



HAROKOPIO UNIVERSITY

SCHOOL OF HEALTH SCIENCE & EDUCATION

DEPARTMENT OF NUTRITION AND DIETETICS

**Evaluation of an intervention targeting diet and physical activity aiming to
improve health behaviours and obesity prevention in European preschool
children**

Doctoral Dissertation

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“The capacity to learn is a gift; The ability to learn is a skill;

The willingness to learn is a choice.”

- Brian Herbert

Thanks

If we knew what it was we were doing, it would not be called research, would it? -Albert Einstein

In my journey to unravel this complex procedure called research I was lucky enough to have amazing guides that stood by my side. First and foremost, my supervisor Prof. Yannis Manios who trusted me with several projects and tasks that contributed to my research experience even from my undergraduate years. His foresight and inquisitive nature opened new horizons and stretched my thinking and learning eagerness even further. Special thanks are also owed to Prof. Lambros Sidossis and Prof. Antonis Zampelas as well as the members of the committee whose advice and comments were vital to the current work.

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Περίληψη

Ο επιπολασμός του υπέρβαρου και της παχυσαρκίας έχει αυξηθεί σημαντικά τα τελευταία 30 χρόνια, τόσο σε ενήλικες όσο και σε παιδιά. Διάφορες παρεμβάσεις δοκιμάζονται σε νεαρή ηλικία προκειμένου να αποφευχθεί η παιδική παχυσαρκία και να βελτιωθούν οι συμπεριφορές που σχετίζονται με την ενεργειακή ισορροπία (EBRBs). Η τρέχουσα εργασία είχε στόχο να αξιολογήσει την αποτελεσματικότητα της παρέμβασης ToyBox στα EBRBs των παιδιών και των ανθρωπομετρικών δεικτών τους, τη διερεύνηση των καθοριστικών παραγόντων της οικογένειας που πιθανώς να διαμεσολαβούν στην αποτελεσματικότητα της παρέμβασης ToyBox στην κατανάλωση νερού καθώς και υγιεινών και ανθυγιεινών σνακ των παιδιών προσχολικής ηλικίας.

Μια παρέμβαση που στόχευε στην προώθηση της κατανάλωσης νερού, της υγιεινής διατροφής και ενδιάμεσων γευμάτων, της σωματικής άσκησης και της μείωσης / διακοπής του καθιστικού χρόνου στα παιδιά προσχολικής ηλικίας και στις οικογένειές τους, εφαρμόστηκε σε έξι ευρωπαϊκές χώρες για ένα σχολικό έτος και αξιολογήθηκε σε μια τυχαιοποιημένη δοκιμή. Τα επίπεδα σωματικής δραστηριότητας των παιδιών καταγράφηκαν χρησιμοποιώντας βηματομετρητές για έξι συνεχόμενες ημέρες, συμπεριλαμβανομένων δύο ημερών σαββατοκύριακου. Οι συμπεριφορές που σχετίζονται με την ενεργειακή ισορροπία, συμπεριλαμβανομένων των πιθανών διαμεσολαβητών τους, καταγράφηκαν από τους γονείς/φροντιστές των παιδιών χρησιμοποιώντας τυποποιημένα ερωτηματολόγια. Το βάρος και το ύψος των παιδιών μετρήθηκαν από εκπαιδευμένους ερευνητές, χρησιμοποιώντας τυποποιημένο εξοπλισμό. Όλες οι μετρήσεις πραγματοποιήθηκαν τον Μάιο/Ιούνιο του 2012 και τον Μάιο/Ιούνιο του 2013. Πραγματοποιήθηκαν πολυεπίπεδες επαναλαμβανόμενες αναλύσεις για την αξιολόγηση των επιδράσεων παρέμβασης στα EBRBs και τα ανθρωπομετρικά χαρακτηριστικά των παιδιών, ενώ τα αποτελέσματα για τους διαμεσολαβητικούς παράγοντες αξιολογήθηκαν με τη διαδικασία bootstrapping.

Στο συνολικό δείγμα, στην ομάδα παρέμβασης παρατηρήθηκε μεγαλύτερη αύξηση της κατανάλωσης νερού, μεγαλύτερη μείωση των συσκευασμένων χυμών φρούτων, γλυκών και προϊόντων κρέατος, μικρότερη αύξηση του χρόνου που αφιερώνεται σε PC/βιντεοπαιχνίδια (τις καθημερινές και τα σαββατοκύριακα) και μικρότερη μείωση των βημάτων τα σαββατοκύριακα σε σύγκριση με τα παιδιά που ανήκαν στην ομάδα ελέγχου. Παρόμοια αποτελέσματα παρατηρήθηκαν σε επίπεδο χώρας, ενώ πρόσθετα ευνοϊκά αποτελέσματα για την ομάδα παρέμβασης παρατηρήθηκαν στη Γερμανία σχετικά με τα ζαχαρούχα ροφήματα και στο Βέλγιο

σχετικά με τα αλμυρά σνακ και το χρόνο παρακολούθησης τηλεόρασης τα σαββατοκύριακα. Στους ανθρωπομετρικούς δείκτες δεν παρατηρήθηκαν σημαντικές επιδράσεις της παρέμβασης.

Όσον αφορά τις επιδράσεις της παρέμβασης σε καθοριστικούς παράγοντες που σχετίζονται με την οικογένεια, η παρέμβαση ToyBox αύξησε σημαντικά τη διαθεσιμότητα νερού κατά τη διάρκεια των γευμάτων, την κατανάλωση νερού από τους γονείς, τη γονική ενθάρρυνση στα παιδιά ώστε να πίνουν νερό και τη γονική γνώση σχετικά με τις συστάσεις για την κατανάλωση νερού. Στο συνολικό μοντέλο, όλοι οι παράγοντες συσχετίστηκαν ανεξάρτητα με την κατανάλωση νερού σε παιδιά προσχολικής ηλικίας και διαμεσολαβούσαν το αποτέλεσμα της παρέμβασης στην κατανάλωση νερού (συνολική επίδραση διαμεσολάβησης = 40%).

Παρόλο που η συνολική επίδραση της παρέμβασης ToyBox στα υγιεινά και ανθυγιεινά σνακ δεν ήταν σημαντική, η παρέμβαση βελτίωσε σημαντικά τη θέσπιση κανόνων από τους γονείς σχετικά με την κατανάλωση ανθυγιεινών σνακ από τα παιδιά (δηλαδή περιορισμός τους κατά την παρακολούθηση τηλεόρασης και άδεια για την κατανάλωσή τους μόνο σε ορισμένες περιπτώσεις) και την κατανάλωση ανθυγιεινών σνακ των γονέων, ενώ αύξησε τη γονική γνώση σχετικά με τις συστάσεις για την κατανάλωση σνακ. Όσον αφορά τα υγιεινά σνακ, η παρέμβαση ToyBox βελτίωσε τη στάση των παιδιών απέναντι στα φρούτα και τα λαχανικά. Όλοι οι προαναφερθέντες καθοριστικοί παράγοντες διαμεσολαβούσαν στην επίδραση της παρέμβασης στην κατανάλωση υγιεινών και ανθυγιεινών σνακ από τα παιδιά προσχολικής ηλικίας, ενώ σχεδόν όλοι οι καθοριστικοί παράγοντες συσχετίστηκαν ανεξάρτητα με την κατανάλωση υγιεινών και ανθυγιεινών σνακ από παιδιά.

Η προσιτή και χαμηλού κόστους παρέμβαση, η οποία πραγματοποιήθηκε από το προσωπικό του νηπιαγωγείου και ενέπλεξε ενεργά τους γονείς, έδειξε ότι μπορεί να προκαλέσει ευνοϊκές αλλαγές στα EBRBs των παιδιών προσχολικής ηλικίας. Οι παρεμβάσεις που αποσκοπούν στην προώθηση της κατανάλωσης νερού και υγιεινών σνακ και στον περιορισμό της κατανάλωσης ανθυγιεινών σνακ σε παιδιά προσχολικής ηλικίας, θα πρέπει να στοχεύουν τους διαμεσολαβητές που αναδείχθηκαν από την παρούσα μελέτη, αλλά και να προσδιορίζουν νέους καθοριστικούς παράγοντες που σχετίζονται με την οικογένεια, το σχολείο ή τους συναδέλφους, για να βελτιώσουν την αποτελεσματικότητά τους.

Λέξεις κλειδιά: διαμεσολαβητικοί παράγοντες, παιδιά προσχολικής ηλικίας, παρέμβαση, κατανάλωση νερού, κατανάλωση ενδιάμεσων γευμάτων

Abstract

The prevalence of overweight and obesity has increased substantially over the past 30 years, in both adults and children. Interventions are tested in early childhood in order to prevent childhood obesity and improve energy balance related behaviours (EBRBs). The current work aimed to evaluate the effectiveness of the ToyBox-intervention on children's EBRBs and anthropometric indices, to examine if family-related determinants mediate the effects of the ToyBox-intervention on pre-schoolers' water consumption as well as the consumption of healthy and unhealthy snacks.

A multicomponent, kindergarten-based, family-involved intervention, aiming to promote water consumption, healthy eating and snacking, physical activity and reduction/interruption of sedentary time in preschool children and their families was implemented in six European countries over one school year and evaluated in a cluster-randomized trial. Children's physical activity levels were recorded using pedometers worn over six consecutive days, including two weekend days. Other EBRBs data, including their possible mediators, were self-reported by their parents/caregivers using standardized questionnaires. Children's weight and height were measured by trained researchers, using standardized equipment. All measurements were performed in May/June 2012 and May/June 2013. Multilevel repeated measures analyses were performed to assess the intervention effects on EBRBs and anthropometrics, while mediation effects were assessed with the bootstrapping procedure.

In the total sample, higher increase of children's water consumption, higher decrease of children's pre-packed/bottled fruit juices, sweets and meat products consumption, lower increase of their time spent on PC/video games (on weekdays and weekends) and lower decrease of children's steps on weekends were observed in the intervention group compared to the control group. Similar effects were observed at a country level, while additional favourable effects for the intervention group were observed in Germany regarding sugar-sweetened beverages and in Belgium regarding salty snacks and TV-time on weekends. No significant effects were observed regarding the anthropometric indices.

Regarding the intervention effects on family-related determinants, the ToyBox-intervention significantly increased water availability during meals, parental water consumption, parental encouragement to their children to drink water, and parental knowledge on water recommendations. In the multiple mediator model, all factors were independently associated

with pre-schoolers' water consumption and mediated the intervention effect on pre-schoolers' water consumption (total mediation effect = 40%).

Even though the total effect of the ToyBox-intervention on healthy and unhealthy snacking was not significant, the ToyBox-intervention significantly improved parental rule setting on children's unhealthy snack consumption (i.e. restriction of snacking while watching television and permission only at certain occasions) and parental consumption of unhealthy snacks, while it increased parental knowledge on snacking recommendations. Regarding healthy snacking, the ToyBox-intervention improved children's attitude towards fruit and vegetables (F&V). All previously mentioned family-related determinants mediated the intervention effects on pre-schoolers' consumption of healthy and unhealthy snacks. Almost all family-related determinants examined in the study were independently associated with pre-schoolers' consumption of healthy and unhealthy snacks.

An affordable, low-cost intervention, which was implemented by kindergarten-personnel and actively engaged parents, showed that it can induce favourable changes of EBRBs in preschool children. Interventions aiming to promote water and F&V consumption and limit the consumption of unhealthy snacks in pre-schoolers should target the aforementioned mediators, but also identify new family-, school- or peer-related determinants, to enhance their effectiveness.

Keywords: mediators, preschool children, intervention, water consumption, snack consumption

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Abbreviations

| | |
|--------------|------------------------------------|
| BMI | Body Mass Index |
| CI | Confidence Interval |
| EBRBs | Energy Balance-Related Behaviours |
| ELM | Elaboration Likelihood Model |
| FFQ | Food Frequency Questionnaire |
| FV | Fruits and Vegetables |
| HBM | Health-Belief Model |
| IOTF | International Obesity Task Force |
| LMIC | Low-To-Middle Income Country |
| NCD | Non-Communicable Disease |
| NGO | Non-Governmental Organization |
| NIH | National Institutes of Health |
| OR | Odds Ratio |
| PA | Physical Activity |
| PCM | Persuasion-Communication Matrix |
| PCQ | Primary Caregivers' Questionnaire |
| PE | Physical Education |
| SCT | Social Cognitive Theory |
| SES | Socioeconomic Status |
| SSBs | Sugar Sweetened Beverages |
| TIP | Theories of Information Processing |
| TL | Theories of Learning |
| TSR | Theory of Self-Regulation |
| TV | Television |
| WHO | World Health Organization |

Chapter 1. Introduction

The prevalence of overweight and obesity has increased substantially over the past 30 years (WHO, 2011). It is estimated that about 170 million children are now estimated to be overweight globally (Tim Lobstein, Baur, & Uauy, 2004). Childhood overweight is on the rise in almost all countries, especially in low-to-middle-income countries (LMICs) (WHO, 2011).

