concentration (Iglesia, 2015; Popkin, D'Anci, & Rosenberg, 2010). Not much research or interventions have been conducted on water consumption in preschoolers yet. This master thesis will therefore investigate the effect of the ToyBox-intervention on water consumption in preschoolers and describe the possible determinants, so they can be taken into account when the intervention effects will be analyzed. In addition, this master thesis will also investigate country-specific intervention effects. This provides a clear view on the differences in intervention effect between the countries. Finally, the intervention effect will be examined according to type of climate.

To start with a correct view on the problem, knowledge about overweight and obesity in preschoolers and their influencing factors is needed. This will be investigated in the first

chapter, the literature study. Each behavior influencing overweight and obesity will shortly be described and water consumption in preschoolers will be extensively examined. To end this chapter, existing interventions on water consumption in preschoolers will be described. Second, the research questions will be formulated and the research method will be described. The research method will provide an overview of the contents and protocol of the ToyBox-study, the participants, the measuring methods and the statistical analyzes used in this master thesis. Next, the chapter 'results' will provide descriptive results and an effect evaluation of the intervention on water consumption in the total sample and according to country and climate. These results will be described and interpreted in the discussion, in which also the strengths and limitations of the study and recommendations for further research will be given. Finally, the conclusion will summarize the most important findings of this master thesis and some recommendations for future research.

1 Literature study

1.1 Overweight and obesity in preschool children

In this chapter, overweight and obesity in preschool children will be examined more closely: a definition of overweight and obesity will be given, the prevalence of overweight and obesity in preschoolers will be investigated and health consequences of overweight and obesity in preschoolers will be described. In this way, a better understanding of the need for an intervention will be established.

1.1.1 Definition of overweight and obesity

The World Health Organization (WHO) (2015) defines overweight and obesity as "abnormal or excessive fat accumulation that presents a risk to health". In adults, the Body Mass Index (BMI) is commonly used to define underweight, normal weight, overweight or obesity. BMI [weight (kg)/height² (m^2)] expresses the weight for height relationship as a ratio. A BMI greater or equal to 25kg/m^2 is defined as overweight and a value greater or equal to 30kg/m^2 is defined as obesity. BMI is easily obtained, it identifies overweight individuals correctly and correlates strongly with body fat percentage (Krebs et al., 2007). In children, it is difficult to use a standardized calculation method, because children are still growing and their bodies go through a lot of physiological changes as they grow. Furthermore, sex and age have a significant impact on body composition. Therefore, different methods to measure a child's healthy weight were developed, depending on age and sex (WHO, 2016a; Gonzalez-Casanova et al., 2013).

The BMI of a child is calculated and compared to an age- and sex-specific reference distribution to define the weight status (Maalouf-Manasseh, Metallinos-Katsaras, & Dewey, 2011). This distribution or dataset is usually based on data collected over a long time period, so that the numbers are not affected by today's obesity epidemic. Two of the most internationally used datasets that define overweight and obesity in preschool children are the WHO-standards and the World Obesity Federation[1] references (Monasta, Lobstein, Cole,

[1] This organization was formerly known as the International Obesity Task Force (IOTF).

Vignerová, & Cattaneo, 2010). Besides those two, a third dataset comes from the Center for Disease Control and Prevention (CDC) (Kuczmarski et al., 2002). Each of these organizations have datasets separately for boys and girls, with one month intervals. In these distributions, a few differences are seen: each database has different cut-off points to define overweight and obesity and all three datasets have different age ranges. The WHO determined some cut-off points based on standard deviations and has separate charts for children aged zero to five years and for five- to nineteen-year-olds. The World Obesity Federation chose cut-off point based on BMI-values in 18-year-olds and then tracked this back through centile lines to the age of two years. This resulted in charts for children and adolescents from two to eighteen years-old (de Onis & Lobstein, 2010). Finally, the CDC growth charts determined cut-off points based on percentiles and presents charts for two- to twenty-year-olds. (Kuczmarski et al., 2002). CDC datasets are only useful in the United States, while both the WHO standards and the IOTF charts on the other hand make it possible to compare the prevalence of overweight and obesity globally.

1.1.2 Prevalence of overweight and obesity in preschool children

Overweight and obesity have been reaching epidemic levels the last three decennia. The prevalence of obesity worldwide in children under the age of five was 4.2% in 1990, 6.7% in 2010 and is estimated to rise to 9.1% in 2020 (de Onis, Blössner, & Borghi, 2010). In terms of numbers, the WHO (2015) estimated that in 2013 42 million children younger than five years were overweight or obese, while in 2008 the estimated prevalence was only 22 million. Furthermore, a report from 2010 stated that 92 million children younger than five years were at risk of overweight (Maalouf-Manasseh, Metallinos-Katsaras, & Dewey, 2011).

In Europe, the prevalence of overweight and obesity increased also significantly the past years, but now it seems to be reaching a steady level (Manios et al., 2012). In general, the literature reports a lot of variety in the prevalence of overweight and obesity in preschoolers between different European countries. The study of van Stralen et al. (2012) examined the prevalence of overweight and obesity in four- to seven-year-olds from six European countries (Belgium, Bulgaria, Germany, Greece, Poland and Spain), and showed that the prevalence fluctuated from 8% to 30% for overweight and from 1% to 13% for obesity, with the highest percentages in southern Europe (i.e. Spain and Greece). In Table 1, the detailed percentages for each country are depicted, according to the World Obesity Federation standards. Recent

numbers of the Belgian Food Consumption survey 2014-2015 showed similar percentages to those mentioned table 1 in three- to five-year-olds: 11.2% of the Belgian preschoolers suffer from overweight while 2.7% of them were obese, based on the World Obesity Federation cut off-points (Lebacq, 2015).

Table 1. Prevalence of overweight and obesity in four- to seven-year-old preschool children from six European countries according to the IOTF cut-offs (adapted from van Stralen et al., 2012).

	Belgium	**Bulgaria**	**Germany**	**Greece**	**Poland**	**Spain**
Prevalence of overweight (%)	11.2%	19.9%	12.3%	27.1%	17.7%	32.5%
Prevalence of obesity (%)	0.8%	6.25%	1.8%	11.1%	4.4%	10.7%

1.1.3 Health consequences of overweight and obesity in preschool children

Not much evidence exists on the association between overweight and obesity in preschool children and health consequences, as they are still young and generally healthy. However, when being obese in early childhood, there is a greater risk at being obese in later childhood (Nader et al., 2006). Therefore existing evidence of health consequences of overweight and obesity in older children - both physical and psychosocial - will be discussed below.

Physically, overweight and obesity can affect almost every organ-system. First, some endocrinal problems leading to a higher risk to develop type 2 diabetes can be experienced (Güngör, 2014). Besides endocrinal problems, overweight and obese children can show early signs of cardiovascular disease like hypertension, dyslipidemia and early stages of the atherosclerotic[2] process, and these cardiovascular problems are good predictors of cardiovascular diseases in adulthood (WHO, 2015). Furthermore, dyslipidemia caused by

[2] Atherosclerose is a vascular disease with blood vessel constriction at different locations (van Everdingen, 2006).

overweight and obesity can lead to liver problems. Fatty liver disease[3] for example, can lead to fibrosis[4], cirrhosis[5] and liver cancer. Additionally, obese children have six times more risk to develop obstructive sleep apnea. This disturbs the normal ventilation process during the sleep and interrupts the normal sleep pattern (Güngör, 2014). Finally, some orthopedic and dermatological problems can be found in children with overweight and obesity (WHO, 2015; de Onis & Lobstein, 2010). Besides these physical consequences, obese children can experience some psychosocial problems such as a lowered self-esteem, dissatisfaction with the body, social isolation and discrimination (Pulgarón, 2013). The quality of life is lower and this can lead to a lower educational- and financial-level in adulthood (Güngör, 2014).

Strong evidence exists that childhood obesity leads to adulthood obesity and its co morbidities. Thirty to fifty percent of people obese in early childhood, will probably suffer from obesity in adulthood (Lakshman, Elks, & Ong, 2012; Singh, Mulder, Twisk, Van Mechelen, & Chinapaw, 2008). Given the physical and psychosocial problems listed above and the chances of childhood obesity evolving into adult obesity, interventions in early childhood targeting overweight and obesity are necessary.

[3] A disease in which fat infiltrates the liver (National Library of Medicine, 2016).

[4] Overgrowth of connective tissue in the liver (van Everdingen, 2006).

[5] Liver disease; the liver parenchyma shrinks and the interstitial tissue proliferates (van Everdingen, 2006).

1.2 Energy balance-related behaviors

Overweight and obesity are multifactorial diseases, resulting from a complex interaction of genetic and non-genetic components. These non-genetic factors include prenatal, infancy and environmental factors and parental influence (Güngör, 2014). The fundamental problem in overweight and obesity however is a long time imbalance in energy intake and expenditure (Lakshman, Elks, & Ong, 2012). The key behaviors that influence the energy balance– and therefore impact the risk on the development of overweight and obesity in children- are physical activity, sedentary behavior and dietary behavior. They are referred to as energy balance-related behaviors (EBRBs). In the following chapter these three EBRBs will be discussed. The focus will be on dietary behaviors rather than on physical activity and sedentary behavior, as water consumption is the subject of this master thesis.

1.2.1 Physical activity

Physical activity plays an important role in obtaining a healthy weight and controlling overweight and obesity in early childhood, as it can cause changes in the balance between calorie intake and expenditure (de Onis, 2015; Ellery, Weiler, & Hazell, 2014). Physical activity is the biggest changeable factor in energy expenditure as it covers 15 to 30% of the total energy expenditure each day (Lambourne & Donnelly, 2011).

1.2.1.1 Definition of physical activity

Physical activity is defined as “any bodily movement produced by muscle action that increases energy expenditure” (Caspersen, Powell, & Christenson, 1985). Physical activity can have a wide variety in intensity, which differs according to the type of activity and the capacity of the individual. Moderate physical activity raises the heartbeat and the individual feels warm and slightly out of breath. During vigorous physical activities people start sweating and become out of breath (Cavill, Kahlmeier, & Racioppi, 2006). In preschoolers, ‘active play’ is the main part of physical activity. Active play can include unstructured free play (i.e. respectively free play in playgrounds), structured physical activity (i.e. action games and songs), active transport (i.e. going to preschool by bike) and everyday physical tasks (i.e. helping with the gardening) (DHA, 2009).

1.2.1.2 Importance of physical activity

It is important to encourage preschoolers to be physically active for two reasons. First, if good habits concerning physical activity are formed in early childhood, it may positively influence future behavior. Second, physical activity in early childhood offers some fundamental health advantages for children, both in the short and long term (DHA, 2009). Children with good levels of physical activity have a better physical fitness regarding the cardio respiratory and musculoskeletal system. They have less body fat and the health of their bones, cardiovascular and metabolic system is better. Physical activity also benefits their neuromuscular awareness; their coordination and movement control is being developed while moving. Besides that, they experience less symptoms of anxiety and depression and also better social skills are established (de Onis, 2015; WHO, 2016b).

1.2.1.3 Recommendations and current level of physical activity in preschool children

International guidelines from the UK, Australia and Belgium are age-specific and recommend at least 180 minutes of total physical activity (i.e. light, moderate or intense physical activity) a day for preschoolers. These three hours should include both structured and unstructured free play and are better spread throughout the day than carried out in one long session. For preschoolers, the amount of physical activity is more important than the intensity (Ministerie van Welzijn, Volksgezondheid en Gezin, 2012; DHPA, 2011; DHA, 2009).

Only a limited amount of studies already studied the compliance with the most recent physical activity guidelines. In an Australian study of three- to five-year-old preschoolers, only 5.1% of the preschoolers met the recommendation of three hours of physical activity on an average day (Hinkley, Salmon, Okely, Crawford, & Hesketh, 2012). In the study of Colley et al. (2013) in Canadian three- to four-year-olds, 84% of the children met the guidelines of 180 minutes of physical activity a day. Finally, also a study by Vale et al. (2013) revealed over 90% of compliance to the guidelines of three hours of physical activity per day in four to six years old Portuguese preschoolers. These studies show great differences in compliance to the guidelines, this could be due to different adjustments of the measuring instruments. However, as the 3 hours recommended in the guidelines are still the minimum of physical activity required, interventions to increase the amount of physical activity are useful.

1.2.2 Sedentary behavior

In our current society, the environment encourages sedentary behavior at work, at school, passive transportation, at home,… Even young children do not escape this trend (de Onis, 2015). Early childhood is a critical period for the development of life-long habits, including sedentary habits. As health consequences related to high levels of sedentary behavior are increasingly recognized, there has been more research about this topic during the last years (Carson et al., 2015).

1.2.2.1 Definition of sedentary behavior

Previously, sedentary behavior was described as a lack of physical activity. However, being sedentary and being physically inactive are not synonyms, and are thus two different constructs. Sedentary behavior can be described as any waking activity whilst sitting or reclining, while the energy expenditure is approximately equal to the energy consumption in a metabolic rest state. More precisely, the energy expenditure is lower or equal to 1.5 metabolic equivalents[6] (Saunders, Chaput, & Tremblay, 2014; SBRN, 2016). Examples of sedentary behavior can be watching TV, using the computer, playing video games, sitting and talking, playing while sitting, passive transport,… (Pate, Mitchell, Byun, & Dowda, 2011 ; Vanderloo, 2014). When talking about sedentary behavior, most researchers only describe screen time (hours spent on computer, television,…) which is frequently used as a proxy marker for sedentary behavior. Despite the fact that screen time is the most sedentary activity in preschool children, also other behaviors can be categorized as sedentary behavior, e.g. quiet playing, reading books, passive transport, etc. (Moreno, Pigeot, & Ahrens, 2011; Vanderloo, 2014).

1.2.2.2 Importance of reducing sedentary behavior in children

Higher levels of sedentary behavior in preschoolers can be associated with an elevated risk on being overweight or obese and having abdominal adiposity, having a decreased cardio

[6] "A measurement of oxygen uptake in a sitting, resting person (resting oxygen consumption), varying with age, sex, race, and other factors. In normal adult men, one MET is approximately 3.5 ml O2/kg/min of body weight. Oxygen uptake during activities or work can be measured in METs which can be use to determine health status and exercise prescription" (National Library of Medicine, 2016).

respiratory fitness and having an increased cardio-metabolic health risk. Besides those physical risks, sedentary behavior can also result in symptoms of ADHD, less psychological well-being, boredom and irregular sleep patterns in preschoolers (Suchert, Hanewinkel, & Isensee, 2015; Vanderloo, 2014).

1.2.2.3 Recommendations and current levels of sedentary behavior in preschool children

As screen time is the most common sedentary behavior in children, guidelines about sedentary behavior often prescribe recommendations about the amount of screen time per day. American guidelines recommend a maximum of two hours of screen time per day for preschoolers (four to six years old) (McCambridge et al., 2006). Australian and Canadian guidelines even recommend less than one hour per day of screen time for two- to five-year-olds. Besides that, these recommendations include that sedentary behavior in general should be interrupted at least once every 60 minutes (Australian Government Department of Health and Ageing, 2014; Tremblay et al., 2012). In Belgium, long periods of sedentary behavior should be limited in preschoolers according to VIGeZ (2016a), the Flemish institute for health promotion and prevention.

Unfortunately, many studies report a high prevalence of sedentary behavior. In a study of De Craemer et al. (2015) that was conducted within the ToyBox-study, low proportions of European preschoolers met the guidelines of maximum one hour of screen time per day. During weekdays, 24.9% to 43.9% met the guidelines, while on weekend days this was only 9.2% to 16.1%. Only in Germany, preschoolers had a higher adherence to the screen time guidelines (71.4% on weekdays and 52.1% on weekend days). However, overall sedentary behavior does not only include screen time. De Craemer et al. (2015) concluded that preschoolers also spent a significant amount of time in quiet play, which was equal or higher than the amount of screen time in some countries. In conclusion, when targeting sedentary behavior in preschoolers trough interventions, not only screen time but also quiet play should be taken into account.

1.2.3 Dietary behavior

Out of all the known risk factors that influence the development of overweight and obesity in early childhood and its continuation trough adulthood, diet is one of the most changeable and

important environmental factors of the energy balance (Moreno, Pigeot, & Ahrens, 2011). In general, the Western lifestyle is encouraging a high energy -intake; nutrition is available in large numbers, is often energy-dense and with a low nutritional value (de Onis, 2015; Moreno & Gracia-Marco, 2012).

1.2.3.1 Importance of a healthy diet

A balanced and varied diet is one of the basic conditions for normal growth and development of preschoolers. A healthy diet can prevent immediate health problems, such as iron deficiency, anemia and dental caries. Besides that, it also helps preventing long term food-related health problems such as coronary heart disease, diabetes, obesity and cancer. Since the dietary behavior in childhood might determine the eating pattern in adulthood, it is important to establish healthy dietary habits in childhood (Kind & Gezin, 2014; Matthys, Huybrechts, Bellemans, De Maeyer, & De Henauw, 2003; Young, 1997).

1.2.3.2 Definition: the active food pyramid

Food based dietary guidelines do not exist on an international level, only on national levels: each European country has its own recommendations. The majority of the European countries converted their dietary guidelines into a ‘food pyramid’, which provides a visual image of the practical guidelines for a balanced diet. In this section, the Flemish food pyramid – which is based on the nutrition recommendations of the Belgian health council - will be discussed (see figure 1) (European Food Information Council, 2009; Ministerie van Welzijn, Volksgezondheid en Gezin, 2012).

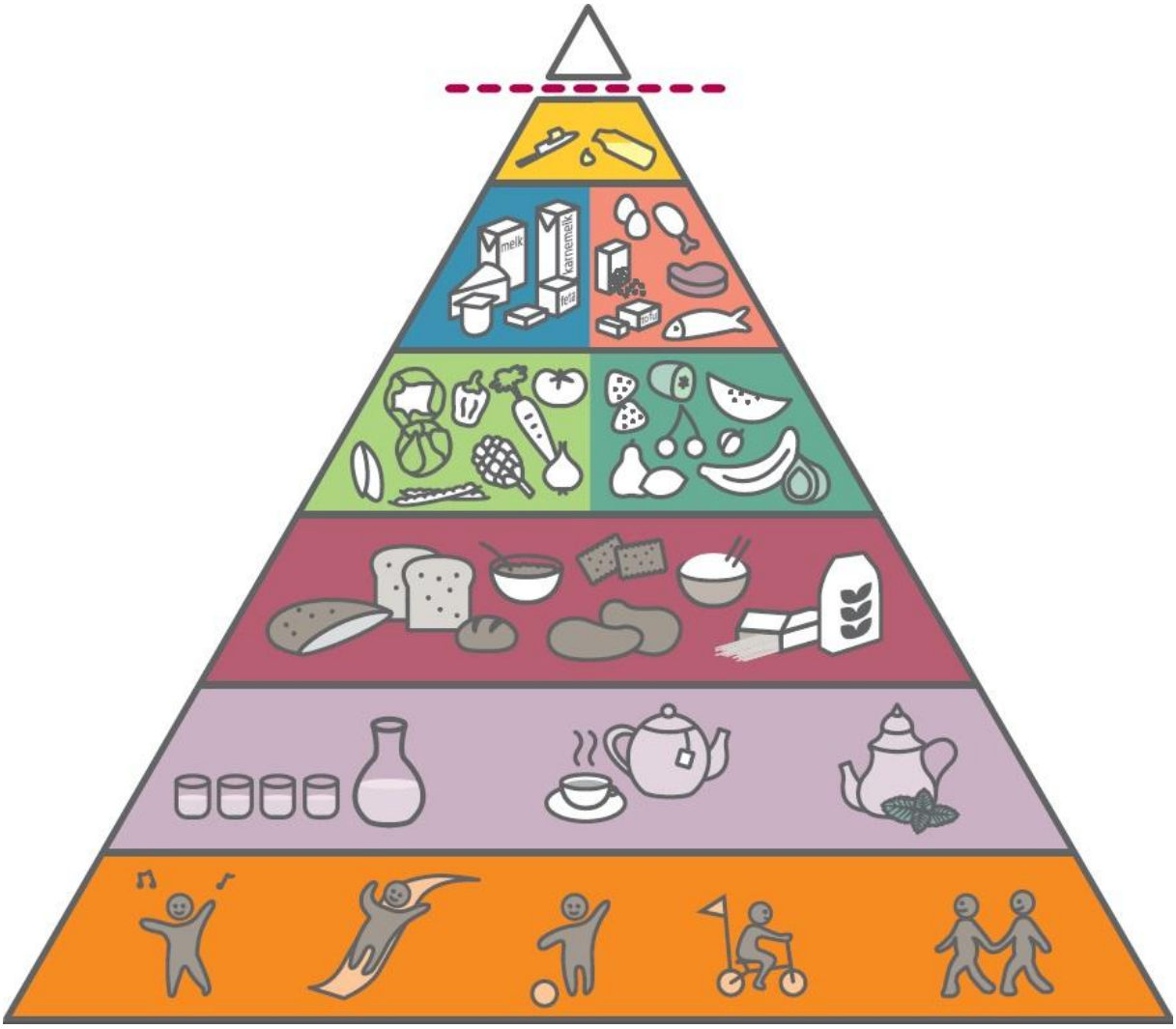

Figure 1. Active food pyramid for children younger than six years (Kind & Gezin, 2016)

The Flemish food pyramid was designed by the Flemish Institute for Health Promotion and Disease Prevention (VIGeZ) (2016c) and adapted by Kind & Gezin (2016) for children younger than six years old. This food pyramid is an 'active food pyramid', as physical activity is also included. It shows how a healthy diet can be composed: the larger the food group is represented in the triangle, the greater the daily amount needed of this food group and vice-versa. The base of the triangle represents the necessary amount of physical activity needed for a healthy body: 180 minutes per day, as earlier mentioned in the section of physical activity. Furthermore, the triangle has seven essential food groups, which will hereafter be presented in order of importance: (1) water, (2) cereal products and potatoes, (3)vegetables, (4) fruits, (5) dairy products and calcium-fortified soy products, (6) meat, fish, eggs and substitute products and (7) fat to cook and spread. Variation of food intake between the different groups is important (i.e. meals with ingredients from multiple food groups), but also within the food

group there must be a variation (i.e. eating different kinds of vegetables). Finally, the top of the triangle is representing the 'rest group', this consists of the nutrients that are not essential in a healthy diet (i.e. unhealthy snacks: candy, sugar-sweetened-beverages, cookies,...). Also sedentary behavior has recently been added to the rest group (Kind & Gezin, 2014).

In Table 2, the recommendations according to VIGeZ (2016b) for children between three and six years old for each part of the active food pyramid can be found.

Table 2. Recommendations of the active food pyramid for children three to six years old (adapted from VIGeZ, 2016b)

	Recommendations for three- to six-year-olds
Physical activity	3 hours per day
Water	0,5 - 1 liter
Cereal products and potatoes	3-5 slices of bread 1-4 pieces of potato (50-200 g)
Vegetables	2-3 spoons (100-150 g)
Fruits	1-2 pieces
Dairy products and calcium-fortified soy products	Whole milk till the age of 4, then semi-skimmed milk 350-500 ml 10-20 g or ½-1 slices of cheese
Meat, fish, eggs and substitute products	50-75 g
Fat to cook and spread	5g per slice of bread Maximum 15 g
Rest group	Not necessary Limit and interrupt sedentary behavior regularly

Water, being at the base of the food pyramid, is an important component of a healthy diet. Children should at least be consuming five to six glasses of water per day. As this master thesis focuses preschoolers' water consumption, water consumption will be discussed in the next chapter.

1.3 Water consumption

Pure water is energy-free and can therefore support a healthy weight status as opposed to sugar-sweetened beverages (Muckelbauer et al., 2009). In this chapter, the importance of water consumption will be discussed, followed by a summary regarding the recommendations about sufficient water consumption in preschoolers. The recommendations will be presented together with the compliance of the children regarding water consumption. Furthermore, some of the determinants of water consumption in preschoolers will be discussed, followed by an overview of possible assessment methods for water consumption. Finally, an overview of existing interventions to increase preschoolers' water consumption will be given.

1.3.1 Importance of water consumption

Water is essential for humans, they can only survive a few days without it. It is needed for nearly every function of the body and is particularly important for thermoregulation (European Food Safety Authority [EFSA], 2010). Besides thermoregulation, water has many other roles in the body: it functions as a building material, solvent, reaction medium, reactant, carrier for nutrients and waste products, lubricant, shock absorber etc. (Jéquier & Constant, 2010). Drinking water is also an effective way to ensure an adequate hydration status (EFSA, 2010). When an acute water imbalance appears due to decreased fluid intake, dehydration can occur. This is a physiological condition which can cause serious consequences in severe circumstances: decreased cognitive and physical performance, impaired thermoregulation and decreased sympathetic nervous activity (Iglesia, 2015).

Preschoolers in particular have a relatively high need for water, as their bodies have a higher water content than adults. Besides that, the body area surface to body weight ratio is higher in preschoolers than adults (Iglesia et al., 2015). Furthermore, they have immature thirst mechanisms and high activity levels (Jacques, 2012). As people are not able to produce water by themselves, by metabolism or by retaining it from food intake, attention should be paid to what is drunk during the day, to ensure the daily water need is fulfilled (Jéquier & Constant, 2010).