Being overweight or obese has serious health consequences, especially for children. Having a high body mass index (BMI) is a major risk factor for diseases such as cardiovascular disease, type 2 diabetes and cancer (Ezzati, Lopez, Rodgers, & Murray, 2004; Fund & Research, 2007). These diseases, also known as non-communicable diseases (NCDs), can cause premature mortality as well as long-term morbidity. Further to the above, overweight and obesity in children are associated with significant reductions in life quality (Tsiros et al., 2009; Williams, Wake, Hesketh, Maher, & Waters, 2005) and a greater risk of bullying and social isolation (Tim Lobstein et al., 2004). Due to the significant increase in the prevalence of obesity and the serious public health consequences, obesity is considered one of the most important public health challenges of the 21st century (WHO, 2005, 2011).

Overweight preschool children are about four times more likely to become overweight adults in comparison to their lean peers (Olstad & McCargar, 2009). Reducing the excess weight has proven to be more difficult in adolescents and adults in comparison to children, therefore, there is growing consensus that obesity prevention strategies should target on early childhood (Osei-Assibey et al., 2012) when behaviours are more flexible than in later life (Skouteris et al., 2012).

Preschool age, together with intrauterine life and infancy, are considered as 'critical periods' for children development and therefore their risk of developing obesity (Olstad & McCargar, 2009). Early childhood is considered to provide a unique opportunity to establish lifestyle behaviours that will promote health and minimize the risk of development of fatness (Campbell & Hesketh, 2007) while it can also be beneficial in order to promote physical activity as young children are responsive to environmental control for both eating and physical activity by either the day care providers and/or parents (Goldfield, Harvey, Grattan, & Adamo, 2012) consider.

Obesity

Weight status is categorized in adults using body mass index (BMI), which is defined as weight in kilograms divided by height in meters squared (kg/m^2) (Ogden, Flegal, Carroll, & Johnson, 2002).

Based on the National Institutes of Health (NIH) guidelines an adult's weight status is defined as underweight if the calculated BMI is less than 18.5, overweight if BMI is between 25 and 30, and obese if BMI is 30 or more (Berrington de Gonzalez et al., 2010). Despite its considerable advantages, BMI has some limitations. The relationship between BMI and body fat varies based on age or ethnicity. BMI can also overestimate body fat in muscular individuals (Prentice & Jebb, 2001). Using BMI to assess overweight and obesity in children is even more controversial. Based on the fact that children are growing, the association between adiposity and BMI (which indicates a ratio of their weight to their height) may be looser than in the case of adults.

However, it has been noted that BMI offers "a reasonable measure with which to assess fatness in children and adolescents" (Dietz & Bellizzi, 1999). Recently, the extended international (International Obesity Task Force; IOTF) body mass index (BMI) cut-offs were published and are widely used to assess the prevalence of child overweight, obesity and thinness. Based on data from six countries, BMI values at 18 years (16, 17, 18.5, 25, 30 and 35 kg/m²) have been linked to child centiles. The IOTF cut-offs can also be expressed as BMI centiles, allowing them to be compared with other BMI references. Children's weight status is defined as overweight or obese if they have a BMI above given age- and sex-specific percentile cut-offs.

Epidemiological Data

The obesity prevalence worldwide has escalated during the last three decades and has been recognized as a global health threat (WHO, 2000). About 300 million adults are obese (Control & Prevention, 2000) and a further 750 million are estimated to be overweight globally (James et al., 2004).

Obesity in children follows the same trend as adults, with IOTF estimating that 10% of the children aged from 5 to 17 years are overweight or obese worldwide. This percentage equates to 155 million children, with 30-45 million children being obese (Tim Lobstein et al., 2004). In 2010, 43 million preschool children in developing and developed countries were estimated to be overweight or obese, while 92 million were estimated to be 'at risk' of overweight (De Onis, Blössner, & Borghi, 2010). The issues with prevalence data in children immerge from the lack of consensus on defining obesity. Even though the highest rates of obesity in children and adults appear in developed areas of the world such as North America and Western Europe, developing countries are currently facing rising rates of obesity and consequently increased incidence of

non-communicable diseases (Amuna & Zotor, 2008). This phenomenon is even more prevalent in countries undergoing rapid socioeconomic growth such as Brazil and China, where the prevalence of overweight and obesity in children and adolescents has risen sharply in recent years (Tim Lobstein et al., 2004).

In the developed world, USA illustrates an example of the severity of the obesity pandemic. In US children, obesity prevalence has increased from 6% in 1980 to 17% in 2008 (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010) and 18.5% in 2016 (Hales, Fryar, Carroll, Freedman, & Ogden, 2018). In Europe, the trend of childhood obesity is following the same pattern, with prevalence increasing across all European countries (Jackson-Leach & Lobstein, 2006). However, in Europe, a clear North-South gradient, with the highest prevalence being in Mediterranean countries, (an estimated 36% of 9 year olds are overweight or obese in Italy) is observed (Tim Lobstein et al., 2004; Pigeot et al., 2009).

Aetiology & Determinants of childhood obesity

Overweight and obesity is the result of a long-term imbalance between energy intake and energy expenditure (Bandini, Must, Phillips, Naumova, & Dietz, 2004). Although certain genes may increase an individual's susceptibility to obesity, it is energy imbalance that leads to weight gain on the vast majority of cases (Ells, Demaio, & Farpour-Lambert, 2018). For weight loss to occur, energy expenditure must exceed energy intake. Literature has not reached consensus as to how differing combinations of diet, physical activity and sedentary behaviour impact the development of obesity.

Regarding dietary factors, drinking water instead of sugar sweetened beverages (SSBs) may be an effective approach to control pre-schoolers' energy intake and body weight, since SSBs consumption has been found to be associated with higher BMI in this age group (van Stralen et al., 2012). Regarding food intake, several studies have shown an association between consumption of energy-dense foods, such as sweets and salty snacks, and excessive weight in pre-school children (Durao et al., 2015). On the other hand, diets high in fruit and vegetables (FV) have been associated with reduced risk for obesity in children (Moschonis et al., 2014).

Physical activity (PA) has been shown to have a protective effect against weight gain in childhood (Steinbeck, 2001) while, on the other hand physical inactivity can contribute to the maintenance of childhood obesity (Trost, Kerr, Ward, & Pate, 2001). Studies show that most children are not

reaching the recommended levels of 60 minutes of moderate intensive activity per day and 180 minutes of activity per day for preschool children despite the widespread perception that young children are spontaneously active (Reilly et al., 2004; Timmons, Naylor, & Pfeiffer, 2007). Evidence suggests that children's physical activity or inactivity track into adolescence and adulthood (Campbell & Hesketh, 2007).

In addition to physical activity, sedentary behaviour has become an important component within health promotion interventions and it should be assessed independently from physical activity (Reilly et al., 2003). Sedentary activities which have been linked to an increase in childhood obesity include television (TV) viewing, video games and computer screen time, however, the evidence is cross-sectional and cannot support causality (Rey-Lopez, Vicente-Rodríguez, Biosca, & Moreno, 2008). It has been suggested that in order to prevent childhood obesity targeting a reduction in sedentary behaviour may be more effective than targeting increases in physical activity (Reilly et al., 2003).

Other factors influencing a child's health behaviours and, consequently childhood obesity include parental factors and family determinants. Parental influence is complex and encompasses parenting styles (authoritarian, authoritative and permissive), parental modelling and control as well as feeding practices. Other factors that are associated with children's diet include appetite and satiety responsiveness, food preferences, food availability and accessibility, exposure and reward, role models and peer influences.

Interventions to prevent obesity in childhood

Whilst obesity prevention interventions conducted in primary schools are numerous, interventions targeting children in preschool settings are lacking. A recent literature review included 37 articles from 29 unique interventions. Eight out of 23 prevention and 4 out of 6 management interventions resulted in significant weight loss, with 3 prevention and 5 management interventions showing sustained effects over 6 to 24 months. This result is to be expected since prevention programs do not necessarily need to reduce the BMI of the participants (Ling, Robbins, & Wen, 2016). In another recent systematic review (Hesketh & Campbell, 2010), 9 out of the 10 included preschool-based interventions demonstrated some degree of success in modifying behaviours, however, only 2 were shown to have any impact on

modifying behaviours such as physical activity and healthy eating, and reducing BMI (Fitzgibbon et al., 2005; Mo-suwan, Pongprapai, Junjana, & Puetpaiboon, 1998).

Many recommendations and strategies are currently available for intervention design targeting overweight and obesity prevention. More specifically, Bluford et al. (Bluford, Sherry, & Scanlon, 2007) support the use of a theoretical framework when developing preschool interventions while parental involvement is also suggested in order to enhance effectiveness since their modelling behaviour is a powerful tool (Hart, Herriot, Bishop, & Truby, 2003; Skouteris et al., 2011). Further research is required to determine which factors and methodologies are most effective in preschool settings (Bluford et al., 2007).

Chapter 2. Research Hypothesis

The prevalence of overweight and obesity in pre-schoolers has drastically increased worldwide over the past decades (Wang & Lim, 2012). More specifically, the prevalence of overweight and obesity in children aged 0-5 years has increased globally from 4.2% in 1990 to 6.7% in 2010 and it is estimated to reach 9.1% in 2020, while the respective percentages in developed countries are even more unsettling (i.e. 7.9, 11.7 and 14,1) (Wang & Lim, 2012). Although obesity is the result of complex interactions among genes, dietary intake, physical activity, and the environment, the most important factors underlying the obesity epidemic are the current opportunities of energy intake coupled with limited energy expenditure (Romieu et al., 2017). Early interventions are required to prevent obesity when health behaviours are still flexible.

Hence, the aims of the current thesis are:

1. to evaluate an innovative and evidence-based intervention aiming to prevent obesity in preschool children, aged 4-6 years
2. to explore the effects of the intervention on family-related factors associated with pre-schoolers' energy-related behaviours,
3. to identify potential associations between changes of these factors and changes of pre-schoolers' energy-related behaviours, and
4. to evaluate the potential mediating role of these factors on the intervention effects on pre-schoolers' energy-related behaviours.

Based on the fact that family dynamics including family rules, modelling, support and encouragement are important determinants of the child's energy-related behaviour (Wilfley, Kass, & Kolko, 2011), emphasis will be given to the family-related mechanisms mediating the effect of the intervention in preschool children's energy-related behaviours.

Chapter 3. Methodology

The Toybox intervention was developed using an evidence-based approach; utilising the findings of reviews and a systematic review of behavioural models on school-based interventions in kindergartens for the prevention of obesity in children aged 4-6 years (Summerbell et al., 2012). Physical activity, sedentary behaviour, and healthy eating recommendations are highlighted for developing a preventive intervention targeting preschool children as depicted in table 3.1 below:

Table 3.1. Physical activity, sedentary behaviour, and healthy eating recommendations.

| Target area | Dietary behaviour | Physical activity | Sedentary behaviour |
|----------------|--|---|---|
| Recommendation | Encourage the provision of a broad variety of healthy foods especially fruit and vegetables and discourage the provision of unhealthy foods such as sweetened soft drinks and energy dense snacks. Discourage the behaviour of eating while watching TV or using game consoles. | Encourage the use of active transport Encourage the development of a large, active play enhancing all-weather play area in preschools. | Discourage the provision of a screen in the bedroom (TV, computer, PlayStation etc.). |

The detailed study design has been published elsewhere (Manios et al., 2014; Manios et al., 2012). In brief, the ToyBox-study (www.toybox-study.eu) aimed to develop, implement and evaluate a kindergarten-based, family-involved intervention to prevent obesity in preschool children in six European countries (Belgium, Bulgaria, Germany, Greece, Poland and Spain). Preschool children and their families were recruited from three socioeconomic groups, following a standardized approach (Manios et al., 2014).

The study has been registered in the clinical trials registry [clinical_trials.gov](https://clinicaltrials.gov) (ID: NCT02116296). Moreover, it was approved by Ethical Committees in the six participating countries [i.e. Ethical committee of Ghent University Hospital (Belgium), Committee for the Ethics of the Scientific

Studies (KENI) at the Medical University of Varna (Bulgaria), Ethikkommission der Ludwig Maximilians Universität München (Germany), the Ethics Committee of Harokopio of Athens (Greece), Ethical Committee of Children's Memorial Health Institute (Poland), and CEICA (Comité Etico de Investigacion Clinica de Aragon (Spain)], in line with national regulations (Manios et al., 2014). All procedures were in accordance with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Parents/caregivers signed an informed consent for the participation of their child and their family prior to their enrolment in the study.