1.3.2 Recommendations and current water consumption in preschool children

As described earlier, water is an important part of a healthy diet. The Flemish Institute for Health Promotion and Disease Prevention (VIGeZ) (2016b) recommends 500 to 1000 ml of water consumption a day for children aged three to six years old. This corresponds to five to six glasses of water per day. It should be noted that the required water intake varies among individuals and according to environmental conditions (Drewnowski, Rehm, & Constant, 2013).

The WHO, EFSA, American Medical Association, US centers for Disease Control and many national dietary guidelines have been recommending water intake over caloric drinks the last few years, to avoid obesity and several chronic diseases. Nevertheless, low water intake is becoming a worldwide problem (Stookey & Koenig, 2015). In a study of Guelincx et al. (2015) 13 datasets on fluid intake were pulled in children (four to nine years old) across the world. In these datasets, water accounted for less than half of the total fluid intake for a large proportion of the study population (Guelincx et al., 2015).

The study of Pinket et al. (2015) executed in Europe for the ToyBox-study revealed that the mean water consumption of preschoolers from six different European countries is 547 ml per day. Another study within the ToyBox-study found varying results across different European countries (De Craemer et al., 2015). Belgian, German and Polish preschoolers had the lowest water intake, only 36% of Polish, 51.8% of German and 37.2% of Belgian preschoolers met the minimum guideline of 500 ml/day of water consumption per day. In Spain, the majority of preschoolers (82%) met the minimum guideline. Mean water consumption varied from 414 ml/day in Polish children to 754 ml/day in Spanish children. These varying water consumptions could be explained by differences in climate (De Craemer et al., 2015). These numbers demonstrate the need for interventions to increase water consumption in preschoolers.

1.3.3 Determinants of water consumption in preschool children

In this section, some determinants of water consumption in preschoolers will be discussed. As the literature on water consumption in preschoolers is limited, only the most important determinants will be discussed, namely gender, socio-economic status and climate. No studies discussing age differences between preschoolers concerning water consumption were found.

1.3.3.1 Gender

In the studies of Guelincx et al. (2015) and Iglesia et al. (2015) 13 datasets on fluid intake pulled in children (four to nine years old) across the world were analyzed. In these studies, no consistent or pronounced differences between preschool-aged boys and girls on water consumption were found. However, in the study of Pinket et al. (2015) on water intake in European preschoolers from the ToyBox-study, some significant differences in water intake by gender were found. In the total sample, male preschoolers drank significantly more water than preschool girls, respectively 561ml and 525ml per day.

1.3.3.2 Socio-economic status (SES)

In the study of Drewnowski, Rehm & Constant (2013) water intake among American children aged four- to 13- years-old was analyzed. Results showed a marginal association between water consumption and SES of the family: children derived from higher-income households consumed more water (as a beverage) than children from lower-income households. Similar findings were described in the study of Pinket et al. (2015) on the water intake among preschoolers from the ToyBox-study. In this study, significant differences in SES were found in the total sample concerning plain water intake: preschoolers whose mothers had a lower SES consumed less plain water than preschoolers with a high-SES mother.

1.3.3.3 Climate

In the study of Iglesia et al. (2015) on fluid intake in children pulled in 13 countries across the world, some notable differences were seen between countries with different climates. The highest mean fluid intakes were seen in Argentina, Turkey, Indonesia and Uruguay. The lowest mean fluid intakes were seen in Belgium, China and France. A possible explanations for this outcome according to Iglesia et al. (2015) is the climate in countries with high intake; they tend to have higher humidity and temperatures, which results in people drinking more. Also in the analyses of De Craemer et al. (2015) similar explanations were given to differences in water consumption among preschoolers from South-European countries and West- and Central-European countries. According to De Craemer et al. (2015) differences in water intake across the countries could be explained by the different climates: temperatures during spring and summer are higher in South-European countries (i.e. Bulgaria, Greece, and Spain) than in West- and Central-European countries (i.e. Belgium, Germany, and Poland). Due to higher temperatures, preschoolers might be more thirsty and drink more water.

1.3.4 Measuring water consumption in preschool children

As the focus on water intake is relatively new, methods to assess water consumption exclusively are not available. Therefore, methods that were validated for other nutrients are often used to measure water consumption (Popkin, D'Anci, & Rosenberg, 2010). Furthermore, it is not always easy to assess food and fluid intake in preschoolers. For example, they eat small portions of food at frequent intervals and their dietary habits are changing fast. However, as preschoolers cannot read, their inability to complete a questionnaire is the most important problem (Ortiz-Andrellucchi et al., 2009). Because of this, commonly used techniques are respondent based methods completed by the parents. Below, the most commonly used methods to assess water consumption will be described, as well as their advantages and disadvantages.

Methods to assess beverage consumption most commonly described in literature are dietary recalls varying in length, dietary records, food frequency questionnaire (FFQ) or a combination of methods (Gandy, 2015). Both 24 hour recalls and FFQs are retrospective, while dietary records are prospective. In dietary recalls, details about the preschoolers' consumed food and drinks are obtained through interviews with parents, mostly about the last 24 hours. FFQs are questionnaires in which a list of food and beverage groups is provided, and parents can mark the frequencies and portions for each food group that their child consumes. In dietary records, parents have to write down detailed information at the time of consumption. The ideal period for this kind of data collection is three to four days. (Mons et al., 2007; Serdula, Alexander, Scanlon & Bowman, 2001).

Each method mentioned above has certain advantages and disadvantages. A general disadvantage is that the total fluid intake is often underestimated. As mentioned earlier, to assess water consumption, methods that were primarily designed to capture food consumption are commonly used. As their primary aim was to capture foods, extensions of those methods are not likely to be sensitive enough to record all drinking events. Those methods are structured around meals, so underestimation is possible, since water and other beverages are consumed throughout the whole day. Furthermore, preschoolers are not always in the home environment, so parents do not have a complete overview of the consumed water (Gandy, 2015). However, this underestimation varies between the different methods. For example, as 24 hour recalls are retrospective, the assessment of the beverage intake depends on the memory and recall abilities of the respondents, which often leads to underestimation. Also the

conceptualization of the portion size of the consumption is a problem in 24 hour recalls (Gandy, 2015). Furthermore, over- or underestimation in 24 hour recalls can be caused by the face to face interview with the researcher, as people tend to give socially accepted answers. In contrast to 24 hour recalls, no memory or conceptualization skills are needed in dietary records, as this method is prospective. Therefore, dietary records are relatively accurate and often used as reference method when other methods have to be tested for validity (Bardosono et al., 2015). However, this measuring method is usually more expensive and time-consuming, imposes a higher burden on the respondents and the process of recording may influence intake (Gandy, 2015). FFQs provide more benefits than dietary records when carrying out large epidemiologic studies, as the workload on the participants here is lower (Huybrechts, De Bacquer, Matthys, De Backer, & De Henauw, 2006). Furthermore, these types of questionnaires are valid, practical and cost-effective (Serdula, Alexander, Scanlon & Bowman, 2001). Parents however could be affected by social desirability and willingness to report a healthy diet when reporting in FFQs (Moreno, Pigeot, & Ahrens, 2011).

Because of the different available methods, inconsistent water intake assessments between countries are seen. None of the existing methods give an absolute correct intake, therefore, when choosing a method, a balance between accuracy and burden for the respondent should be taken in consideration (Gandy, 2015).

1.3.5 Interventions to increase water consumption in preschool children

In this section, some interventions that targeted water consumption in preschoolers are discussed. The first years of life may represent the best opportunity for overweight and obesity prevention. During this period, lifestyle behaviors are being developed, and it is easier to learn new behaviors than to change the existing ones (Natale et al. 2013). Still, few interventions targeting an increase in water consumption in preschoolers have been developed. Most interventions focused on healthy eating in general and only some of the intervention include water consumption.

A program reported by McGarvey et al. (2004) only focused on the behaviors of parents of two- to four-year-old American children to address the problem of childhood obesity. Low-income mothers of preschoolers were selected from local clinics in Virginia. Six key dietary and physical activity behaviors were targeted during one year by educational group sessions

once every two months and an individual session with a nutritionist every six months. These targeted behaviors included substituting sweetened beverages with water, the consumption of five fruits and vegetables a day, and mealtime monitoring. After the intervention, an increased frequency in offering water to the children instead of sweetened beverages appeared in the control and intervention group, although the increase was significantly larger for participants in the intervention group. The participants of the intervention group offered 0.64 times more water per day to their children than before, while this was only 0.13 more times a day in the control group (McGarvey et al., 2004, Peters, Sinn, Campbell, & Lynch, 2011).

A British program also chose parents to focus on for their intervention, with children of two to six years old. Parents who were part of the intervention group received a training based on habit formation. In the intervention, habit formation of three parental feeding behaviors was encouraged: serving healthy snacks, serving fruit/vegetables, and serving non-sweetened drinks. This was attempted through four visits to the family home in an eight-week period. During these one hour visits, parents were given tips on how best to contribute to habit formation and they got practical advice for each specific feeding habit. The results showed a significant positive effect on the child's water consumption in the intervention group: the child consumed water on 0.6 more occasions per day than before. No changes in water intake were found in the control group. Therefore, the researchers concluded that habit formation is a promising new tool for family-based obesity prevention programs (McGowan et al., 2013).

A German nutritional intervention by De Bock, Breitenstein & Fisher (2012) aiming to reduce overweight in German preschoolers (three- to six-year-olds), targeted both parents and children. This preschool-based intervention wanted to obtain results on anthropometric measures as well as behavioral outcomes, such as children's fruit, vegetable and water consumption. The intervention was conducted for six months with weekly sessions at school and was delivered by nutrition experts. During these six months, fifteen standardized two-hour nutrition sessions were given, mostly during preschool hours. Ten sessions only targeted the children, five sessions included the parents, targeting them alone or together with their children. In these sessions, the participants were getting used to preparing different types of food and eating together in groups of children, parents and teachers. One session in particular focused on healthy drinking behaviors. After the intervention, no significant differences in water consumption were found. The researchers suggest this might be due to the design of the intervention, which focused more on fruit and vegetable exposure and on testing new foods than on beverage consumption (De Bock, Breitenstein, & Fisher., 2012).

Also a Belgian intervention, developed to assist schools to develop a healthy school policy, wanted -besides increasing healthy food consumption and decreasing unhealthy beverage intake- to increase the water consumption in preschoolers. This intervention worked on three different levels: class level, school level and the home environment, and lasted six months. During this period, healthy food was made available at school, children did activities linked to healthy food and drinks (including water), parents received more information on healthy food and drinks, teachers had group discussions and training sessions and also at the level of the school environment, different measures were taken (i.e. training for cafeteria staff, examples of good practice,...). The follow-up measurements did not show any significant change in water consumption associated with the intervention (Vereecken et al., 2009).

Finally, in the IDEFICS study, daily consumption of water in children was targeted as well. This program focused on six key behaviors related to obesity in two- to ten-year-olds from eight European countries. These behaviors included dietary, physical activity and stress-related behaviors. In contrast to the programs described above, this intervention acted upon four different levels: the community, the school, the family and the child, with promoting key messages about the behaviors. The part of the intervention that focused on water consumption, was carried out at the school level. An environment was created that discouraged the consumption of sugar-sweetened beverages and stimulated the intake of water, by providing free water during breaks, playtime and lessons. Results of the program showed no differences between baseline and follow-up measurements between the intervention group and the control group for water consumption in the eight participating countries. According to the researchers, this could be due to a lack of clear guidelines about reducing the sweetened-drink consumption and replacing it with water (Kovács et al., 2015).

As seen in the interventions discussed above, parents are often included in interventions for preschoolers, as they are the dietary gatekeepers for young children (McGowan et al., 2013). Also the school environment should be part of such interventions, as preschoolers spend a lot of time there and preschool is one of the first settings in which children encounter different behavioral norms from those at home (De Bock, Breitenstein, & Fisher., 2012). Furthermore, Jacques (2012) explains that easy access to water at school is important to retain a good fluid intake in school children. Therefore, besides the home environment, school is an important setting to promote healthy drinking patterns.

2 Research purpose

Overweight and obesity have been reaching epidemic levels the last three decennia (Maalouf-Manasseh, Metallinos-Katsaras, & Dewey, 2011). The existing literature clearly showed that overweight and obesity in preschoolers is a problem that cannot longer be ignored, as high rates of overweight and obesity are found. In the countries participating in the ToyBox-study, these rates vary from 11 to 33% for overweight and from 0.8 to 11% for obesity (van Stralen et al., 2012). These numbers are alarming, as a wide variety of health consequences of overweight and obesity in preschoolers can be listed. Overweight and obesity, as well as their related diseases, can be prevented. Therefore, prevention of childhood overweight and obesity should be prioritized. The cause of the development of overweight and obesity has mainly to do with the energy imbalance, which is determined by three different behaviors: physical activity, sedentary behavior and dietary behavior; which are well-known as energy balance-related behaviors. To prevent overweight and obesity in preschoolers, these behaviors should be changed. This can be done by targeting them through an intervention. For this reason, the ToyBox-intervention was developed and implemented in six European countries: Belgium, Bulgaria, Germany, Greece, Poland, and Spain.

The main aim of this master thesis was to investigate the effect of the ToyBox-intervention on water consumption in preschool children from those six European countries and to look for differences in effects between those six countries. Water is an essential part of a healthy diet, however, an important part of preschoolers did not meet the guidelines of 500 to 1000 ml of water intake per day at the baseline measurements. This master thesis will examine whether or not the ToyBox-intervention increased water consumption in the total sample and in the country-specific samples. As an intervention took place, it was expected that the mean water consumption will have increased in the intervention group of the total sample and for each individual country.

Furthermore, differences in water intake among preschoolers were seen especially between countries with different climates: in southern countries the consumption of water amongst preschoolers was higher than in central and western countries. Therefore, this master thesis will also investigate if the intervention had different effects in different types of climate. An increase in the intervention group is expected in both types of climates because of the intervention.

3 Research method

3.1 Study protocol

3.1.1 Introduction on the ToyBox-study

The data used in this master thesis is part of the ToyBox-study (www.toybox-study.eu). The main aim of the ToyBox-study was to prevent overweight and obesity during early childhood by promoting water consumption, healthy snacking and physical activity in preschool children and decreasing their sedentary behavior. Therefore, a multidisciplinary team of researchers from 10 countries across Europe developed, implemented and evaluated a multicomponent kindergarten-based, family-involved intervention with a randomized cluster design. This intervention was established according to a systematic stepwise approach that combines the use of the 'Precede-Proceed' model (Green & Kreuter, 2005) and the intervention mapping protocol (Bartholomew, Parcel, Kok, Gottlieb, & Fernandez, 2011).With this approach, key behaviors and their determinants related to early childhood obesity were explored. The intervention was implemented in preschools during the schoolyear 2012-2013 in six European countries: Belgium, Bulgaria, Germany, Greece, Poland and Spain The research conducted in this master thesis was approved by the ethics committee of the University of Ghent.

3.1.2 Recruitment

Initially, a minimum sample of 800 children and their families from at least 20 kindergartens were targeted per country. This would result in a total sample of 4800 children of 120 kindergartens. However, since a dropout rate of about 30% must be taken into account, the total number of recruited children and their families was increased to at least 6500 in the six participating countries. For this, a standardized, multistage sampling approach was applied. First, in each country provinces were selected: West- and East-Flanders in Belgium, Varna in Bulgaria, Bavaria in Germany, Attica in Greece, Warsaw and surroundings in Poland and Zaragoza in Spain. Out of theses provinces, municipalities were chosen. Municipalities within a maximum radius of 50km of the local institutes were divided into three SES groups: low SES, medium SES and high SES. These SES groups were based on mean years of education for the population of 25-55years and/or annual income. Then, in each country, five municipalities were randomly selected in each of these SES groups and kindergartens located

in the selected municipalities were contacted. After the completion of the baseline measurements in the preschools, the recruited municipalities were randomized to the intervention or control group with a ratio of 2:1. As the randomization was conducted at a municipality level, the kindergartens within each municipality were automatically assigned to the intervention or control group. When kindergartens agreed to participate in the study, parents or caregivers received an information letter on the study. Parents or caregivers who agreed on participating in the study, had to provide written consent. After this, several questionnaires had to be filled in by them, in which water consumption was questioned amongst other things. These had to be filled in before and after the intervention.

3.1.3 ToyBox-intervention

The recruitment of participants started in February 2012 and baseline data was collected between May and June 2012. Kindergartens who were allocated to the intervention group, received the ToyBox-intervention between October 2012 and April 2013. Kindergartens part of the control group were asked to continue the normal routine during this period. During the six-month-implementation phase, there was an initial focus on each behavior during four weeks (see Figure 2). Thereafter, a repetition period followed, in which there was again focused on each component for two weeks. The module on drinking behaviors –targeting water consumption – was implemented in the first four weeks and then again repeated in week 17 and 18. Furthermore, certain environmental aspects of the intervention, such as providing water stations, were implemented during the entire school year. The follow-up measurements were performed exactly a year after the baseline measurements, between May and June 2013, to avoid influences of the seasons. In order to illustrate the above, in Figure 2, the timeline of the ToyBox is illustrated (www.toybox-study.eu).

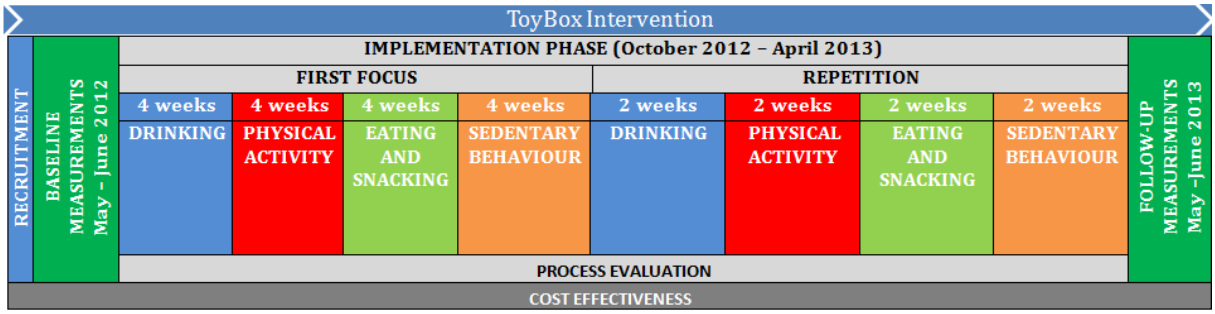

Figure 2. Timeline of the ToyBox intervention ("ToyBox- a European multi-country study", 2015).

3.2 Water consumption component

The water consumption of the preschoolers was targeted during the drinking module of the intervention. Prior to the implementation phase, a box was handed to the teachers of the intervention groups, containing the materials necessary for the intervention implementation. This box included a general guide with information about the ToyBox-intervention, classroom activity guides for each targeted behavior and a kangaroo hand puppet. This kangaroo hand puppet was the mascot of the ToyBox-project. The guide for classroom activities regarding water consumption provided the teachers with some information about the importance of water consumption. Furthermore, this classroom guide was divided into three major sections. The first section dealt with the environmental changes teachers could make in the classrooms, such as installing a water drinking station. In this way, water was always available. The second part of the manual handled about the preschoolers performing the actual behavior. Tips were provided on how to accustom preschoolers to drink water on a regular basis. Finally, in the third part, some fun classroom activities concerning water consumption were illustrated. For example, teachers could let preschoolers make a personally designed water cup or tell stories in which the kangaroo is a role model to the preschoolers. Furthermore, suggestions were made for sensory perception games around drinking, e.g. recognizing different types of water or learning how to feel the sensation of thirst. Finally, some experiments about water consumption or excursions (e.g. to the city water supply) were illustrated. Teachers were informed and guided about how to implement the intervention trough the general guide, but also received the opportunity to attend some teacher training sessions. In these sessions, teachers were motivated and trained for the implementation of the intervention. Sessions were given at three different times: at baseline, after the first four weeks of intervention and before the start of the repetition phase. The participation of all intervention teachers was aimed, if not possible so, it was aimed that at least one teacher per class participated.

Also the parents or caregivers were included in the intervention. At the start of the intervention a general newsletter about the ToyBox-intervention was provided at home. In this letter more information was given about ToyBox, the aims of the program were illustrated and some suggestions were given to the parents or caregivers (i.e. they were encouraged to read the coming newsletters and tip cards). This newsletter can be consulted in appendix A. Furthermore, parents or caregivers were targeted through the use of newsletters

and tip cards: at the start of every new behavior module a newsletter was provided and half way through the module the preschoolers brought home a tip card for the parents. In total, parents or caregivers received two newsletters and tip cards on water consumption, as the water module was performed twice. The first newsletter (appendix B) on water consumption provided information on the appropriate amount of water consumption, some tips to change the home environment and ideas for experiments with water. The first tip card (appendix C) for water consumption was provided to the parents or caregivers two weeks later and included some tips about how to motivate the child to drink enough water every day. The second newsletter (appendix D) on drinking behaviors reached the parents or caregivers by the start of the repetition module of water consumption. In this letter, some information was given about other drinks such as sugar-sweetened beverages and fruit juices and some tips for creating family rules about drinking behaviors were provided. The second tip card (appendix E), reaching the parents or caregivers one week after the newsletter, gave more information about what drinks are appropriate for children.

3.3 Participants

In order to get kindergartens to participate in the study, they were visited by researchers to inform the staff about the ToyBox-study. After agreeing to participate, an information letter on the study was given to the preschoolers to take home to their parents or caregivers. Kindergartens and preschoolers however had to meet certain conditions to be included in the intervention. First, the families'/children's participation rate in the preschool had to be at least 50%. Furthermore, preschoolers within the kindergartens had to be born between January 2007 and December 2008, could not be part of any other clinical trial or health-oriented project during the academic years 2012-2013 and 2013-2014 and their parents or caregivers had to provide a signed consent form.

Recruitment of kindergartens and children continued until minimum 1100 signed consent forms by parents or caregivers were acquired in each country. Finally, at baseline the study sample consisted of 309 kindergartens and 7056 children aged 3.5-5.5 years out of six European countries. Out of this total sample, 4574 participants (51.6% boys; mean age: 4.7 ± 0.4 years) had complete data for water consumption at baseline and follow-up measurements.

3.4 Measurements

Data were collected with the use of anthropometric measurements, questionnaires (Food Frequency Questionnaire (FFQ) and Primary Caregivers' Questionnaire) and pedometers or accelerometers. As this master thesis focuses on water consumption, only the FFQ will be discussed.

Preschoolers participating in the ToyBox-study received a closed envelope to take home which contained the FFQ and clear instructions for the parents or caregivers on how to fill in this questionnaire. The FFQ was designed as a self-completion questionnaire, in such a way that the primary caregiver of the child could easily fill it in at home. The FFQ used in the ToyBox-study was semi-quantitative and contained 44 items which focused on children's food and beverages consumption patterns. Thirty-seven of the questions were questioning the frequency and average portion size of frequently consumed foods and beverages. Seven extra questions were about the consumption of food between meals and supplement intake. To assess the water consumption of the preschoolers, parents or caregivers were asked how often their child drinks water. This question could be answered through a six-point scale ranging from "never or less than once a month" to "every day". Additionally, the parents or caregivers were also asked about the average amount of consumed water per day on the days of water consumption. This could be answered by indicating the average amount on an eleven-point scale, ranging from "100ml or less" to "1000ml or more". To help the parents or caregivers quantify the average portion size of the water, pictures of different portion sizes were added to the questionnaire. The FFQ used in the ToyBox-study is an adapted version of the previous validated questionnaire developed by Huybrechts et al. (2009). For beverage consumption, the questionnaire showed a moderate to good reproducibility and a good relative validity.

3.5 Data analysis

In the data analysis only the data of participants with complete data was used, meaning only the participants with data on frequency of water consumption as well as on portion of water consumption on both the pre and follow-up measurements were included.

3.5.1 Recoding of variables

In order to obtain an average amount of water consumption per day, both the frequency of water consumption and portion of water consumption were recoded into numeric variables and multiplied by each other. To recode the frequency of water consumption the following steps were taken: frequency of water consumption could first be answered through a six-point scale, response categories were: "never or less than once per month", "1–3 days per month", "1 day per week", "2–4 days per week", "5–6 days per week" and "every day". The first category ("never or less than once per month") was given the value 0, meaning that no water is drunk on any days. The last category ("every day") was given the value 1, meaning that water is drunk every day. The four other categories ("1–3 days per month", "1 day per week", "2–4 days per week" and "5–6 days per week") received values between 0 and 1, respectively 0.07, 0.14, 0.43 and 0.79, representing the percentual amount of days on which water was drunk. This was calculated by dividing the middle of the category by 30 (average amount of days per month) or 7 (total number of days in a week). The response categories for the portion of water consumption were: "100ml or less", "100–200ml", "200–300ml", "300–400ml","400–500ml", "500–600ml", "600–700ml", "700–800ml", "800–900ml", "900–1000ml" and"1000ml or more". To recode the average consumption of water these response categories were recoded using the midpoint method. The categories were changed into respectively 50ml, 150ml, 250ml, 350ml, 450ml, 550ml, 650ml, 750ml, 850ml, 950ml and 1000ml.