Sampling: Kindergartens were recruited from the provinces of Oost-Vlaanderen and West-Vlaanderen (Belgium), Varna (Bulgaria), Bavaria (Germany), Attica (Greece), Mazowieckie (Poland) and Zaragoza (Spain). A minimum sample of 800 children and their families and 20 kindergartens per country, resulting in a total sample of 4,800 children and their families and 120 kindergartens, was initially targeted. However, in order to account for an estimated dropout rate of about 30%, a minimum total number of about 6,500 children and their families were aimed to be recruited in the six participating countries.

Eligibility criteria: Kindergartens were considered eligible for inclusion in the intervention if (i) they were located within a radius of 50 km around the local institutes; (ii) headmasters and teachers provided signed consent form and (iii) families'/children's participation rate was at least 50%. Children within recruited kindergartens were eligible if (i) they were aged between 3.5 and 5.5 years at the time of recruitment (i.e. born between January 2007 and December 2008); (ii) their parents/caregivers provided a signed consent form and (iii) were not participating in any other clinical trial or other health-oriented project during the academic years 2012–2013 and 2013–2014.

Randomization: Randomization of the recruited municipalities to intervention and control group was conducted centrally by the coordinating centre, after the completion of baseline measurements. The municipalities were assigned to the intervention or control group in a 2 : 1 ratio within each SES group. Since the randomization was conducted at a municipality level, the kindergartens within each municipality were automatically allocated to the intervention or control group.

Development of the intervention

The ToyBox-intervention had a clustered randomized design. It targeted the energy balance-related behaviours (EBRBs) which in the preliminary phases of the programme were found to be associated with overweight/obesity at preschool age, i.e.: drinking-, snacking-, physical activity- and sedentary- behaviours, as well as their determinants (Marieke De Craemer et al., 2013; Manios et al., 2014; van Stralen et al., 2012). All material used during the intervention was the same across participating countries, allowing for some small cultural adaptations at a local level. The development of the intervention material was based on the intervention mapping protocol and the PRECEDE-PROCEED model, as described elsewhere (Manios et al., 2014; Manios et al., 2012). Furthermore, the intervention was developed based on the findings of preparatory studies conducted during the early phases of the ToyBox-study (PRECEDE phase) (20–24). The relative intervention material can be found in the study's website (www.toybox-study.eu).

Implementation of the ToyBox-intervention

The implementation of the ToyBox-intervention was conducted at four levels. The first three levels were implemented in the kindergarten setting, while the fourth level addressed parents/caregivers aiming to induce certain changes at children's social and physical environment at home in order to promote the four targeted EBRBs. More specifically:

Level 1. Teachers conducted permanent environmental changes in the classroom/kindergarten, in order to create a classroom and kindergarten environment supportive to the execution of the four targeted EBRBs (i.e. installations of water stations and the 'magic snack plate' to assist water and healthy snack consumption and rearrangements of the classroom/kindergarten to create some free space to assist children's movement breaks and physical activity).

Level 2. Teachers promoted the four targeted EBRBs on regular basis and predefined time within each day, in the classroom/kindergarten, aiming at total class participation (i.e. reminding every day children to drink water regularly and do short movement breaks twice in the morning and twice in the afternoon, arranging a daily break for the whole class to eat healthy snacks and performing two physical education sessions per week with a duration of 45 minutes each).

Level 3. Teachers implemented interactive classroom activities, aiming at total class participation, minimum for 1 hour per week (e.g. children's participation in experiments, kangaroo stories with

children following the movements described in the stories, etc.). Teachers were also instructed to use the kangaroo puppet and perform these four EBRBs themselves, so as to enhance the effects of the intervention via role modelling.

Level 4. Parents/caregivers were encouraged and advised via simple and friendly to read material (nine newsletters and eight tip cards, as well as four posters which were coloured by their child, images 3.1 & 3.2 below) to apply relevant environmental changes at home, act as role models and implement these lifestyle behaviours together with their children.



Image 3.1. Poster on water consumption

Caregivers' Questionnaire (PCQ) measuring socio-demographic factors, lifestyle behaviours and perinatal factors, as well as a food frequency questionnaire (FFQ) which was developed based on a previously validated FFQ (Huybrechts, De Backer, De Bacquer, Maes, & De Henauw, 2009). Monthly logbooks were kept for the teachers in order to assess the intervention's fidelity.

Statistical Analysis

Descriptive statistics describing the baseline characteristics of the participating children per intervention or control group will be conducted in SPSS 23.0 (IBM) (Inc., [2010-08-29].). Differences between these two groups will be tested using independent t-tests for continuous variables or chi-square tests for dichotomous variables. Missing data will be imputed for the food items under study using the "multiple imputation" macro in SPSS 23.0.

Mediation effects will be assessed with bootstrapping procedure (Mackinnon et al) following mediation analysis steps: 1. Estimating the effect of the intervention on a specific behaviour (i.e. water consumption or unhealthy snacking and FV consumption) (c-coefficient); 2. Estimating the effect of the intervention on the proposed mediator (a-coefficient); 3. Estimating the effect of the mediator on the specific behaviour (i.e. water consumption or unhealthy snacking and FV consumption) (b-coefficient) adjusting for the intervention effect (c'-coefficient); 4. Computing the indirect effect of the intervention on the specific behaviour (i.e. water consumption or unhealthy snacking and FV consumption) via the proposed mediator (ab-coefficient); and 5. Bootstrapping the sampling distribution of ab and deriving a bias corrected confidence interval with 5,000 bootstrapped sampling distribution.

All models will be adjusted for age, sex, maternal education, country, baseline level of the specific behaviour (i.e. water consumption or unhealthy snacking and FV consumption) and baseline level of the mediator. It will be tested if adding a random intercept for kindergarten site will improve the model fit. Mediation analysis will run in Mplus 8.0 (Muthén, 1998-2012).

Chapter 4. Results

4.1 Study I: Effects of an obesity prevention intervention (the ToyBox-study) on body weight and key energy balance-related behaviours in 6,290 pre-school children across Europe: a cluster-randomized controlled trial.

Introduction

The high prevalence of overweight and obesity calls for early prevention strategies (T. Lobstein et al., 2015). Childhood is a critical period of life for adopting healthy energy balance related behaviours (EBRBs) and preventing unhealthy lifestyle and excessive weight gain later in life (Craigie, Lake, Kelly, Adamson, & Mathers, 2011; Singh, Mulder, Twisk, van Mechelen, & Chinapaw, 2008). Moreover, school is a convenient setting for approaching many children and their families simultaneously and implementing low-cost, scalable interventions by using existing facilities, equipment and personnel.

The effectiveness of school-based, obesity prevention interventions has previously been found to be limited (Flynn et al., 2006; Khattar, 2015). The ToyBox-study aimed to develop, implement and evaluate a multicomponent, kindergarten-based, family-involved intervention to prevent obesity at preschool age (Manios et al., 2012). The Intervention Mapping Protocol was used to develop the ToyBox-intervention (Bartholomew LK, 2011; M. De Craemer et al., 2014; De Decker et al., 2014). Based on this procedure the EBRBs which were found to be associated with obesity at preschool age provided the relevant programme objectives, i.e. increasing water consumption, improving healthy snacking (in the morning and in the afternoon), increasing physical activity levels and decreasing/interrupting prolonged sedentary time (i.e. time devoted to TV/DVD-viewing, PC/video games use and quiet play) (te Velde et al., 2012; van Stralen et al., 2012). The determinants of these EBRBs were also identified and targeted in the ToyBox-intervention (Marieke De Craemer et al., 2013; De Decker et al., 2013; Manios et al., 2014). The effectiveness of the ToyBox-intervention was tested at different levels (i.e. evaluation of impact, outcome and process, as well as assessment of cost-effectiveness of the intervention) (Androutsos, Apostolidou, et al., 2014; Mouratidou et al., 2014; Pil et al., 2014).

The current paper reports on the effectiveness of the ToyBox-intervention regarding the targeted preschool children's EBRBs, namely children's dietary, physical activity and sedentary behaviours and children's anthropometric indices.

Methods

Study design

The ToyBox-study (www.toybox-study.eu) adhered to the Declaration of Helsinki and the conventions of the Council of Europe on human rights and biomedicine and has been registered in clinicaltrials.gov (ID: NCT02116296). Before the execution of the study, all countries received ethical clearance from the local authorities and all study participants (headmasters/teachers, parents/caregivers and their children) signed a consent form before being enrolled in the study (Manios et al., 2014). Regarding the eligibility criteria, it was required that: (a) kindergartens were located within a radius of 50 Km around the local Institutes, (b) participants (i.e. parents/caregivers and headmasters/teachers) signed a consent form, (c) families'/children's participation rate per kindergarten was $\geq 50\%$, (d) children's age at baseline was 3.5-5.5 years (i.e. born within January 2007-December 2008) and (e) children were not participating in other clinical trials or health-related projects at the same time period (Manios et al., 2014).

The detailed study design has been published elsewhere (Manios et al., 2014; Manios et al., 2012). In brief, the ToyBox-intervention had a cluster randomized design and it was conducted during the school year 2012-2013 in six European countries, namely Belgium, Bulgaria, Germany, Greece, Spain and Poland. Preschool children and their families were recruited from three socioeconomic groups, following a standardized approach. The randomization was conducted centrally for all centres by the Coordinating centre at a municipality level, in order to avoid contamination among kindergartens within the same municipality. The recruited municipalities were assigned to the intervention or control group in a 2:1 ratio within each socioeconomic group.

Implementation of the ToyBox-intervention

The ToyBox-intervention targeted four EBRBs: drinking-, snacking-, physical activity- and sedentary- behaviours, as well as their determinants (De Decker et al., 2013; Manios et al., 2014; te Velde et al., 2012; van Stralen et al., 2012). The implementation of the ToyBox-intervention was conducted at four levels. The first three levels were implemented in the kindergarten setting, while the fourth level addressed parents/caregivers aiming to induce certain changes at children's social and physical environment at home in order to promote the four targeted EBRBs. More specifically:

Level 1. Teachers conducted permanent environmental changes in the classroom/kindergarten, in order to create a classroom and kindergarten environment supportive to the execution of the four targeted EBRBs (i.e. installations of water stations and the 'magic snack plate' to assist water and healthy snack consumption and rearrangements of the classroom/kindergarten to create some free space to assist children's movement).

Level 2. Teachers promoted the four targeted EBRBs on regular basis and predefined time within each day, in the classroom/kindergarten, aiming at total class participation (i.e. reminding every day children to drink water regularly and do short movement breaks twice in the morning and twice in the afternoon, arranging a daily break for the whole class to eat healthy snacks and performing two physical education sessions per week with a duration of 45 min each).

Level 3. Teachers implemented interactive classroom activities, aiming at total class participation, minimum for 1 h per week (e.g. children's participation in experiments, kangaroo stories with children following the movements described in the stories, etc.). Teachers were also instructed to use the kangaroo hand puppet and perform these four EBRBs themselves, so as to enhance the effects of the intervention via role modelling.

Level 4. Parents/caregivers were encouraged and advised via simple to read and friendly material (nine newsletters and eight tip cards, as well as four posters which were coloured by their child) to apply relevant environmental changes at home, act as role models and implement these lifestyle behaviours together with their children.

Measures

Standardized time plan, material, protocols and tools were used across all participating countries regarding the implementation, process-, impact- and outcome- evaluation and assessment of cost-effectiveness of the ToyBox-intervention (Androutsos, Apostolidou, et al., 2014; Mouratidou et al., 2014; Pil et al., 2014). All measurements and data collection for impact and outcome evaluation were performed during the same time period at baseline and follow-up (i.e. May/June 2012 and May/June 2013, respectively), in order to avoid potential seasonality effects. The primary outcome of the ToyBox-intervention was children's BMI, while the secondary outcomes included children's EBRBs. The study was powered to assess both parameters; the procedure has been published elsewhere (Manios et al., 2014).

Children's weight and height were measured, using standard protocol and equipment which was calibrated before and during the period of data collection. All measurements were taken by research assistants, who were rigorously trained to achieve very good intra- and inter- observed reliability agreement before the initiation of the study (De Miguel-Etayo et al., 2014). Three measurements of children's weight to the nearest 100 g using electronic scales (types SECA 861 and SECA 813; Seca, Hamburg, Germany) and height to the nearest 0.1 cm using a portable stadiometer (types SECA 225 and SECA 214; Seca) were taken. Weight status was categorized to normal weight, overweight or obesity, based on children's BMI z-scores which were calculated with the use of LMS parameters and cut-off criteria provided by Cole and Lobstein (Cole & Lobstein, 2012).