To explore the effect of different climates on the intervention, the six participating countries were divided into warm and relatively cold/mild climates. Bulgaria, Greece and Spain were classified among countries with a warm climate, Belgium, Germany and Poland represented the countries with a relatively cold/mild climate. This distribution was earlier mentioned in De Craemer et al. (2015), as the temperatures during spring and summer are usually higher in Bulgaria, Greece and Spain compared to Belgium, Germany and Poland.

The socio-economic status (SES) of the preschoolers in the sample was based on the educational level of the mother. Three categories were made: low educational level (<= 14 years of education), medium educational level (15 or 16 years of education), high educational level (>16 years of education). Preschoolers with mothers with a low educational level were classified with a low SES, preschoolers of mothers with a medium educational level were classified as having a medium SES and preschoolers of mothers with a high educational level received were classified with a high SES.

3.5.2 Statistical analyses

All statistical analyses in this master thesis were performed using IBM SPSS Statistics for Windows, version 20.0. A result was interpreted as significant if it had a p-value of less than 0.05. A trend towards significance was interpreted if a p-value was obtained between 0.5 and 0.10. Since hypotheses were set, all p-values were divided by two. All variables were first checked for missings and adjusted if necessary. Only the preschoolers with complete data on water consumption were included in the analyses.

The effect evaluation examines if the intervention had an impact on the water consumption of preschoolers. To invest the effect of the intervention, a Repeated Measures ANOVA was performed on the total sample and on different subgroups (country and climate). All analyses were adjusted for age, gender and SES, by adding them to the analyzes as covariates.

4 Results

4.1 Demographic data

In total, 4574 parents or caregivers of preschool children (51.6% boys; mean age: 4.7±0.4 years) across six European countries provided complete data at baseline and follow-up. In table 3, 4 and 5 demographic data (age, gender and SES) at baseline is described for the total sample, for each of the countries separated and according to climate.

Table 3. Demographic data (age, gender and SES) at baseline according to group

		Total sample	**Control group**	**Intervention group**
n		4574	1596	2978
Mean age (x ± SD) (years)		4.7 ± 0.4	4.7 ± 0.4	4.7 ± 0.4
Boys (%)		51.6	50.9	52.0
SES of the mother (%)	**Low**	38.2	36.7	39.0
	Medium	22.4	22.3	22.5
	High	39.4	41	38.5

x= mean; SD= standard deviation

Table 4. Demographic data (age, gender and SES) at baseline according to country

		Belgium	**Bulgaria**	**Germany**	**Greece**	**Poland**	**Spain**
n		699	545	838	755	944	793
Age (x ± SD) (years)		4.4 ± 0.5	4.9 ± 0.3	4.5 ± 0.5	4.9 ± 0.3	4.9 ± 0.3	4.9 ± 0.3
Boys (%)		50.5	50.5	51.8	49.9	51.4	55.0
SES of the mother (%)	**Low**	34.3	38.1	51.4	53.3	20.5	35.1
	Medium	37.0	26.6	18.2	27.5	14.9	19.3
	High	28.7	41.3	30.4	19.2	64.6	45.6

x= mean; SD= standard deviation

Table 5. Demographic data (age, gender and SES) at baseline according to climate

		Relatively cold/mild climate	Warm climate
n		2481	2093
Age (x ± SD) (years)		4.6 ± 0.5	4.9 ± 0.3
Boys (%)		51.3	52.0
SES of the mother (%)	**Low**	34.6	42.5
	Medium	22.2	22.6
	High	43.2	34.9

x= mean; SD= standard deviation

4.2 Water consumption at baseline

To get a proper view on the state of affairs at baseline, the mean water consumption at baseline is described for the total sample, for each of the countries separated and according to climate in table 6, 7 and 8. At baseline, the mean water consumption of the preschoolers was 554.7 ± 301.1 ml per day. The control group had a significant lower mean water consumption than the intervention group at baseline ($p=0.015$)[7]. Almost every countries' water consumption differed significantly from each other at baseline ($p<0.05$)[8], except Bulgaria and Greece ($p=0.629$). The mean water consumption of preschoolers at baseline according to climate differed significantly ($p<0.001$)[9]. Preschoolers in warm climates had much higher mean water consumption than preschoolers living in relatively cold/mild climates.

[7] This was demonstrated through an Independent T-test. The Levene's test was significant, so equal variances were not assumed.

[8] This was demonstrated through Mann-Whitney U tests, as the conditions in order to perform a One-Way ANOVA were not met. The p-value for the Mann-Whitney U test for Belgium and Poland was 0.007 and all other p-values were ≤ 0.001.

[9] This was demonstrated through an Independent T-test. The Levene's test was not significant, so equal variances were assumed.

Table 6. Mean water consumption at baseline according to group

	Control group (N=1596)	**Intervention group (N=2978)**	**t-value**	**p-value**
Water consumption *(ml/day)* **(x ± SD)**	540.1 ± 294.9	562.6 ± 304.2	2.4	0.015**

x= mean; SD= standard deviation

***p<0.001, **p<0.05, *p<0.1

Table 7. Mean water consumption at baseline according to country

	Belgium (N=699)	**Bulgaria (N=545)**	**Germany (N=838)**	**Greece (N=755)**	**Poland (N=944)**	**Spain (N=793)**
Water consumption *(ml/day)* **(x ± SD)**	425.6 ± 225.1	667.3 ± 236.4	486.7 ± 302.9	657.9 ± 269.7	410.4 ± 294.2	736.7 ± 256.1

x= mean; SD= standard deviation

Table 8. Mean water consumption at baseline according to climate

	Relatively cold/mild climate (N=2481)	**Warm climate (N=2093)**	**t-value**	**p-value**
Water consumption (ml/day) (x ± SD)	440.5 ± 281.5	690.2 ± 265.4	-30.7	<0.001***

x= mean; SD= standard deviation

***p<0.001, **p<0.05, *p<0.10

4.3 Effect evaluation

Below, the effect of the intervention will be analyzed. Based on Repeated Measures ANOVA tests, it will be determined if the water consumption evolves differently over time depending on the group to which the preschoolers belonged to (intervention group or control group). This will first be determined on the total sample and then according to country and climate. In all the analyses, age, gender and SES were taken into account as covariates. As hypotheses were set before analyzing, all p-values were divided by two.

4.3.1 Intervention effect on the total sample

In the total sample, the Repeated Measures ANOVA revealed a significant interaction effect of time*condition (F= 3.20, p= 0.04). This means there is significant difference in water consumption amongst preschoolers between the baseline and follow-up measurements depending on the group (control or intervention) they belonged to. Compared to the control group, the intervention group showed a greater increase in water consumption from baseline to follow-up measurements (intervention group: +43.3 ml/day; control group: +28.3 ml/day). In table 9 the results of the Repeated Measures can be found. In figure 3 the interaction effect is presented.

Table 9. Water consumption of the preschoolers at baseline and follow-up measurements according to group.

Water consumption (ml/day) (x ± SD)	**Baseline**	**Follow-up**	**F-value**	**p-value**
Control group (N=1538)	539.3 ± 295.7	567.6 ± 295.7	3.202	0.037**
Intervention group (N=2855)	564.3 ± 303.6	607.6 ± 286.9		

x= mean; SD= standard deviation

***p<0.001, **p<0.05, *p<0.10

In the analysis, there was controlled for age, gender and SES.

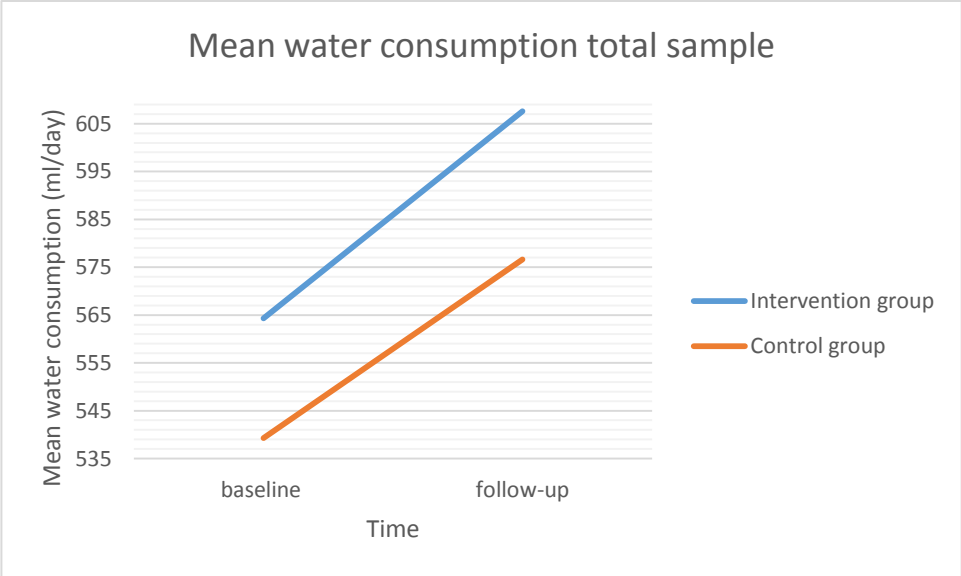

Figure 3. The water consumption from baseline to follow-up measurements according to condition (control or intervention group).

4.3.2 Intervention effect according to country

Besides investigating the intervention effect on the total sample, this master thesis also aimed to investigate if the intervention had different effects in different countries. A significant three-way interaction effect of time*condition*country (F= 2.0, p= 0.04) was found, this means that there are significant differences in intervention effects between the countries. Therefore, a Repeated Measures ANOVA was run separately for each country. Results from the Repeated Measures ANOVA for all countries are presented in table 10. As the interaction effect in the sample of Belgium, Bulgaria and Poland is significant and a trend to significant in Germany is seen, these interaction effects will be discussed below.

Table 10. Results of the Repeated Measures ANOVA for each of the 6 countries.

	Group	**Baseline** *Water consumption (ml/day) (x ± SD)*	**Follow-up** *Water consumption (ml/day) (x ± SD)*	**F-value**	**p-value**
Belgium (N=678)	C	427.0 ± 238.6	452.8 ± 238.3	5.662	0.009**
	I	422.8 ± 215.3	489.1 ± 234.4		
Bulgaria (N=520)	C	651.2 ±251.9	695.7 ± 245.1	2.995	0.042**
	I	681.8 ± 267.3	681.7 ± 252.8		
Germany (N=838)	C	472.1 ± 291.8	510.2 ± 292.7	1.843	0.088***
	I	493.0 ± 307.3	556.9 ± 293.7		
Greece (N=730)	C	679.5 ± 248.5	711.1 ± 234.5	0.133	0.358
	I	655.3 ± 274.9	677.7 ± 271.8		
Poland (N=927)	C	394.0 ± 272.5	441.6 ± 306.7	4.858	0.014**
	I	420.0 ± 303.7	508.1 ± 300.8		
Spain (N=747)	C	747.3 ± 248.1	731.7 ± 253.3	1.491	0.111
	I	742.8 ± 253.8	747.1 ± 244.6		

x= mean; SD= standard deviation

***p<0.001, **p<0.05, *p<0.10

In the analysis, there was controlled for age, gender and SES.

4.3.2.1 Belgium

The Repeated Measures ANOVA on the Belgian sample revealed a significant interaction effect of time*condition (F= 5.66, p= 0.01). This means there is a significant difference in water consumption amongst Belgian preschoolers between the baseline and follow-up measurements depending on the group (control or intervention) they belonged to. Both conditions increased their water consumption, but the increase in the control group was smaller than the increase in the intervention group (intervention group: +66.3 ml/day; control group: +25.8 ml/day). In figure 4 the interaction effect is presented for Belgian preschoolers.

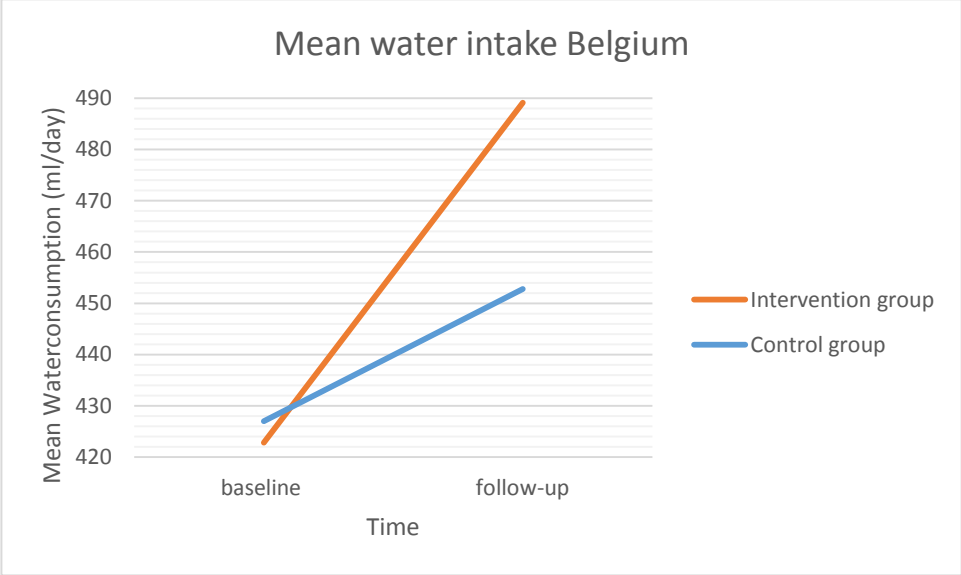

Figure 4. The water consumption from baseline to follow-up measurements according to condition (control or intervention group) for Belgian preschoolers.

4.3.2.2 Bulgaria

In the Repeated Measures ANOVA on the Bulgarian sample a significant interaction effect time*condition was found (F= 3.00, p= 0.04). This means there is a significant difference in water consumption amongst Bulgarian preschoolers between the baseline and follow-up measurements depending on the group (control or intervention) they belonged to. The mean water consumption of the control group increased, while the mean water consumption in the intervention group remained the same (intervention group: -0.1 ml/day; control group: +44.5 ml/day). In figure 5 the interaction effect is presented for Bulgarian preschoolers.

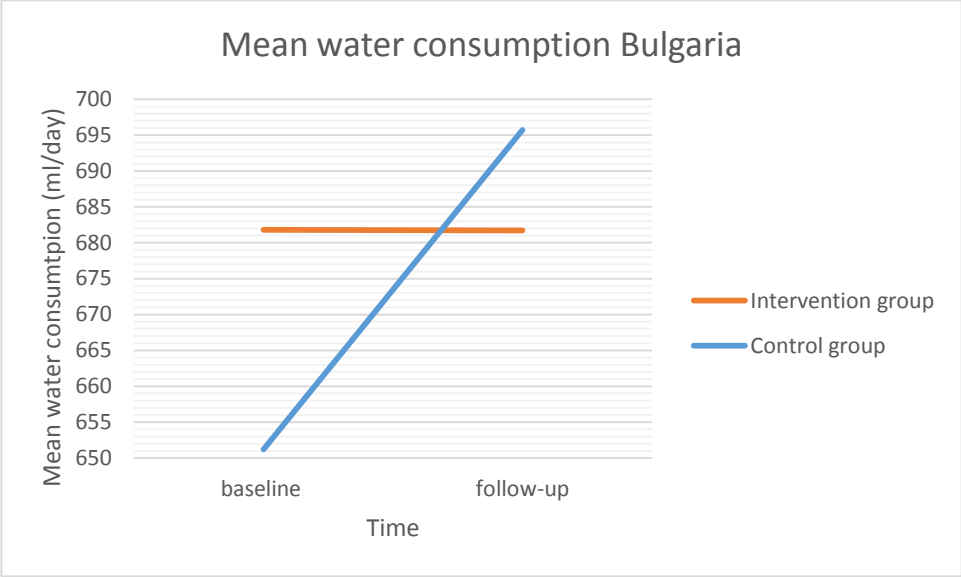

Figure 5. The water consumption from baseline to follow-up measurements according to condition (control or intervention group) for Bulgarian preschoolers.

4.3.2.3 Germany

The Repeated Measures ANOVA on the German sample revealed a trend towards a significant interaction effect time*condition (F= 1.84, p= 0.09). This means there is a trend towards a significant difference in water consumption amongst German preschoolers between the baseline and follow-up measurements depending on the group (control or intervention) they belonged to. The water consumption increased in the control as well as in the intervention group, however, the increase was greater in the intervention group (intervention group: +63.9 ml/day; control group: +38.1 ml/day). In figure 6 the interaction effect is presented for German preschoolers.

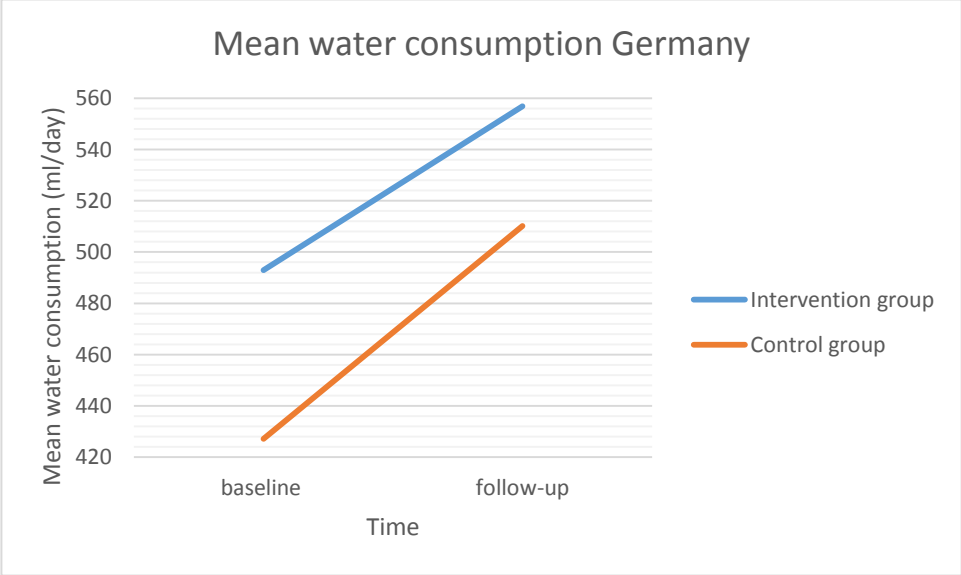

Figure 6. The water consumption from baseline to follow-up measurements according to condition (control or intervention group) for German preschoolers.

4.3.2.4 Poland

In the Repeated Measures ANOVA on the Polish sample a significant interaction effect time*condition was found (F= 4.86, p= 0.01). This means there is a significant difference in water consumption amongst Polish preschoolers between the baseline and follow-up measurements depending on the group (control or intervention) they belonged to. The increase in water consumption was greater in the intervention group compared to the control group (intervention group: +88.1 ml/day; control group: +47.6 ml/day). In figure 7 the interaction effect is presented for Polish preschoolers.

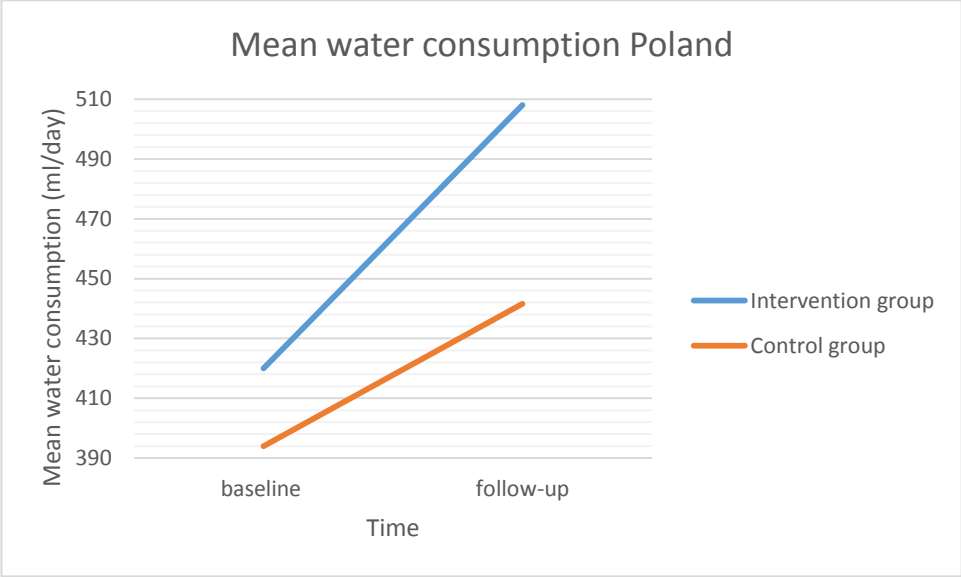

Figure 7. The water consumption from baseline to follow-up measurements according to condition (control or intervention group) for Polish preschoolers.

4.3.3 Intervention effect according to climate

The third aim of this master thesis was to investigate whether or not the intervention had different effects in countries with different climates. A significant three-way interaction effect of time*condition*climate (F= 5.24, p= 0.01) was found through a Repeated Measures ANOVA, this means there is a significant difference in intervention effects between the climates. Therefore, a Repeated Measures ANOVA was run separately for the two types of climate. The results of this analyze can be found in table 11. For warm climates, there was no significant effect of the intervention on the water consumption of preschoolers depending on group. This means that the ToyBox-intervention had no effect in countries with a warm climate. For relatively cold/mild climates however, a significant intervention effect was found. Therefore, the effect of the intervention on relatively cold/mild climates will be discussed below.

Table 11. Results of the Repeated Measures ANOVA for type of climate.

	Group	**Baseline** *Water consumption (ml/day) (x ± SD*	**Follow-up** *Water consumption (ml/day) (x ± SD*	**F-value**	**p-value**
Relatively cold/ mild climate	C	429.3 ± 271.2	467.3 ± 284.5	10.034	0.001**
	I	445.1 ± 285.5	519.1 ± 283.0		
Warm climate	C	702.1 ± 252.3	716.2 ± 245.8	0.081	0.388
	I	692.3 ± 268.4	702.6 ± 259.6		

x= mean; SD= standard deviation

***p<0.001, **p<0.05, *p<0.10

In the analysis, there was controlled for age, gender and SES.

The Repeated Measures ANOVA on the countries with a relatively cold/mild climate revealed a significant interaction effect time*condition (F= 10.04, p= 0.001). This means that there is a significant difference in water consumption amongst preschoolers from relatively cold/mild climates between the baseline and follow-up measurements depending on the group (control or intervention) they belonged to. The mean water consumption increased in both the conditions, but the increase was larger in the intervention group (+74.0 ml/day) than in the control group: +38.0 ml/day). In figure 8 the interaction effect is presented for preschoolers from relatively cold/mild climates.

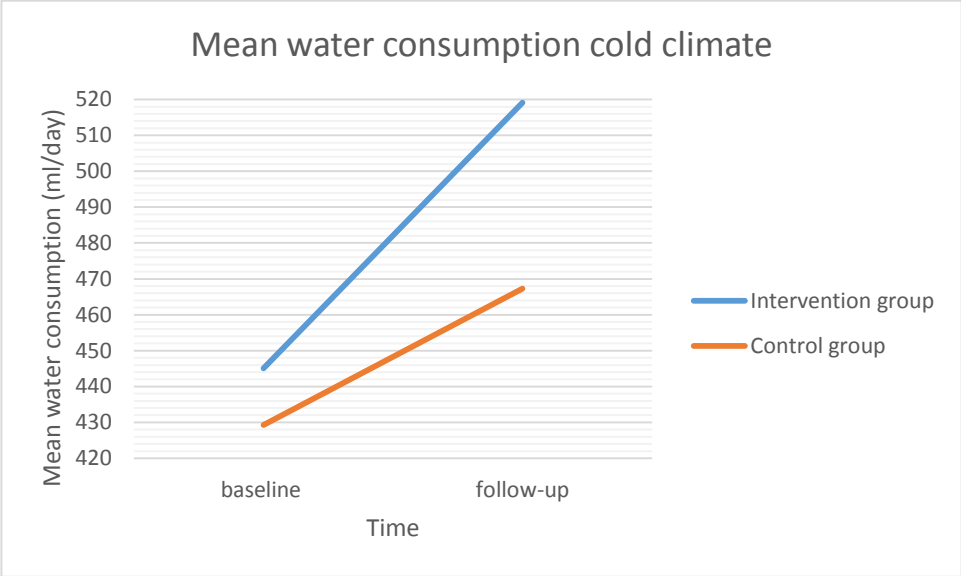

Figure 8. The water consumption from baseline to follow-up measurements according to condition (control or intervention group) for preschoolers from relatively cold/mild climates.

5 Discussion

This master thesis aimed to investigate the effect of the ToyBox-intervention on water consumption in preschoolers between the age of four and six years old, in six European countries (Belgium, Bulgaria, Germany, Greece, Poland and Spain). The ToyBox-intervention was developed to prevent overweight and obesity in preschoolers. At this young age, lifelong health habits are developed, and therefore it is the ideal moment to change existing habits and develop healthy new ones (Natale et al. 2013). To obtain this, behaviors playing an important role in the development of overweight and obesity were targeted: physical activity, sedentary behavior and dietary behavior. Water consumption – being an essential nutrient in life – was part of the dietary behaviors targeted in the intervention. Both parents and teachers of the preschoolers were involved in the intervention. This master thesis' aim was to evaluate the effect of the intervention on the total sample, per country and per climate. Within this effect evaluation, an increase in water consumption in preschoolers from the intervention group was expected, both on the total sample as well as in each individual country. Furthermore also an increase in the intervention group was expected in both types of climates because of the intervention.