Children's drinking and snacking behaviour was assessed via a parent-reported food frequency questionnaire (FFQ), which was developed based on a previously validated FFQ developed by Huybrechts et al (Huybrechts et al., 2009) and tested in the preparatory phases of the ToyBox-intervention (unpublished data). More specifically, their usual consumption of water (plain), sugared soft-drinks, home-made freshly-squeezed fruit juices, pre-packed/bottled fruit juices, fresh fruit, vegetables (raw and cooked), sweet snacks (chocolate, dairy-based desserts, cakes, biscuits, pastries and sugar-based desserts), salty snacks and meat products was reported as following. Parents/caregivers reported first the frequency of pre-schoolers' consumption, selecting one of the following categories: "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". Then, they selected the average consumption per day, choosing from categories which were specific for each food item. Parents/caregivers were also asked to indicate the portion size, selecting from categories which were specific for each food item and based on colour images which were given to facilitate the selection of portion sizes. Dietary data were finally recoded to average daily intake values by multiplication of number of days per week and amount per day divided by 7.

Children's physical activity levels were objectively recorded with pedometers (Omron Walking Style Pro Pedometer, HJ-720IT-E2; Omron Healthcare, Kyoto, Japan), which were worn over six consecutive days and their sedentary time (i.e. screen time) was reported separately for weekdays and weekend days by their parents/caregivers via the following questions: "About how many hours a day does your child usually watch television (including DVDs and videos) in his/her free time?" and "About how many hours a day does your child use the computer for activities like playing games on a computer, game consoles (e.g. PlayStation, Xbox, GameCube) during

leisure time?”, with the possible answers being: “Never”, “Less than 30 minutes/day”, “30 minutes to <1 hr/day”, “1-2 hrs/day”, “3-4 hrs/day”, “5-6 hrs/day”, “7-8 hrs/day”, “8 hrs/day”, “More than 8 hrs/day”, “I don’t know”. The reliability of these questions was assessed in the preparatory phases of the ToyBox-intervention and showed good-to-excellent reliability (Gonzalez-Gil et al., 2014).

Case report forms were completed for each subject.

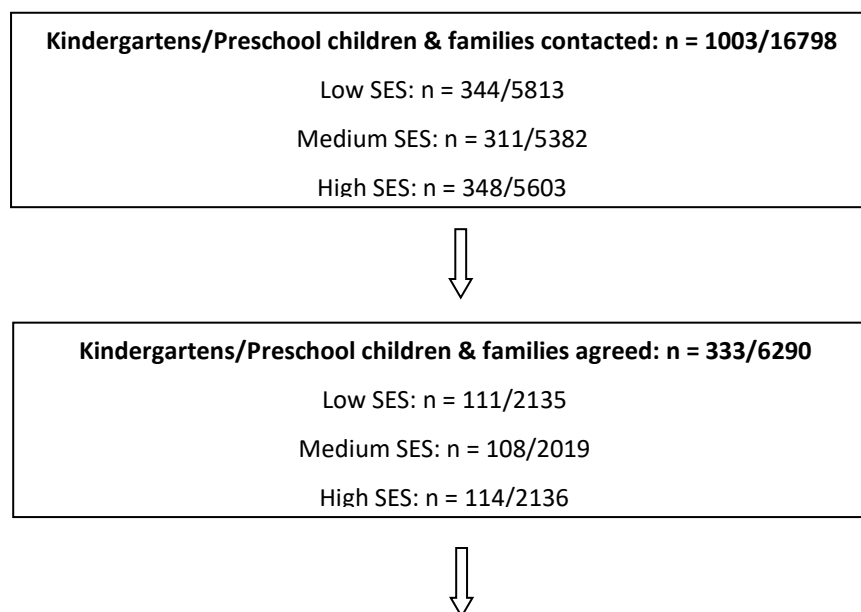
Statistical analysis

The Kolmogorov-Smirnov test was applied to examine the normality of data distribution. Normally distributed data are presented as mean values, whereas skewed variables are presented as median (25th, 75th centiles). Multilevel repeated measures analyses were performed (three levels: ‘country’, ‘kindergarten’, ‘class’) to examine the effects of the ToyBox-intervention on anthropometric indices and EBRBs, taking clustering of preschool children in classes, kindergartens and countries into account. All analyses were adjusted for children’s age and gender and maternal level of education.

Results

In total, 6,290 children and families from 333 kindergartens (179 intervention) participated in the study and out of them 5,529 provided complete data (i.e. anthropometric data 100% completed and parents’/caregivers’ questionnaire at least 75% completed) at baseline and follow-up (Figure 4.1). Participation rate in the total study sample was 63.3%. Children’s and parents’/caregivers’ characteristics at baseline have been previously published (Manios et al., 2014). In brief, children’s mean age was 4.7 ± 0.01 years, 51.9% of the study sample were boys, and subjects (children and their families) were recruited from three socioeconomic strata (i.e. low-, medium- and high-SES municipalities, at a percentage of 34.5%, 32.0% and 33.5%, respectively) (Manios et al., 2014). No adverse event was reported in the case report forms collected in the six participating centres.

Figure 4.1. Kindergartens and preschool children/families that were contacted, entered the ToyBox-programme and provided complete data at baseline and follow-up.



| Country | BMI | Waist circumference | Parental core questionnaire | FFQ | Pedometers |
|--------------|----------------------------|----------------------------|-----------------------------|----------------------------|----------------------------|
| | Total (I/C) | Total (I/C) | Total (I/C) | Total (I/C) | Total (I/C) |
| Total | 6290 (4012/2278) | 6290 (4012/2278) | 5529 (3599/1930) | 4970 (3255/1715) | 3052 (2040/1012) |
| Belgium | 1209 (709/500) | 1209 (709/500) | 1029 (612/417) | 771 (468/303) | 714 (447/267) |
| Bulgaria | 882 (626/256) | 882 (626/256) | 792 (565/227) | 642 (456/186) | 94 (47/47) |
| Germany | 995 (610/385) | 995 (610/385) | 936 (587/349) | 884 (552/332) | 359 (294/65) |
| Greece | 1013 (727/286) | 1013 (727/286) | 854 (633/221) | 825 (612/213) | 458 (329/129) |
| Poland | 1324 (785/539) | 1324 (785/539) | 1065 (653/412) | 1020 (636/384) | 921 (567/354) |
| Spain | 867 (555/312) | 867 (555/312) | 853 (549/304) | 828 (531/297) | 506 (356/150) |

SES = socioeconomic status. I = intervention group. C = control group. BMI = body mass index.

FFQ = food frequency questionnaire

Table 4.1 presents the effects of the ToyBox-intervention on pre-schoolers' percentage of overweight/obesity. No significant change was observed in the total sample and in each country.

Table 4.1. Effectiveness of the ToyBox-intervention on preschool children's percentage of overweight/obesity in the total sample and by country.

| | | % overweight/obese | | | | |
|-----------------|---------|--------------------|----------------|----------------|------------------|--------------------------|
| | | N | T ₀ | T ₁ | Time (β) | Time * group (β) |
| Total | I | 5139 | 14.1 | 15.1 | -0.01 | 0.01 |
| | C | | 13.8 | 14.6 | | |
| | P-value | | | | 0.137 | 0.962 |
| Belgium | I | 959 | 11.2 | 8.7 | 0.03 | 0.01 |
| | C | | 11.5 | 9.0 | | |
| | P-value | | | | 0.040 | 0.875 |
| Bulgaria | I | 735 | 13.7 | 16.3 | -0.01 | -0.01 |
| | C | | 18.8 | 20.2 | | |
| | P-value | | | | 0.531 | 0.727 |
| Germany | I | 777 | 10.6 | 9.2 | -0.02 | 0.03 |
| | C | | 10.4 | 11.3 | | |
| | P-value | | | | 0.164 | 0.045 |
| Greece | I | 814 | 19.5 | 21.8 | -0.06 | 0.03 |
| | C | | 19.3 | 25.2 | | |
| | P-value | | | | 0.004 | 0.173 |
| Poland | I | 1037 | 13.0 | 13.7 | -0.01 | 0.01 |
| | C | | 12.2 | 12.7 | | |
| | P-value | | | | 0.695 | 0.986 |
| Spain | I | 817 | 15.9 | 20.7 | -0.02 | -0.03 |
| | C | | 14.8 | 16.4 | | |
| | P-value | | | | 0.335 | 0.214 |

I = intervention group. *C* = control group. *T*₀ = baseline. *T*₁ = follow-up. All analyses were adjusted for: age, gender and maternal education.

Table 4.2 shows the effects of the ToyBox-intervention on pre-schoolers' drinking behaviour. More specifically, in the total sample it was observed that children both in the intervention and in the control group significantly increased their daily consumption of plain water, however this increase was higher in the intervention group. At a country level, significant intervention effects were observed in Belgium and Poland. Regarding pre-packed/bottled fruit juices, a significantly higher decrease of daily consumption was observed in the intervention group compared to the control group in the total sample and in Spain, while a significant decrease in the intervention group and a significant increase in the control group were observed in Germany. Regarding sugar-sweetened beverages, no significant effects were observed in the total sample. However, a significant decrease in children's sugar-sweetened beverages consumption in the intervention group compared to no change in the control group was observed in Germany.

Table 4.3 shows the effects of the ToyBox-intervention on children's snacking behaviour. Specifically, a significantly higher decrease of children's consumption of sweet snacks was observed in the intervention compared to the control group in the total sample and in Germany, while regarding children's salty snacks consumption a significant decrease was observed only in the intervention group in Belgium. No significant effects were observed regarding children's fruit and vegetables consumption. However, the ToyBox-intervention resulted in significant reduction of children's meat products (e.g. ham, salami, etc.) consumption in the total sample and in Spain.

Table 4.4 presents the effects of the ToyBox-intervention on sedentary behaviour and physical activity. Regarding the percentage of children meeting the threshold of 1 hour/day for screen time on weekdays, a significantly lower increase was observed for the intervention group compared to the control group in the total sample. No significant effects were observed in the percentage of children meeting the threshold of 1 hour/day for screen time on weekend days. No significant effects were observed on the percentage of children meeting the threshold of 10,000 steps/day on weekdays. In contrast, a significantly lower decrease of the percentage of children meeting the threshold of 10,000 steps/day on weekend days was observed in the intervention compared to the control group in the total sample but not at a country level where no effects have been identified.

Table 4.2. Effectiveness of the ToyBox-intervention on preschool children's drinking behaviour in the total sample and by country.

| | | Plain water (cups/day) | | | | | Pre-packed/bottled fruit juice (cups/day) | | | | | Sugar-sweetened beverages (cups/day) | | | | |
|----------|---------|------------------------|----------------|----------------|------------------|------------------|---|----------------|----------------|--------------|------------------|--------------------------------------|----------------|----------------|------------------|------------------|
| | | N | T ₀ | T ₁ | Time (β) | Time * group (β) | N | T ₀ | T ₁ | Time (β) | Time * group (β) | N | T ₀ | T ₁ | Time (β) | Time * group (β) |
| Total | I | 4248 | 2.50 | 2.70 | -0.12 | -0.08 | 3708 | 0.54 | 0.38 | 0.06 | 0.10 | 1966 | 1.23 | 0.83 | 0.32 | 0.08 |
| | C | | 2.40 | 2.51 | | | | 0.52 | 0.46 | | | | 1.27 | 0.96 | | |
| | P-value | | | | <0.001 | 0.037 | | | | 0.001 | <0.001 | | | | <0.001 | 0.107 |
| Belgium | I | 655 | 1.87 | 2.19 | -0.09 | -0.24 | 551 | 0.48 | 0.34 | 0.09 | 0.05 | 355 | 1.50 | 0.95 | 0.49 | 0.06 |
| | C | | 1.91 | 1.99 | | | | 0.50 | 0.42 | | | | 1.66 | 1.17 | | |
| | P-value | | | | 0.121 | 0.003 | | | | 0.004 | 0.224 | | | | <0.001 | 0.582 |
| Bulgaria | I | 500 | 2.99 | 2.99 | -0.20 | 0.20 | 466 | 0.46 | 0.29 | 0.10 | 0.06 | 284 | 0.92 | 0.59 | 0.25 | 0.04 |
| | C | | 2.89 | 3.07 | | | | 0.40 | 0.30 | | | | 0.80 | 0.55 | | |
| | P-value | | | | 0.032 | 0.081 | | | | 0.006 | 0.200 | | | | 0.001 | 0.684 |
| Germany | I | 696 | 2.21 | 2.44 | -0.14 | -0.10 | 537 | 0.59 | 0.38 | -0.01 | 0.22 | 252 | 1.22 | 0.74 | 0.01 | 0.48 |
| | C | | 2.11 | 2.26 | | | | 0.52 | 0.53 | | | | 0.88 | 0.88 | | |
| | P-value | | | | 0.048 | 0.286 | | | | 0.946 | 0.003 | | | | 0.904 | 0.001 |
| Greece | I | 719 | 2.91 | 3.02 | -0.11 | 0.01 | 659 | 0.34 | 0.21 | 0.07 | 0.05 | 283 | 0.59 | 0.37 | 0.26 | -0.05 |
| | C | | 3.02 | 3.10 | | | | 0.39 | 0.32 | | | | 0.72 | 0.47 | | |
| | P-value | | | | 0.186 | 0.947 | | | | 0.085 | 0.238 | | | | 0.020 | 0.651 |
| Poland | I | 918 | 1.84 | 2.25 | -0.21 | -0.20 | 895 | 0.81 | 0.64 | 0.09 | 0.08 | 529 | 1.70 | 1.26 | 0.32 | 0.13 |
| | C | | 1.77 | 1.98 | | | | 0.75 | 0.66 | | | | 1.63 | 1.31 | | |
| | P-value | | | | 0.002 | 0.021 | | | | 0.040 | 0.157 | | | | 0.001 | 0.284 |
| Spain | I | 760 | 3.26 | 3.29 | 0.04 | -0.07 | 600 | 0.45 | 0.31 | 0.02 | 0.12 | 263 | 1.13 | 0.72 | 0.47 | -0.07 |
| | C | | 3.29 | 3.25 | | | | 0.37 | 0.35 | | | | 1.24 | 0.78 | | |
| | P-value | | | | 0.545 | 0.392 | | | | 0.680 | 0.009 | | | | <0.001 | 0.652 |

I = intervention group. *C* = control group. *T*₀ = baseline. *T*₁ = follow-up. All analyses were adjusted for: age, gender and maternal education.