Below, the intervention effect on water consumption will be discussed for the total sample and according to country and type of climate. Furthermore, some considerations about the results will be discussed and the strengths and limitations of this research will be given. Finally some recommendations for further research will be made.

5.1 General findings

In the total sample, the intervention had a significant effect on the water consumption of preschoolers: a significant difference was found in water consumption between the baseline and follow-up measurements depending on the condition. Both the control group as the intervention group had an increased water consumption, but the increase was larger in the intervention group (+43.3 ml/day) compared to the control group (+28.3 ml/day).

Furthermore, the effect of the intervention was also analyzed for each country separately. The intervention was found to be effective in Belgium as well as in Poland. In Belgium, the increase in water consumption of preschoolers was larger in the intervention group (+66.3 ml/day) than in the control group. (+25.8 ml/day). In Poland the mean water consumption of

preschoolers belonging to the intervention group (+88.1 ml/day) also increased more than in the control group (+47.6 ml/day). In Germany, only a trend towards a significant intervention effect was found and no significant intervention effects were found in Greece or Spain. In Bulgaria, a negative intervention effect was found: the mean water in the intervention group remained the same, while the consumption in the control group increased with an average of 44.5ml/day.

Finally the intervention effect was evaluated according to climate. The intervention affected the mean water consumption of preschoolers living in relatively cold/mild climates, namely in Belgium, Germany and Poland, but not in warm climates, namely in Bulgaria, Greece and Spain. The intervention was effective in relatively cold/mild climates, as the mean water consumption of the intervention group increased more (+74.0 ml/day) than in the control group (+38.0 ml/day). For warm climates, no significant intervention effects were found.

5.2 Interpretation of the results

Generally, the ToyBox-intervention was effective for water consumption in preschoolers. However, some notable observations were made. First, the mean water consumption also increased in the control group. This could be due to a raised awareness about water consumption of the parents or caregivers through the completion of the FFQ's. However, the increase in the intervention group was significantly higher than in the control group, meaning that the intervention itself still had an effect and therefore was a helpful intervention to increase water consumption. Second, the effect on mean water consumption was rather small. This could be due to several reasons. First, it is possible that the intervention may have been implemented poorly. In the study of Pinket et al. (2016) a process evaluation on implementation was made about the ToyBox-intervention in Belgium. This revealed that not all the planned classroom activities were performed and many parents did not read the newsletters and tip cards. Further research is needed to investigate if these problems with implementation also appeared in other countries, as this could possibly explain the limited intervention effects in some countries. Nevertheless, poor implementation could be plausible. As teachers were not obligated to attend the training sessions for implementation, they could therefore not have been well informed about or motivated for the classroom activities. Parents not reading the letters and cards, could also explain a rather small intervention effect. As parents are the dietary gatekeepers of preschoolers, it is very important to involve them in

interventions (McGowan et al., 2013). A review of 21 interventions preventing obesity in children three- to eighteen-years-old by Sharma (2007) even revealed that involving parents is an important factor for success of school-based interventions in international settings. By targeting parents through newsletter and tip cards in the ToyBox-intervention, they were only passively involved in the intervention. When studying the few existing interventions on water consumption in preschoolers, only the interventions in which parents were actively involved through sessions were successful (Kovács et al., 2015; McGarvey et al., 2004; McGowan et al., 2013; Vereecken et al., 2009). In the study of Mc Garvey et al. (2004) for example, parents were targeted trough six educational group sessions and two individual sessions with a nutritionist. In the study of Mc Gowan et al. (2013) parents were visited at home and given practical advice to change specific feeding habits. Both of the studies mentioned above were able to increase water consumption in preschoolers. Furthermore, the intervention effect could also be small because it focused on several behaviors simultaneously. The behaviors were targeted in separate weeks, however still four behaviors were targeted and this can be overwhelming for teachers, parents and preschoolers. A study of Kunin-Batson et al. (2015) recently showed that families are more able to focus on a single health behavior than on multiple behaviors at the same time. Another reason for a small intervention effect could be the length of the intervention. In the ToyBox-intervention the focus on water consumption lasted for six weeks in total, but during the whole six-month-intervention some environmental changes, such as the availability of water through water stations, remained present. This seems rather short when comparing to other interventions. The IDEFICS-intervention for example lasted two years. In this intervention, some environmental changes were made during those two years to improve water consumption: posters with key messages at school, provision of water fountains at school and changing school policy related to water. However, in the IDEFICS-intervention only two weeks actively promoted water consumption and finally no intervention effects were found for water consumption (Pigeot, Baranowski, & De Henauw, 2015). A program by McGowan et al. (2013) on the other hand, only lasted eight weeks, with only four sessions on water consumption at home for parents every two weeks. This program resulted in an increase in water consumption in preschoolers. Based on those two examples, it is hard to conclude if the length of interventions affects the results. Furthermore, the review of 21 interventions preventing obesity in children three- to eighteen-years-old by Sharma (2007) could not find any pattern regarding the length of the intervention and the success of the intervention. Consequently, it remains inconclusive if the length of the intervention really influenced the results. It seems more reasonable that poor implementation

of the intervention at school, passive instead of active involvement of parents and a focus on too much behaviors at once were limiting factors for intervention effects.

The second aim of this master thesis was to explore country-specific effects of the ToyBox-intervention. The results for this were not in line with the expectations. Only in Belgium and Poland significant intervention effects were found. In Germany a trend towards a significant intervention effect was found, but taken into account the size of the sample this is not relevant. In Greece and Spain no intervention effects were found. In Bulgaria, a negative effect was found, the intervention group did not increase its water consumption while the control group did. The country-specific results could be explained by type of climate in these countries. When analyzing the intervention effects according to climate – which was the third aim of this master thesis – an intervention effect was only seen in relatively cold/mild climates (i.e. Belgium, Germany and Poland). These countries started out with a significantly lower water consumption than the countries with a warm climate (i.e. Bulgaria, Greece and Spain). In warm climates, children are thirsty more often and already have more opportunities to drink water (for free) in preschools, therefore preschoolers in warm climates already had a higher water consumption. As a result, increasing the availability of water (which was part of the actions to increase water consumption in the ToyBox-intervention), did not affect the water consumption. Nevertheless further increase of water consumption in preschoolers from warm climates is still important, as they need more water to compensate for fluid losses caused by high temperatures and excessive sweating (Feferbaum, de Abreu, & Leone, 2012). Other measures should therefore be taken in countries with a warm climate. Finally, the results of the intervention in Bulgaria are remarkable. In this sample, the intervention group did not increase its water consumption while the control group did. Possible explanations for this might be found through a process evaluation.

Even though the intervention effect on water consumption was rather small and not present in every country, in the total sample the intervention still caused a positive evolution in water consumption in preschoolers. Water is often replaced by sugared-sweetened beverages, which provide additional energy intake and therefore may cause weight gain (Feferbaum, de Abreu, & Leone, 2012; Ludwig, Peterson, & Gortmaker, 2001). When more water is consumed by preschoolers, this means more healthy beverage choices are being made (i.e. water could be chosen over sugared-sweetened beverages). As water does not provide any additional energy intake and is an important part of a healthy diet, an increase in water consumption can only be encouraged (Kind & Gezin, 2016).

5.3 Strengths and limitations of the research

The ToyBox-intervention had many strengths. First of all, as the intervention was developed with the use of the 'Precede-Proceed' model (Green & Kreuter, 2005) and Intervention Mapping (Bartholomew, Parcel, Kok, Gottlieb, & Fernandez, 2011), a well-structured approach for assessment, development, implementation and evaluation of the intervention was guaranteed (Manios et al., 2012). Another strength of the ToyBox-study was the large sample size of preschoolers from six European countries. Furthermore, seasonal effects on the targeted behaviors were taken into account, by performing the follow-up measurements exactly a year after the baseline measurements. Finally, not much research has been done in preschoolers, especially on water consumption, so this study reveals useful information.

However, this research also showed some limitations. First of all, the mean water consumption was assessed through FFQ's, which require self-reporting. As preschoolers are not able to fill in these forms, parents or caregivers had to complete them. It is therefore possible that not all water consumption was recorded, as parents are not with their children at all times a day. Parents could also be affected by social desirability and willingness to report a healthy diet when reporting in FFQs (Moreno, Pigeot, & Ahrens, 2011). Furthermore, FFQ's were primarily designed to capture foods, and could therefore not be sensitive enough to record all drinking events (Gandy, 2015). However, González-Gil et al. (2014) studied the reliability of the self-administered primary caregivers questionnaire (including a section for water consumption) used in the ToyBox-intervention. The study concluded that this is a reliable tool to assess lifestyle behaviors (such as water consumption) in preschoolers. Furthermore, the FFQ used in the ToyBox-study is an adapted version of the previous validated questionnaire developed by Huybrechts et al. (2009). For beverage consumption, the questionnaire showed a moderate to good reproducibility and a good relative validity. Secondly, as mentioned earlier, this intervention focused on multiple behaviors, while focusing on one single behavior could be more effective. An intervention solely on water consumption, would probably result in a higher increase of water consumption. However, the ToyBox-intervention aimed to prevent overweight and obesity and those are mostly influenced by a combination of physical activity, sedentary behavior and dietary behaviors. Therefore targeting those behaviors all together in one intervention was necessary. Finally it should be noted that the mean water consumption in this study was slightly underestimated, as all values of water consumption reported above 1000ml were recoded to 1000ml.

5.4 Recommendations for further research

The ToyBox-study generated a lot of useful information and good approaches to prevent overweight and obesity in preschoolers. To better explain the results of the intervention on water consumption of preschoolers, a process evaluation should be carried out for each country. In this way, a better interpretation of the results will be possible. Furthermore, it would be interesting to examine if the increase of water consumption had any effect on the health status of the preschoolers, by analyzing the effect of the changes in water consumption on the BMI of the preschoolers.

In future studies on water consumption in preschoolers, the recording of water consumption could be combined with the collection of urine. In this way, biomarkers in the urine can indicate if the reported water consumption is accurate. Furthermore, to improve results in future interventions in preschoolers, parents or caregivers should be actively involved through sessions. As parents are such important figures in preschoolers' lives, they could be of great value to achieve intervention goals. By actively targeting them through sessions, they will better understand the importance of healthy behaviors and their responsibilities in this. Also, to achieve better implementation by teachers, they could be approached personally at school by investigators and the training for interventions could take place at school. This allows teachers to better understand the importance of their role in the implementation of the intervention. In this way, they will be more motivated to attend the training sessions. Finally, when interventions on water consumptions are performed in warm climates, a different approach should be chosen than in countries with relatively cold/mild climates. As water consumption levels are different between the two types of climates due to environmental factors, a more specific approach according to climate is necessary. Determinants of water consumption in preschoolers from warm climates could be investigated with the use of Intervention Mapping.

Finally, some practical implications towards preschools can be made. If preschools want to increase water consumption amongst their students, the elements of the water consumption component of the ToyBox-intervention could be used. The installation of a water fountain for example is a good start. Also, using a mascot to encourage preschoolers to drink more water and doing some classroom activities around the theme of water consumption are good elements to use. Besides that, preschools should actively involve parents, by offering free sessions on water consumption during several school events for example.

6 Conclusion

This master thesis wanted to examine the effect of the ToyBox-intervention on the water consumption in preschoolers from six different countries. Since the type of climate proved to be an important determinant of water consumption in preschoolers, the intervention effect was also examined according to different climates. The results revealed that the ToyBox-intervention did increase water consumption in preschoolers. As water is an essential aspect of a healthy diet for preschoolers, this is a positive evolution. However, this increase was rather small and not found in every country. Preschoolers from countries with warm climates did not consume more water after the intervention, while preschoolers from countries with a relatively cold/mild climate did. Therefore, different approaches for different type of climates are necessary in future interventions. Furthermore, to explain the rather small intervention effects, process evaluations should be carried out for every country. Finally, in future interventions, parents should be included actively through sessions. As parents are the dietary gatekeepers of preschoolers, their active participation could increase intervention effects.

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8 Appendixes

Appendix A: Newsletter for the ToyBox-intervention

7S212gbNL0

Introduction

Taste and move adventures

Newsletter

ToyBox – Taste and move adventures

A programme to achieve healthy growth and development

Infancy and preschool years are sensitive periods of rapid bodily, cognitive and emotional development. For this reason, during these time periods, the foundations for attaining long-term health benefits and reducing risk of chronic diseases during adult life are laid down.