Table 4.3. Effectiveness of the ToyBox-intervention on preschool children's snacking behaviour in the total sample and by country.

| | | Sweet snacks (g/day) | | | | | Salty snacks (g/day) | | | | |
|----------|---------|----------------------|----------------|----------------|----------|------------------|----------------------|----------------|----------------|----------|------------------|
| | | N | T ₀ | T ₁ | Time (β) | Time x group (β) | N | T ₀ | T ₁ | Time (β) | Time x group (β) |
| Total | I | 1924 | 85.61 | 79.81 | 0.65 | 5.06 | 3487 | 6.29 | 6.07 | 0.18 | 0.02 |
| | C | | 82.27 | 81.94 | | | | 6.26 | 6.12 | | |
| | P-value | | | | 0.737 | 0.039 | | | | 0.438 | 0.934 |
| Belgium | I | 280 | 90.12 | 89.89 | -0.79 | 8.00 | 570 | 5.03 | 4.89 | -0.09 | 0.91 |
| | C | | 89.83 | 98.03 | | | | 4.86 | 5.72 | | |
| | P-value | | | | 0.099 | 0.178 | | | | 0.003 | 0.018 |
| Bulgaria | I | 265 | 82.94 | 78.77 | -3.37 | 7.14 | 429 | 9.89 | 9.48 | 1.40 | -1.05 |
| | C | | 75.02 | 78.54 | | | | 11.00 | 9.74 | | |
| | P-value | | | | 0.553 | 0.323 | | | | 0.217 | 0.435 |
| Germany | I | 307 | 76.87 | 78.29 | 6.05 | -8.35 | 508 | 4.81 | 4.82 | -0.13 | 0.27 |
| | C | | 80.55 | 74.80 | | | | 4.22 | 4.46 | | |
| | P-value | | | | 0.075 | 0.050 | | | | 0.817 | 0.684 |
| Greece | I | 229 | 81.68 | 67.57 | 4.29 | 9.88 | 540 | 6.35 | 6.34 | -0.41 | 0.42 |
| | C | | 77.57 | 73.36 | | | | 6.06 | 6.58 | | |
| | P-value | | | | 0.460 | 0.146 | | | | 0.528 | 0.593 |
| Poland | I | 557 | 91.27 | 82.40 | 5.67 | 3.72 | 754 | 4.55 | 4.98 | 0.04 | 0.48 |
| | C | | 86.90 | 81.17 | | | | 5.00 | 4.95 | | |
| | P-value | | | | 0.154 | 0.470 | | | | 0.935 | 0.348 |
| Spain | I | 286 | 85.07 | 79.03 | -5.41 | 10.69 | 686 | 7.66 | 6.45 | 1.22 | -0.04 |
| | C | | 76.78 | 83.49 | | | | 8.12 | 6.92 | | |
| | P-value | | | | 0.296 | 0.107 | | | | 0.024 | 0.948 |

I = intervention group. *C* = control group. *T*₀ = baseline. *T*₁ = follow-up. All analyses were adjusted for: age, gender and maternal education.

| | | Fruit & Vegetables (g/day) | | | | | Meat products (g/day) | | | | |
|----------|---------|----------------------------|----------------|----------------|----------|------------------|-----------------------|----------------|----------------|--------------|------------------|
| | | N | T ₀ | T ₁ | Time (β) | Time x group (β) | N | T ₀ | T ₁ | Time (β) | Time x group (β) |
| Total | I | 1503 | 268.45 | 266.06 | -4.58 | 7.23 | 3936 | 15.00 | 14.20 | -0.56 | 1.38 |
| | C | | 275.09 | 279.25 | | | | 14.92 | 15.43 | | |
| | P-value | | | | <0.001 | 0.255 | | | | 0.088 | 0.001 |
| Belgium | I | 158 | 247.25 | 270.54 | -14.14 | -12.62 | 624 | 18.61 | 19.20 | -2.78 | 2.22 |
| | C | | 260.53 | 273.87 | | | | 18.82 | 21.57 | | |
| | P-value | | | | 0.242 | 0.427 | | | | 0.001 | 0.044 |
| Bulgaria | I | 225 | 346.35 | 317.84 | 2.98 | 25.79 | 418 | 8.83 | 7.08 | 0.85 | 0.59 |
| | C | | 347.76 | 343.79 | | | | 7.54 | 6.69 | | |
| | P-value | | | | 0.855 | 0.210 | | | | 0.321 | 0.568 |
| Germany | I | 244 | 270.74 | 269.47 | 0.35 | 1.20 | 663 | 18.43 | 17.91 | -0.06 | 0.80 |
| | C | | 305.43 | 304.29 | | | | 17.89 | 17.98 | | |
| | P-value | | | | 0.974 | 0.935 | | | | 0.943 | 0.459 |
| Greece | I | 227 | 271.89 | 264.53 | 11.68 | -3.49 | 648 | 10.17 | 9.61 | -0.13 | 0.78 |
| | C | | 280.43 | 269.42 | | | | 9.39 | 9.42 | | |
| | P-value | | | | 0.437 | 0.843 | | | | 0.842 | 0.323 |
| Poland | I | 514 | 249.59 | 252.46 | -17.37 | 14.88 | 906 | 18.10 | 16.95 | -0.23 | 1.28 |
| | C | | 242.07 | 259.44 | | | | 16.95 | 17.04 | | |
| | P-value | | | | 0.037 | 0.153 | | | | 0.755 | 0.153 |
| Spain | I | 135 | 217.78 | 219.53 | 14.16 | -13.20 | 677 | 14.06 | 12.63 | -0.25 | 1.80 |
| | C | | 229.50 | 215.44 | | | | 12.70 | 12.92 | | |
| | P-value | | | | 0.405 | 0.503 | | | | 0.730 | 0.043 |

I = intervention group. *C* = control group. *T*₀ = baseline. *T*₁ = follow-up. All analyses were adjusted for: age, gender and maternal education.

Table 4.4. Effectiveness of the ToyBox-intervention on preschool children's sedentary behaviour and physical activity in the total sample and by country.

| | | Screen time weekdays (% >1h/d) | | | | | Screen time weekend days (% >1h/d) | | | | |
|----------|---------|--------------------------------|----------------|----------------|------------------|--------------------------|------------------------------------|----------------|----------------|------------------|--------------------------|
| | | N | T ₀ | T ₁ | Time (β) | Time x group (β) | N | T ₀ | T ₁ | Time (β) | Time x group (β) |
| Total | I | 4882 | 60.1 | 65.4 | -0.08 | 0.03 | 4855 | 82.1 | 88.3 | -0.07 | 0.001 |
| | C | | 57.2 | 65.1 | | | | 80.0 | 86.5 | | |
| | P-value | | | | <0.001 | <0.001 | | | | <0.001 | 0.784 |
| Belgium | I | 894 | 51.9 | 62.6 | -0.17 | 0.06 | 879 | 82.2 | 87.3 | -0.10 | 0.05 |
| | C | | 53.0 | 69.3 | | | | 81.6 | 91.5 | | |
| | P-value | | | | <0.001 | 0.074 | | | | <0.001 | 0.062 |
| Bulgaria | I | 691 | 77.5 | 84.4 | -0.10 | 0.03 | 687 | 93.1 | 96.6 | -0.03 | -0.01 |
| | C | | 76.7 | 86.4 | | | | 93.1 | 95.5 | | |
| | P-value | | | | 0.004 | 0.522 | | | | 0.163 | 0.609 |
| Germany | I | 740 | 25.2 | 30.8 | -0.10 | 0.03 | 739 | 43.4 | 60.9 | -0.16 | -0.02 |
| | C | | 24.7 | 34.2 | | | | 45.7 | 61.8 | | |
| | P-value | | | | <0.001 | 0.345 | | | | <0.001 | 0.614 |
| Greece | I | 778 | 71.2 | 72.6 | -0.01 | -0.01 | 785 | 90.4 | 94.5 | -0.01 | -0.04 |
| | C | | 74.6 | 75.6 | | | | 88.2 | 89.1 | | |
| | P-value | | | | 0.768 | 0.917 | | | | 0.841 | 0.206 |
| Poland | I | 996 | 67.7 | 71.4 | -0.02 | -0.02 | 990 | 88.1 | 91.8 | -0.05 | 0.02 |
| | C | | 66.9 | 69.5 | | | | 84.4 | 89.9 | | |
| | P-value | | | | 0.423 | 0.660 | | | | 0.004 | 0.372 |
| Spain | I | 783 | 61.6 | 65.9 | -0.06 | 0.02 | 775 | 89.7 | 95.2 | -0.01 | -0.04 |
| | C | | 56.3 | 62.5 | | | | 91.6 | 92.3 | | |
| | P-value | | | | 0.073 | 0.623 | | | | 0.577 | 0.056 |

I = intervention group. *C* = control group. *T*₀ = baseline. *T*₁ = follow-up. All analyses were adjusted for: age, gender and maternal education.

| | | Steps weekdays (% >10,000 steps/d) | | | | | Steps weekend days (% >10,000 steps/d) | | | | |
|----------|---------|------------------------------------|----------------|----------------|----------|------------------|--|----------------|----------------|----------|------------------|
| | | N | T ₀ | T ₁ | Time (β) | Time x group (β) | N | T ₀ | T ₁ | Time (β) | Time x group (β) |
| Total | I | 2151 | 62.4 | 62.1 | 0.01 | 0.001 | 2152 | 43.7 | 38.6 | 0.08 | -0.03 |
| | C | | 48.8 | 49.1 | | | | 42.0 | 34.1 | | |
| | P-value | | | | 0.953 | 0.999 | | | | <0.001 | <0.001 |
| Belgium | I | 481 | 57.6 | 64.1 | 0.001 | -0.07 | 481 | 28.0 | 39.1 | 0.01 | -0.13 |
| | C | | 56.3 | 56.8 | | | | 32.2 | 32.2 | | |
| | P-value | | | | 0.999 | 0.251 | | | | 0.821 | 0.034 |
| Bulgaria | I | 70 | 28.1 | 21.9 | 0.001 | 0.10 | 70 | 28.1 | 28.1 | 0.03 | -0.03 |
| | C | | 24.4 | 24.4 | | | | 48.8 | 46.3 | | |
| | P-value | | | | 0.999 | 0.356 | | | | 0.705 | 0.841 |
| Germany | I | 183 | 68.5 | 64.8 | 0.14 | -0.12 | 183 | 46.7 | 42.2 | 0.18 | -0.15 |
| | C | | 57.1 | 42.9 | | | | 32.1 | 14.3 | | |
| | P-value | | | | 0.142 | 0.251 | | | | 0.043 | 0.144 |
| Greece | I | 292 | 41.0 | 46.8 | -0.09 | 0.02 | 292 | 29.3 | 32.9 | -0.01 | -0.03 |
| | C | | 25.3 | 35.4 | | | | 24.1 | 25.3 | | |
| | P-value | | | | 0.156 | 0.755 | | | | 0.847 | 0.726 |
| Poland | I | 722 | 64.3 | 62.1 | -0.02 | 0.04 | 723 | 56.2 | 39.6 | 0.12 | 0.06 |
| | C | | 49.1 | 51.2 | | | | 52.3 | 40.6 | | |
| | P-value | | | | 0.667 | 0.393 | | | | 0.003 | 0.242 |
| Spain | I | 403 | 81.9 | 75.1 | 0.07 | 0.01 | 403 | 52.0 | 39.9 | 0.16 | -0.03 |
| | C | | 57.9 | 50.8 | | | | 44.4 | 28.6 | | |
| | P-value | | | | 0.167 | 0.999 | | | | 0.002 | 0.626 |

I = intervention group. C = control group. T₀ = baseline. T₁ = follow-up. All analyses were adjusted for: age, gender and maternal education.

Discussion

The aim of the present study was to evaluate the effectiveness of the ToyBox-intervention regarding the EBRBs targeted in this programme, namely preschool children's dietary, physical activity and sedentary (i.e. screen) behaviours and children's anthropometric indices.

Several statistically significant beneficial intervention effects were observed for most of the EBRBs examined in this study and no significant differences were observed for the percentage of overweight/obese children. Still, the mean values of the EBRBs changed from baseline to follow-up to a small extent, despite the fact that the ToyBox-intervention was developed according to the steps of the Intervention Mapping and P-P model and taking into consideration all state-of-the-art knowledge produced within the preparatory phases of the ToyBox-study (e.g. findings of systematic literature reviews, secondary analyses of existing data and focus groups conducted with teachers and parents of preschool children in the six intervention counties) (Marieke De Craemer et al., 2013; M. De Craemer et al., 2014; De Decker et al., 2014; De Decker et al., 2013; Summerbell et al., 2012; van Stralen et al., 2012).

The findings of the present study may be explained in different ways. First of all, the ToyBox-intervention aimed to promote EBRBs which were found to be associated with obesity at preschool age and their determinants (De Decker et al., 2013; te Velde et al., 2012; van Stralen et al., 2012). The decision to focus on four EBRBs was based on the fact that the overall aim of the ToyBox-study was to prevent obesity, which means that both sides of energy balance should be targeted. Still, the fact that teachers had to focus on four EBRBs in a short period of time (i.e. one school year) may have increased the burden for them in delivering the programme. Considering that further to the four EBRBs the ToyBox-intervention had four levels of implementation per EBRB (i.e. environmental changes, implementation of the actual EBRB, classroom activities and parental involvement via newsletters which were distributed to them by the teachers), it might have been too time consuming and challenging for the teachers to implement the complete ToyBox-intervention (Manios et al., 2014). The first results of the process evaluation data collected in ToyBox showed that the degree of implementation of the intervention by the teachers and parents was relatively low regarding the components of "sedentary behaviour" and "water consumption" (Latomme et al., 2017; Pinket, Van Lippevelde, et al., 2016). The next set of analyses on the process evaluation data are expected to shed light regarding the other components of the intervention (i.e. "snacking" and "physical activity") (Androutsos, Apostolidou, et al., 2014).

Beyond the number of targeted EBRBs, it should also be noted that parental involvement was promoted via newsletters. Perhaps this approach did not provide the intensity needed to achieve the behavioural changes aimed in this study. Considering that in most participating countries the parents are those who prepare the snacks consumed by the children at kindergarten and also provide the opportunities to be physically active or sedentary in the afternoons and on weekends, it might be worthwhile putting more emphasis on their actual engagement and participation in the programme. Moreover, a co-participatory approach was achieved by the ToyBox-intervention only to a small degree (i.e. mainly via focus groups with parents and teachers of preschool children) during the design of the study (Marieke De Craemer et al., 2013; De Decker et al., 2013). A more intensive participation of the relevant stakeholders throughout the development as well as implementation and evaluation may improve the relevance, attractiveness and thereby the implementation and effectiveness of the intervention. Engagement of other stakeholders such as parents' associations at schools, municipalities, local organizations of experts (e.g. dietitians, PE-instructors), NGOs etc. may be necessary to create and support environmental changes at the local level.

Closer collaboration with the stakeholders may also result in a better balance between the 'fidelity' and 'fit' of the intervention to the six participating countries and the large number of kindergartens within each country. More specifically, implementing 'hybrid ToyBox-interventions' at a kindergarten level, using the original ToyBox-intervention as the basis but allowing further adaptations, tailor-made solutions and practical tips for the teachers and families not only at a country level but also at a kindergarten level might be the optimum approach for delivering a well-standardized intervention that would better fit to each kindergarten's needs and reality (e.g. considering diversity of food and sport facilities, policies, human resources, etc.) (Castro, Barrera, & Martinez, 2004; van Daele, van Audenhove, Hermans, van den Bergh, & van den Broucke, 2014). Previous European studies in older children have also reached similar conclusions (De Bourdeaudhuij et al., 2015).

In line with the findings of the present study, the effectiveness of previous school-based obesity prevention interventions in older children has been found to be small (Flynn et al., 2006; Khattar, 2015). Key strategies of successful interventions, which were considered in the design of the ToyBox-intervention, include the target on both sides of energy balance, i.e. both on dietary behaviour and on physical activity and sedentary behaviour, the creation of a physical and social environment promoting healthy EBRBs, the inclusion of both educational and environmental

components, the active involvement of the family and role modelling (De Bourdeaudhuij et al., 2011; Summerbell et al., 2012). The intervention effects which were observed for the majority of the EBRBs in this study will be further examined taking into account the process evaluation results and especially the fidelity/compliance of the teachers and parents in the delivery of the intervention. Moreover, it remains to be elucidated which factors may have exerted a mediating role in the ToyBox-intervention. The study by Lambrinou et al (in press) revealed that the ToyBox-intervention induced significant, positive changes in most of the targeted family-related determinants of children's water consumption determinants (i.e. availability, parental modelling, parental encouragement and parental knowledge), which may explain the significant effects on children's water consumption. Still, the mediators of the ToyBox-intervention regarding the rest of EBRBs will be further explored in future analyses.

The findings of the current study should be interpreted in light of its strengths and limitations. Specifically, the cluster-randomized design of the study and the large sample size, the diversity of participating regions and socioeconomic groups, the standardization of all study procedures and tools and the objective assessment of children's physical activity levels should be noted as strengths of this study. All measurements at pre- and post- test were taken in the same time period (i.e. May/June 2012 and 2013), thus limiting the potential seasonality effects. The parent-reported information of children's food and beverages consumption and screen time are limitations of this study. Although the validity and reliability of the relevant questionnaires were tested before the start of the intervention, this approach is prone to recall bias and social desirability.

Conclusion

The findings of the present study showed that the ToyBox-intervention resulted in positive but small mean effects on children's EBRBs. This might in part be due to large diversity of the actual study sample (including low-, medium- and high- SES groups, as well as high- and low- motivated families and teachers), but also to the fidelity of the programme implementation since it was largely dependent on the motivation and skills of the kindergarten teachers in 179 kindergartens in six European countries. The significant, positive effects observed on children's EBRBs may be explained by the changes of the relevant family-related determinants, indicating that the ToyBox-intervention actively engaged parents/caregivers to change their social and physical environment at home and become role models for their children.

4.2 Study II: Mediators of the Effectiveness of an Intervention Promoting Water Consumption in Preschool Children: The ToyBox Study

INTRODUCTION

The health benefits of adequate water consumption are well established (Jequier & Constant, 2010; Kleiner, 1999). Especially at preschool age, meeting the recommendations for water intake is vital, since children at this age are more vulnerable to dehydration compared to adults (Iglesia et al., 2015; Jacques, 2012; WHO., 2005). Furthermore, drinking water instead of sugar-sweetened beverages (SSBs) may be an effective approach to control pre-schoolers' energy intake and body weight, since SSBs consumption has been found to be associated with higher body mass index (BMI) in this age group (van Stralen et al., 2012).

Recent studies have shown that a large percentage of preschool and primary school children in Europe do not meet the recommendations for water intake (Huybrechts & De Henauw, 2007; Vieux, Maillot, Constant, & Drewnowski, 2016). In line with these observations, the ToyBox-study revealed that only 28.1% of European preschool children meet the European Food Safety Authority (EFSA) recommendations regarding water intake (i.e., 1280 mL water from beverages), with pre-schoolers of lower socioeconomic (SES) families having lower consumption of plain water compared to their higher-SES peers (Pinket, De Craemer, Maes, et al., 2016).

In the preliminary phases of the ToyBox-study focus groups with parents and teachers of preschool children were executed in 6 European countries to explore the determinants of water consumption at preschool age. According to the findings of this study, parental modelling, water availability and parental knowledge, and self-efficacy were identified as determinants of pre-schoolers' water consumption (Marieke De Craemer et al., 2013). These findings were translated into practical strategies following the intervention mapping (IM) protocol (Bartholomew, Parcel, & Kok, 1998) and were included in the design of the ToyBox- intervention (Manios et al., 2014). The results of the ToyBox-intervention showed that the intervention had a small but significant effect on increasing preschool children's water consumption and decreasing their consumption of pre-packed fruit juices (Pinket, De Craemer, Huybrechts, et al., 2016). To increase the effectiveness of the ToyBox and future interventions, knowledge of effective mechanisms underlying changes in water consumption is needed. By conducting mediation analysis one can gain insight into the mechanisms that are critical for influencing children's water consumption,

e.g., insight into whether the intervention affected the potential mediators and whether this in turn affected the behaviour. This insight into what works and what does not work in interventions informs future intervention development and can improve their (cost)-effectiveness (Hafeman & Schwartz, 2009).

Hence, the aims of the current study were: (1) to explore the effects of the ToyBox-intervention on family-related factors associated with pre-schoolers' water consumption, (2) to identify potential associations between changes of these factors and changes of pre-schoolers' water consumption, and (3) to evaluate the potential mediating role of these factors on the ToyBox-intervention effects on pre-schoolers' water consumption.

METHODS

Participants

The detailed study design has been published elsewhere (Manios et al., 2014; Manios et al., 2012). In brief, the ToyBox-study (www.toybox-study.eu) aimed to develop, implement, and evaluate a kindergarten-based, family-involved intervention to prevent obesity in preschool children in 6 European countries (Belgium, Bulgaria, Germany, Greece, Poland, and Spain). Preschool children and their families were recruited from 3 socioeconomic groups, following a standardized approach (Manios et al., 2014).

The study has been registered in the clinical trials registry clinicaltrials.gov (ID: NCT02116296). Moreover, it was approved by Ethical Committees in the 6 participating countries (i.e., Ethical committee of Ghent University Hospital [Belgium], Committee for the Ethics of the Scientific Studies [KENI] at the Medical University of Varna [Bulgaria], Ethikkom- mission der Ludwig Maximilians Universitat Munchen [Germany], the Ethics Committee of Harokopio of Athens [Greece], Ethical Committee of Children's Memorial Health Institute [Poland], and CEICA [Comite' Etico de Investigacion Clinica de Aragon, Spain]), in line with national regulations (Manios et al., 2014). All procedures were in accordance with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Parents/caregivers signed an informed consent for the participation of their child and their family prior to their enrollment in the study.

Procedure

The ToyBox-intervention had a clustered randomized design and was conducted during the school year 2012-2013. It targeted the energy balance-related behaviours (EBRBs) that in the preliminary phases of the program were found to be associated with overweight/obesity at preschool age, i.e., drinking-, snacking-, physical activity-, and sedentary-behaviours, as well as their determinants (Marieke De Craemer et al., 2013; Manios et al., 2014; van Stralen et al., 2012). The implementation of the ToyBox-intervention was conducted at 4 levels. The first 3 levels were implemented in the kindergarten setting, while the fourth level addressed parents/caregivers aiming to induce certain changes at children's social and physical environment at home in order to promote the 4 targeted EBRBs. The relative intervention material can be found in the study's website (www.toybox-study.eu) while details on the development of the intervention have been described elsewhere (Manios et al., 2014; Manios et al., 2012).

More specifically, regarding the component of "drinking behaviour" level 1 included the installation of water stations at class/kindergarten, level 2 the daily consumption of water by the children, level 3 the execution of interactive classroom activities using the kangaroo hand-puppet as role model, and level 4 the delivery of 2 newsletters, 2 tip-cards, and 1 poster to the parents/caregivers via the teachers which included key messages and practical tips on consumption of water instead of SSBs (Manios et al., 2014). Levels 1 and 2 were conducted from the beginning until the end of the school year 2012-2013, whereas levels 3 and 4 were conducted overall for 6 weeks (i.e., during the first focus period between weeks 1 and 4 and during the repetition period between weeks 17 and 18) (Manios et al., 2012).