Therefore, children should adopt a healthy nutrition and lifestyle early in life ensuring an appropriate food intake - neither too much nor too little food - but an amount and quality of food that ensures optimal growth and promotes health and well-being.

Now is the best time to make a difference!

The establishment of healthy habits early in life provides short term health benefits, but also increases the probability that these learned patterns can endure during adolescence and be retained throughout the life span.

So, what is "ToyBox – Taste and move adventures"?

Your child's kindergarten participates in a project called "ToyBox – Taste and move adventures". The key goal is to influence in a positive way lifestyle and behaviour of children, aiming at achieving healthy growth and a low likelihood of developing overweight and associated diseases in later life.

These are our aims:

- Your child consumes healthy snacks.
- Your child drinks water to quench thirst, instead of sugar-sweetened beverages.
- Your child is physically active for 2 to 3 hours daily.
- Your child limits sedentary activities such as watching TV or playing computer games.

Children from all across Europe are participating in this project. The active involvement of you, the parent, is of great importance since the positive lifestyle options that the "ToyBox" programme promotes in the kindergarten will then be enhanced and reinforced at home as well.

BE A ROLE MODEL FOR YOUR CHILD!

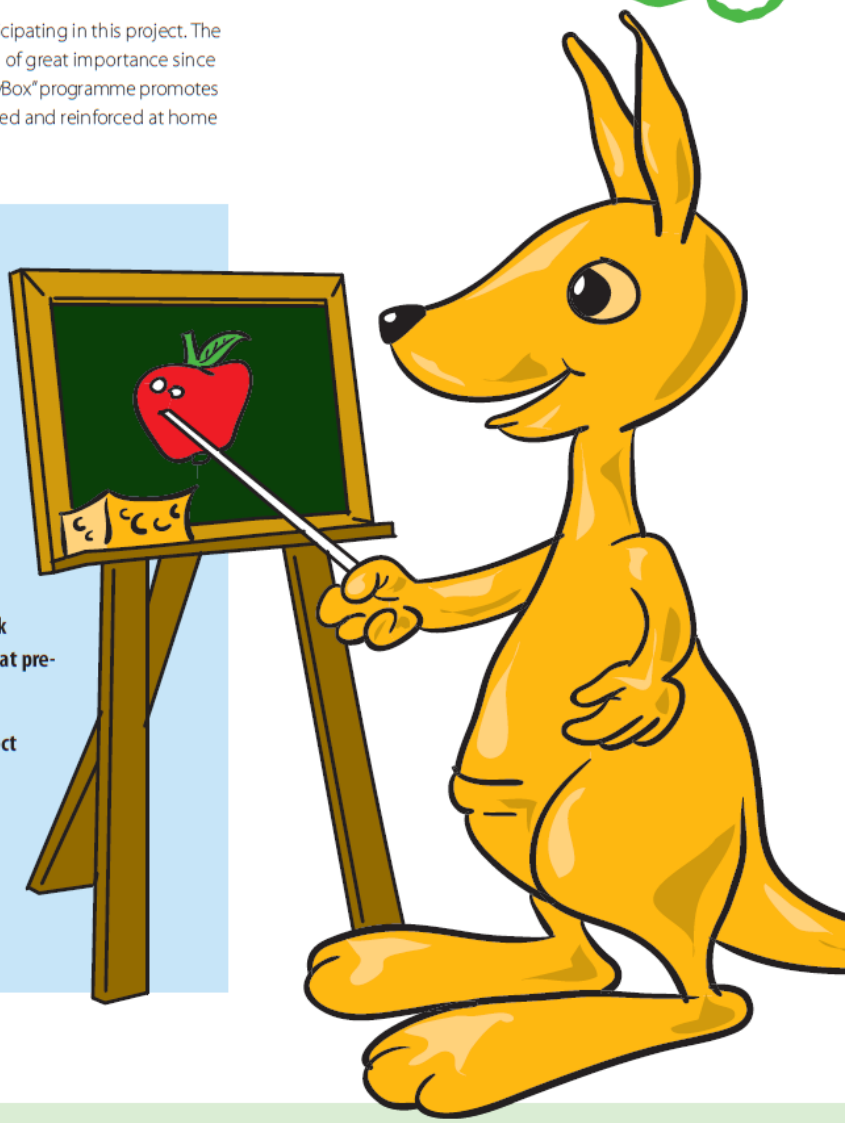
Children do what they see. The conditions you offer your child and your own drinking, snacking and physical activity habits have a strong influence on your child!

SUGGESTIONS FOR PARENTS

Regularly read the Newsletters and Tip Cards, and consider how you can support your child at home. You will receive a total of nine Newsletters and eight Tip Cards during the school year.

Show a positive interest in your child's project and be supportive of the activities that they are doing. Ask him/her about the activities they do at pre-school for the ToyBox project.

Talk to other parents about the project and share your experiences on what works well for your family regarding the promotion of drinking water rather than sugar containing beverages, healthy snacking, increasing physical activity and reducing your child's sedentary time.



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Appendix B: Newsletter 1 Water Consumption

75212gbNL1

Drinking

Toy Box

Taste and move adventures

Newsletter 1

Water – the best thirst quencher

Did you know...?

Water is vital for life! One of the reasons why water is so precious for life is that more than 65% of our body consists of water! Every day we lose water via urine, sweat, and breath. Water is a very important building block for our body that we need to replace every day to preserve our body function and performance.

When we feel thirsty we have already lost at least 2% of our body weight as water. However, losing 1% can already decrease the ability to concentrate and perform well. Losses of 4% or more may cause dizziness, fatigue, and headaches.

Children are even more sensitive to water losses than adults. If a child constantly does not consume enough water, an increased risk of infections could be a consequence.

TIP

You can figure out whether your child's body has enough water by the urine colour. The less yellowish the urine, the better hydrated is your child!

Thus remember: The higher your child's water consumption the more hydrated is his/her body and the more transparent the urine.

How much water should my child drink?

Children aged 3 to 6 years should drink about 0,8 to 1 litre per day.

And what about me?

Adults should drink ~2 litres/day.

Hot days and very active days

With very active physical activity, on hot days, or with a fever or diarrhoea, your child loses much more water and should drink more.

So you learned that water is vital. Yet perhaps we occasionally forget that water also is pleasant, calorie free, nutritious, almost always available and of course cheap! Drinking enough water also helps to keep the skin hydrated, so that it appears healthier as well as more shiny.

CHANGE YOUR HOME ENVIRONMENT

- **Drink water with every meal!**
- **Fill a flask of water every morning, and take it with you wherever you go. You will have water available for you and your child at all times, no matter how busy or in a hurry you may be.**
- **Always make sure that you have water available on the table during and in-between meals.**

MINI EXPERIMENT!

Show to your child how much water it should drink every day.

Divide 1 litre of water between the glasses from which your child normally drinks. Your child will probably be surprised to see that 5 to 6 glasses of water should be drunk every day.

Cold or warm water – what does your child prefer?

MINI EXPERIMENT!

Give your child a glass of water at room temperature, and a cold glass of water with an ice cube. Let your child tell you which one he/she prefers.

BE A ROLE MODEL FOR YOUR CHILD!

Children do what they see. The conditions you offer your child and your own drinking behaviour have a strong influence on your child!

SO REMEMBER:

Drink sufficient amounts of water every day yourself! Express how pleasant this is for you and show to your child how energetic it makes you feel.

WILL ToyBox MAKE A DIFFERENCE?

Start noticing your child's drinking behaviours and whether they change as the school year and the ToyBox programme progresses.

Perhaps, you could monitor your child's behavioural changes through a nice picture that you can hang on the wall. You can keep noting the glasses of water that your child drinks every day. Choose a colourful pencil!

Imprint

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For further information and reproduction purposes please visit the Toybox website: www.toybox-study.eu

Appendix C: Tip Card 1 Water Consumption

75212gbTC1

Toy Box

Taste and move adventures

Drinking

Tip Card 1

Tip Card 1

Water every day!

Two thirds of your child´s body consists of water. It is really important that your child drinks sufficient amounts of water every day!

REMEMBER!

The recommended drinking amount for children from 3 to 6 years is 800 ml to 1 litre daily! This makes about 5 to 6 glasses of water daily!

TIPS

- Serve water with every meal as well as in-between meals.
- Always have a bottle or carafe of water on the table, so your child can serve him/herself.
- Motivate your child to use the special cup that he/she made at school or her/his favourite beaker.
- Always carry a bottle of water with you when you are out and about, so you and your child always have the chance to drink!
- Take care that your child drinks more when it is hot or when he/she is physically active. Your child's water demands can more than double on such occasions!

BE A ROLE MODEL FOR YOUR CHILD!

Drink sufficient amounts of water every day yourself!

YOUR CHILD WILL COPY YOUR BEHAVIOUR!

Appendix D: Newsletter 2 Water Consumption

7S12gbNL2

Toy Box

Taste and move adventures

Drinking

Newsletter 2

Water is the best choice!

Choose water instead!

Many children, especially at preschool age, enjoy drinking sugar-sweetened beverages such as lemonades, cola and juices more than drinking water! Such beverages often are more attractive at this young age because they are colourful and taste sweet.

Are sugar-sweetened beverages a good thirst quencher?

No! Many children like lemonades and cola, but these beverages contain a large amount of sugar and therefore are not recommended for regular consumption.

If your child drinks large amounts of sugar-sweetened beverages, a large amount of extra calories will be consumed on top of the calories provided by solid foods, but without much intake of the essential nutrients needed for growth and well-being. As a consequence your child may consume far too many calories and may gain excessive weight.

Are diet drinks a good alternative to sugar-sweetened beverages?

Diet drinks with sweeteners instead of sugar do not contain a lot of calories, but they also accustom your child to learn to like a rather sweet taste. Therefore, it is better to provide water or unsweetened drinks as the regular thirst quencher.

Are fruit juices a good alternative to appease thirst?

Fruit juices contain a certain amount of valuable nutrients such as vitamins, but they are also high in calories. Therefore, pure fruit juices are not appropriate to quench thirst. A glass of fruit or vegetable juice can from time to time substitute one portion of fruit or vegetable, respectively.

REMEMBER

Whole fruit and vegetables are preferable over juices, because they provide higher nutritional value and greater satiety.

Create family rules

Consider creating family rules for the consumption of lemonades and cola:

- Avoid offering sugar sweetened beverages such as lemonades and cola on a daily basis – think of them like sweets.
- Offer sugar sweetened beverages to the child on an irregular basis only, e.g. at a certain occasion like a birthday.

BE A ROLE MODEL FOR YOUR CHILD!

Children do what they see. The conditions you offer your child and your own drinking behaviour have a strong influence on your child!

SO REMEMBER:

Prefer drinking water instead of sugar-sweetened beverages such as lemonades and cola.

Try to minimize the consumption of sugar-sweetened beverages yourself.

TIP

Buy only small amounts of lemonades and cola so you don't get tempted to drink more of them!

Reward your child for drinking less sugar-sweetened beverages such as lemonades and cola by surprising him/her with an exciting day excursion!

WILL TOY BOX MAKE A DIFFERENCE?

Start noticing your child's drinking behaviours and whether they change as the school year and the ToyBox programme progresses.

Along with the consumption of water you could monitor, perhaps you are already doing it, whether your child's behaviour changes in regard to the times that it makes a fuss about drinking lemonades and cola!

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Appendix E: Tip Card 2 Water Consumption

75212gbTC2

Drinking

Taste and move adventures

Tip Card 2

Drinking according to the traffic light!

Tip Card 2

Drinking according to the traffic light!

Not appropriate for children!

- Coffee
- Black tea
- Ice tea (with caffeine)
- Cola (with caffeine)

Only on certain occasions in limited amounts!

- Lemonades
- Cola (caffeine-free)
- Nectars
- Pure fruit juices

Plenty of it every day!

- Tap water
- Mineral water
- Unsweetened tea (herbal, fruit)

TIPS

- Always make water available for your child!
- Always have a bottle or a jar of water on the table, so your child can help him/herself!
- To make drinking water more attractive, let your child use his/her own special "water cup"!
- Always have a bottle of water when you're out and about! So your child always has the chance to drink!
- Buy sugar-sweetened beverages only in limited amounts, so you will not get tempted.
- Do not use diet drinks as an alternative! They would also accustom your child to the sweet taste!
- Milk is important for your child´s development. However, it is not a suitable thirst quencher, but rather a food.

BE A ROLE MODEL FOR YOUR CHILD!

Drink water every day!
Drink sugar-sweetened beverages only in small amounts, if at all, yourself!

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