The ToyBox-intervention was implemented by kindergarten teachers, who received 3 training sessions by the research staff, of minimum 1 hour per session (Androutsos, Katsarou, et al., 2014). The first 2 training sessions were implemented prior to the first focus period and the third training session was implemented prior to the repetition period. During the first training session, the teachers were informed about the goals and the materials of the ToyBox-study. During the second training session, the teachers received the ToyBox-material (i.e., 9 newsletters, 8 tip cards, 4 posters, a hand puppet, 1 teachers' general guide, and 1 classroom activity guide for each of the targeted EBRBs). The third session aimed at recall and consolidation of the intervention. More information on how the Toybox-Intervention aimed to change water consumption determinants via theoretical methods can be found in Table 4.5.

Table 4.5. The Toybox-intervention, determinants, theoretical methods and program components to change water consumption

| Determinant | Theoretical method | Example of program component |
|--|--|---|
| Parental consumption (portion/day) (How many portions of water (include tap water, still and sparkling mineral water) do YOU usually consume?) | Guided practice, Modelling SCT, TSR, TL | Individual level- Preschool child Drinking station, Kangaroo stories, Kangaroo hand puppet, Sensory perception games, Experiments, Excursion |
| Availability of water (I make water always available for my child) | Direct experience, Modelling, Facilitation, Focused perception SCT, TL | |
| Availability of water during meals (During meals, water is always available on the table) | Direct experience, Modelling, Facilitation, Focused perception SCT, TL | |
| Encouragement (I encourage my child to drink water) | Consciousness raising (providing information), Modelling, Guided Practice, Active learning, Elaboration, Discussion HBM, SCT, TL, TSR, ELM, TIP | Interpersonal level- Parents/caregivers Newsletters Tip cards Poster Parents' evening Organizational level Teachers Teachers' training Teachers' guide Classroom Activities Guide |
| Self-efficacy (I find it difficult to give my child water if he/she wants soft drinks or pre-packed juices) | Consciousness raising (providing information), Guided practice, Discussion, Modelling, Reinforcement HBM, SCT, TSR, TIP, TTM | |
| Enjoyment (My child does not enjoy drinking water) | Guided practice, Modelling, Reinforcement, Facilitation | |

| | | |
|--|---|--|
| | SCT, TSR, TL | |
| Perceived recommendation water (glasses/day) (How many glasses of water do you think your child should drink daily?) | Consciousness raising (providing information), Active learning, Elaboration, Discussion HBM, PCM, ELM, SCT, TIP | |

*** ELM: Elaboration likelihood model, HBM: health-belief model, PCM: Persuasion-communication matrix, SCT: Social Cognitive Theory, TL: Theories of Learning, TSR: Theory of self-regulation, TIP: Theories of Information Processing

Instrumentation

The pre-test measurements were conducted in May/June 2012, and the post-test measurements were conducted 1 year later during May/June 2013. All parents/caregivers who agreed to participate in the study were asked to fill out the Primary Caregivers' Questionnaire (PCQ) measuring sociodemographic factors, lifestyle behaviours, and perinatal factors, as well as a food frequency questionnaire (FFQ) that was developed based on a previously validated FFQ (Huybrechts et al., 2009).

Water intake was assessed by combining the frequency as well as the average consumption. Response categories for assessing frequency 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," while regarding the average consumption, the response categories were "100 mL or less," "100-200 mL," "200-300 mL," "300-400 mL," "400-500 mL," "500-600 mL," "600-700 mL," "700-800 mL," "800-900 mL," "900-1000 mL," and "1000 mL or more." From these data, the average amount of water in millilitre per day was calculated by multiplication of the number of days per week and amount per day in mL (using the midpoint) divided by 7 (total number of days in a full week) and was then calculated as cups/day (1 cup 240 mL of water).

Determinants of pre-schoolers' water consumption were self-reported by one of the parents/caregivers, using Likert-type questions, in the PCQ. More specifically, based on the question "How many portions of water (include tap water, still and sparkling mineral water) do YOU usually consume," parental consumption of water was reported. Availability of water was assessed via 2 questions: "I make water always available for my child" and "During meals, water

is always available on the table.” Regarding parental encouragement to their children to drink water, the following question was included in the PCQ: “I encourage my child to drink water.” Regarding parental self-efficacy, parents replied to the question: “I find it difficult to give my child water if he/she wants soft drinks or pre-packed juices” while regarding child’s enjoyment they replied to the question: “My child does not enjoy drinking water” and regarding parental perceived water recommendation they responded to the following question: “How many glasses of water do you think your child should drink daily?” The response alternatives to each question item are depicted in Table 4.6.

Table 4.6. Determinant and questionnaire items.

| Determinant | Question item | Response alternatives |
|---|---|---|
| Parental consumption (portion/day) | How many portions of water (include tap water, still and sparkling mineral water) do YOU usually consume? | 0= never 0,14= 1 portion or less per week 0,53= 2-4 portions per week 0,79= 5-6 portions per week 1,5= 1-2 portions per day 3,5= 3-4 portions per day 5= 5 or more portions per day |
| Availability of water | I make water always available for my child | -2= strongly disagree- +2= strongly agree |
| Availability of water during meals | During meals, water is always available on the table | -2= strongly disagree- +2= strongly agree |
| Encouragement | I encourage my child to drink water | -2= strongly disagree- +2= strongly agree |
| Self-efficacy | I find it difficult to give my child water if he/she wants soft drinks or pre-packed juices | -2= strongly agree-+ 2= strongly disagree |
| Enjoyment | My child does not enjoy drinking water | -2= strongly agree-+ 2= strongly disagree |
| Perceived recommendation water (glasses/day) | How many glasses of water do you think your child should drink daily? | 0= less than 5, more than 6 glasses per day or I don’t know |

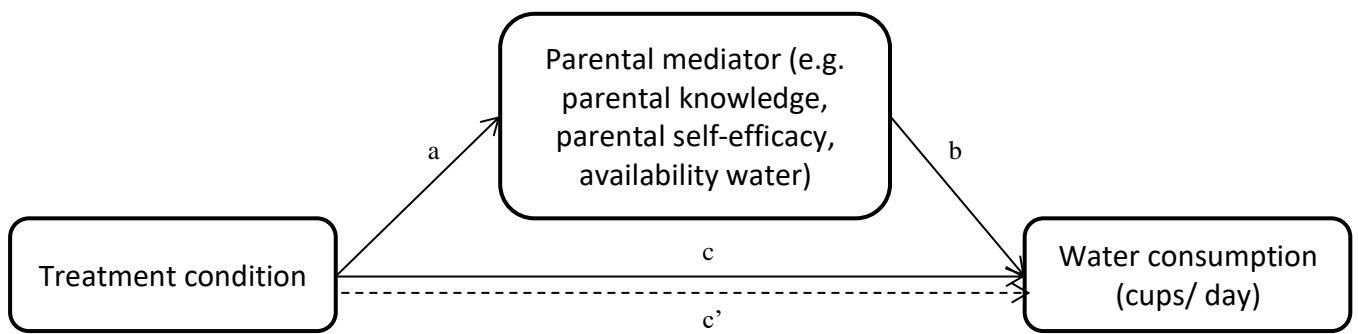
Preschool children's age was computed based on the date of birth and the date when the PCQ was completed. Pre-schoolers' sex and the educational level of the parents/caregivers were self-reported by one of the parents/caregivers in the PCQ. The educational level of the mother was used as SES indicator (Winkleby, Jatulis, Frank, & Fortmann, 1992). For this analysis, the education level was dichotomized into "medium/low" (≤ 14 years of education) and "high" (> 14 years of education) SES, which distinguishes families with a mother who has completed medium or higher education, college, or university training from other families and has been used in previous European projects (Brug et al., 2012).

Data Analysis

Descriptive statistics describing the baseline characteristics of the participating children per intervention or control condition were conducted in SPSS 23.0 (IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp). Differences between intervention and control groups were tested using independent t test for continuous variables or chi-square test for dichotomous variables. Missing data analysis was conducted with logistic regression analysis, to test whether missing was dependent on children's age, sex, water consumption, maternal education, and treatment condition.

Mediation effects were assessed with bootstrapping procedure following mediation analysis steps (Figure 4.2): (1) estimating the effect of the intervention on water consumption (c-coefficient); (2) estimating the effect of the intervention on the proposed mediator (a-coefficient); (3) estimating the effect of the mediator on water consumption (b-coefficient) adjusting for the intervention effect (c'-coefficient); (4) computing the indirect effect of the intervention on water consumption via the proposed mediator (ab-coefficient); and (5) bootstrapping the sampling distribution of ab and deriving a bias corrected confidence interval (CI) with 5000 bootstrapped sampling distribution.

Figure 4.2. Conceptual ToyBox mediation model



We assessed both single and multiple mediator models. All models were adjusted for age, sex, maternal education, country, baseline level of water consumption, and baseline level of the mediator. Adding a random intercept for kindergarten site did not improve the model fit and was therefore not eliminated. Mediation analysis were run in Mplus 8.0. (Muthén, 1998-2012).

RESULTS

Participant Characteristics

Out of the 6290 children who participated in the ToyBox-intervention, 3725 completed the study and had complete data on water consumption, potential mediators, and covariates at baseline and follow-up. Missing data analysis showed that the children included in the analysis did not differ in terms of age, sex, maternal education or treatment condition, but consumed slightly more water at baseline than the children who initially enrolled in the study (2.48 vs 2.38 cups/day, $p < .05$). Table 4.7 shows the baseline characteristics of the European children participating in the Toybox-study. Participating children were on average 4.75 years old, 48% were girls and 63.9% had a mother with more than 14 years of education. Intervention and control group participants did not differ in terms of children's age, sex, weight status, parental age, education, weight status or water consumption, or any of the baseline values of the potential mediators, with the exception of intervention children consuming slightly more water at baseline than control participants ($p = .03$).

Table 4.7. Baseline characteristics of the European children in the intervention and control group (mean, standard deviation unless otherwise stated)

| | Total (N=3725) | Intervention group (N=2388) | Control group (N=1337) |
|---|---------------------------|--|-----------------------------------|
| Demographics | | | |
| Age child | 4.75 (.43) | 4.76 (.42) | 4.75(.44) |
| Sex (% girls) | 48.1 | 48.2 | 47.9 |
| Child weight status (%overweight) | 13.9 | 14.4 | 13.1 |
| Age parent (years) | 35.83 (4.79) | 35.88 (4.86) | 35.73(4.67) |
| Maternal education (%maternal education > 14 years) | 63.9 | 63.1 | 65.1 |
| Parental weight status (%≥ 1 parent overweight) | 70.3 | 71.1 | 68.7 |
| Behaviours | | | |
| Water consumption child (cups/ day) | 2.48 (1.33) | 2.52 (1.34)* | 2.42 (1.31) |
| Water consumption parent (portions per day) | 3.45 (1.56) | 3.43 (1.54) | 3.46 (1.57) |
| Determinants | | | |
| Availability of water [-2,+2] | 1.69 (.62) | 1.69 (.63) | 1.69 (.61) |
| Availability of water during meals [-2,+2] | 1.25 (1.02) | 1.26 (1.01) | 1.23 (1.04) |
| Encouragement [-2,+2] | 1.54 (.72) | 1.54 (.72) | 1.54 (.72) |
| Parental self-efficacy [-2,+2] | .72 (1.16) | .72 (1.16) | .73 (1.18) |
| Child's enjoyment [-2,+2] | .21 (1.51) | .24 (1.50) | .16 (1.52) |
| Knowledge on recommendation water (%) | 34.2 | 34.2 | 34.2 |

*Significant differences between intervention and control groups at * $p < .05$ based on an independent t-test for continuous variables or χ^2 test for dichotomous variables.*

Intervention Effect on Water Consumption (c-Coefficient)

Table 4.8 shows that increases were found in water consumption in both the intervention (2.72 ± 1.28 cups/day) and control (2.52 ± 1.32 cups/day) participants after the intervention. The increases in water consumption over time in the intervention group were significantly higher compared to the control group (c-coefficient: .12; 95% CI: .05, .19).

Intervention Effect on Potential Mediators (a-Coefficient)

Table 4.8 also shows the intervention effect on each potential mediator in single mediation analysis. Compared to the control group, the intervention group significantly increased availability of water during meals ($a = .06$; 95% CI: .01, .11), parental water consumption ($a = .09$; 95% CI: .00, .18), encouragement of drinking water ($a = .06$; 95% CI: .01, .11) and parental knowledge on the water recommendation ($a = .11$; 95% CI: .02, .20; odds ratio [OR] 1.11).

No statistically significant intervention effects were found on availability of water during the day, parental self-efficacy, and child's enjoyment in drinking water.

Effect of Potential Mediator on Water Consumption (b-Coefficient)

As Table 4.8 shows, increases in availability of water during the day ($b = .19$; 95% CI: .13, .25), availability of water during meals ($b = .20$; 95% CI: .15, .25), parental water consumption ($b = .14$; 95% CI: .11, .17), parental encouragement ($b = .15$; 95% CI: .09, .20), parental self-efficacy to serve water ($b = .16$; 95% CI: .12, .20), and parental knowledge on water recommendation ($b = .19$; 95% CI: .14, .23) were associated with increases in water consumption. No association was found between parental perceived children's enjoyment to drink water and changes in water consumption.

Mediated Effects (ab): Single-Mediated Models

As Table 4.8 shows, in the single mediator models, changes in availability of water during meals ($ab = .01$; 95% CI: .00, .02), parental water consumption ($ab = .01$; 95% CI: .00, .03), parental encouragement ($ab = .01$; 95% CI: .00, .02), and parental knowledge on water consumption ($ab = .02$; 95% CI: .00, .04) mediated the intervention effect on water consumption. The proportion of the intervention effect on children's water consumption that could be explained by the mediator

ranged from 7% by parental encouragement to 16% by parental knowledge on water consumption.

Table 4.8. Potential family related mediators of water consumption; single mediator model

| | a | b | ab | c' | %mediation |
|------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-------------------|
| Availability of water | .02 (-.02; .06) | .19 (.13; .25) | .00 (-.00; .01) | .12 (.05; .19) | - |
| Availability of water during meals | .06 (.01; .11) | .20 (.15; .25) | .01 (.00; .02) | .11 (.04; .18) | 9% |
| Water consumption parents | .09 (.00; .18) | .14 (.11; .17) | .01 (.00; .03) | .11 (.04; .18) | 10% |
| Encouragement | .06 (.01; .11) | .15 (.09; .20) | .01 (.00; .02) | .12 (.05; .18) | 7% |
| Self-efficacy | .04 (-.02; .10) | .16 (.12; .20) | .01 (-.00; .02) | .12 (.06; .19) | - |
| Knowledge on recommendation | .11 (.02; .20) | .19 (.14; .23) | .02 (.00; .04) | .10 (.04; .17) | 16% |
| Enjoyment | -.04(-.09; .02) | .02 (-.03; .06) | -.00 (-.01; .00) | .12 (.05; .19) | - |

All analyses were adjusted for child's sex and age, maternal education, country and baseline values of water consumption and the baseline value of the specific mediators. Bias-corrected bootstrapping using 5000 samples was conducted using Mplus version 8 (Muthén& Muthén). Bold font are significant associations.

Mediator Effects (ab): Multiple Mediator Models

Table 4.9 shows the finding of the multiple mediator model, including all mediators as found to be significant in the single mediator models. In the multiple mediator model, all included parent-related factors remained significant mediators of the intervention effect on children's water consumption. The total mediated effect ($ab = .048$; 95% CI: .02, .08) mediated 40% of the total intervention effect on water consumption. After including all mediators into the model, the direct intervention effect on water consumption remained significant ($c' = .07$; 95% CI: .01, .14).

Table 4.9. Potential family related mediators of water consumption; multiple mediator model

| | a | b | ab | %mediation |
|------------------------------------|-----------------------|-----------------------|-----------------------|-------------------|
| Availability of water during meals | .05 (.01; .11) | .19 (.15; .24) | .01 (.00; .02) | 9% |
| Water consumption parents | .08 (-.00; .17) | .13 (.11; .16) | .01 (.00; .02) | 9% |
| Encouragement | .06 (.01; .11) | .13 (.08; .19) | .01 (.00; .02) | 6% |
| Knowledge on recommendation | .11 (.02; .19) | .18 (.14; .22) | .02 (.00; .04) | 16% |

All analyses were adjusted for child's sex and age, maternal education, country and baseline values of water consumption and the baseline value of the included mediators. Bias-corrected bootstrapping using 5000 samples was conducted using Mplus version 8 (Muthén& Muthén). Bold font are significant associations.

DISCUSSION

The ToyBox-intervention was a kindergarten- based, family-involved intervention aiming to prevent obesity at preschool age via the promotion of healthy EBRBs. The aim of the present study was to examine if selected family-related determinants of water consumption mediated the effects of the ToyBox-intervention on one of the targeted EBRBs, namely pre-schoolers' water consumption.

Our previous findings showed that the ToyBox- intervention led to small but significant increase of pre-schoolers' water consumption (Pinket, Van Lippevelde, et al., 2016). The present study showed that the majority of the selected family-related determinants of water consumption mediated the effects of the ToyBox-intervention on pre-schoolers' water consumption. These mediators were water availability during meals, parental water consumption, parental encouragement to the child to drink water, and parental knowledge on water recommendations. In other words, we observed that the ToyBox-intervention improved the determinants that were identified in the ToyBox-study, linked to specific program goals to form specific change objectives via the IM-protocol and targeted via the intervention material, such as newsletters and tip- cards (Marieke De Craemer et al., 2013; Manios et al., 2014). Our findings confirm that the selected

determinants are relevant in changing pre-schoolers' water consumption and suggest that the intervention strategies (e.g., role modelling) we applied were effective.

Our findings concur with previous studies conducted in this field. More specifically, a recent study showed that increasing water availability in older children may be an effective approach to increase children's water consumption and improve their BMI (Schwartz, Leardo, Aneja, & Elbel, 2016). Although focusing on different age group, our study showed similar to that, that the ToyBox-intervention increased water availability during children's meals, which partially mediated the ToyBox-intervention effects on children's water consumption. Furthermore, the systematic review conducted by van Stralen et al found some evidence for attitude, knowledge, and habit strength as mediators of interventions targeting dietary behaviour (van Stralen et al., 2011). In the case of the ToyBox-study, these determinants referred to the parents and teachers of the preschool children, due to the very young age of the children. Our findings are in line with the review as the ToyBox-intervention increased parental knowledge on water recommendations, parental encouragement, and parental water consumption. Especially regarding the latter, there is accumulated evidence highlighting that parental role modelling, which in our case is depicted as parental water consumption, exerts a significant role in children's water consumption (Derbyshire, 2016; Grimm, Harnack, & Story, 2004). Future intervention developers targeting pre-schoolers' water consumption are recommended to target these determinants and the intervention strategies used in the ToyBox-intervention to change them. Availability of water during the day (not during the meals), parental self-efficacy to provide water and child's enjoyment in drinking water as perceived by the parent did not mediate the intervention effect; mainly because the intervention was not effective in changing these determinants. To the authors' knowledge no previous study focused on these specific determinants to improve pre-schoolers' drinking behaviour, so no comparison can be made taking into account previous interventions. Still, it needs to be mentioned that these determinants were identified via focus groups executed with groups of parents with a different SES- background and the ToyBox-intervention was applied in similar population groups, thus tailor-made to a large extent to the actual needs of the targeted population.

It should be noted that the results of the process evaluation conducted in the ToyBox-intervention showed that many parents did not read the newsletters and the tip-cards provided to them, which might explain that the intervention effects regarding pre-schoolers' water consumption were rather small (Pinket, Van Lippevelde, et al., 2016). On the other hand, our

previous findings showed that in the families that complied most with the ToyBox- intervention (i.e., received/read the ToyBox material, implemented ToyBox-activities at home, and reported satisfaction with the intervention overall), the children had a higher increase of water consumption after the intervention (Pinket, Van Lippevelde, et al., 2016). Therefore, it could be hypothesized that these families probably improved the relevant determinants which in turn resulted in their children's increase of water consumption. Future interventions should aim developing strategies to increase participants' compliance with the program to increase its potential effectiveness.

Limitations and Strengths

The findings of the present study should be interpreted in light of its strength and limitations. The large study sample, the diversity of participating regions and socioeconomic groups, the standardization of all study procedures and tools, and the assessment of all determinants found to be associated with preschool children's water consumption in the early phases of the ToyBox-study comprise some of the strengths of the present study. Moreover, all measurements at pre- and post-test were taken during the same time period (i.e., May/June 2012 and 2013), thus limiting any potential seasonality effects regarding pre-schoolers' water consumption. On the other hand, data were self-reported by the parents, thus may be prone to recall bias or social desirability responses. Still, it should be noted that the reliability of the FFQ and PCQ were tested before the start of the intervention and found to be acceptable (Gonzalez-Gil et al., 2014). Furthermore, the vast majority of questionnaires were reported by mothers, which does not allow the extraction of useful results regarding paternal- and grandparental-related factors mediating the effects of the ToyBox-intervention on pre-schoolers' water consumption.

Conclusion

In conclusion, the current study showed that the ToyBox-intervention increased water availability during meals, parental water consumption, parental encouragement, and parental knowledge on water recommendations. Next, these determinants mediated the effects of the ToyBox-intervention on preschool children's water consumption. These findings imply that future interventions aiming to promote water consumption in pre-schoolers should target the family and home-related determinants to enhance their effectiveness.

IMPLICATIONS FOR SCHOOL HEALTH

The current study showed that the ToyBox- intervention may be an effective approach to increase preschool children's water consumption. These effects may be attributed to a large extent to the improvement of several mediating family-related factors that were targeted in the ToyBox-intervention. Kindergartens interested in promoting water consumption in pre-schoolers could:

- Use the ToyBox-intervention material available in 7 languages (Bulgarian, Flemish, German, Greek, English, Polish, Spanish),
- Adapt the relative material to the local social, political, and economic conditions,
- Incorporate the ToyBox intervention in the regular school curriculum considering that its implementation does not require intensive training of the teachers or the use of extra equipment/materials.

Human Subjects Approval Statement

Ethical approval was taken by the Ethics Committees and other relevant authorities, such as Ministries, in all participating countries.¹² More specifically, the Ethical committee of Ghent University Hospital in Belgium (review number: B670201213485), Committee for the Ethics of the Scientific Studies (KENI) at the Medical University of Varna in Bulgaria (review number:15), Ethikkommission der Ludwig Maximilians Universitat Munchen in Germany (review number: 400-11), the Ethics Committee of Harokopio of Athens in Greece (review number: 28/02-12-2010), Ethical Committee of Children's Memorial Health Institute in Poland (review number: 1/KBE/2012), and CEICA (Comite' Etico de Investigacion Clinica de Aragon in Spain (review number: C.P.-C.I. PI11/056). All participants (school headmasters, parents/caregivers) signed an informed consent form prior to their enrolment in the study.

4.3 Study III: Mediators of the effectiveness of a kindergarten-based, family-involved intervention on pre-schoolers' snacking behaviour: the ToyBox-study

INTRODUCTION

Several studies have shown an association between the consumption of energy-dense foods, such as sweets and salty snacks, and excessive weight in pre-school children (Duraio et al., 2015). On the other hand, diets high in fruits and vegetables (F&V) have been associated with reduced risk for obesity in children (Moschonis et al., 2014). The WHO and the US Department of Agriculture suggest the sparing consumption of unhealthy snacks, while the recommendation for F&V is at least five servings (approximately 400 g) daily (WHO, 1990). However, intake seems to fall well short of these guidelines, both in the case of unhealthy snacks (Nicklas & Johnson, 2004), as well as in the case of vegetables (Patterson, Block, Rosenberger, Pee, & Kahle, 1990), with consumption among young children being particularly low (Dennison, Rockwell, & Baker, 1998). In line with these observations, the ToyBox-study revealed that European pre-school children's intake exceeds the recommendation regarding unhealthy snacks, with consumption varying from 53.3 g/d in Greece to 73.1 g/d in Belgium (Marieke De Craemer et al., 2015).

Improving children's dietary habits as early as possible is particularly important. Eating behaviour is formed in childhood, tracks over childhood (Kelder, Perry, Klepp, & Lytle, 1994) and persists into adulthood (Lien, Lytle, & Klepp, 2001). Thus, the adoption of healthy instead of unhealthy food choices early in life could provide lifelong benefits. In addition, there is growing evidence that poor diet in childhood can lead to health problems commonly observed in adults, such as diabetes (Whincup et al., 2002), obesity (Klesges, Klesges, Eck, & Shelton, 1995) and CVD (Moller, Taubert, Allen, Clark, & Lauer, 1994). As a result, interventions targeting early childhood, such as the Toy-Box study, could offer the maximum health benefits. Furthermore, consuming healthy snacks such as F&V instead of unhealthy snacks may contribute in controlling pre-schoolers' energy intake and body weight, since energy-dense food consumption has been found to be associated with higher BMI in young children (van Stralen et al., 2012).

In the ToyBox-study, focus groups with parents and teachers of pre-school children were executed in six European countries. The findings of the focus groups identified parental modelling, availability of healthy snacks and certain parenting practices as determinants of pre-schoolers' dietary habits (report submitted to the European Commission). Following the

intervention mapping protocol (Bartholomew et al., 1998), these findings were translated into practical strategies and were considered in the design of the ToyBox-intervention (Manios et al., 2014).

So far, analysis of the results of the ToyBox-intervention has shown significant improvements in pre-schoolers' diet quality (Pinket, De Craemer, Huybrechts, et al., 2016). Because family dynamics including family rules, modelling support and encouragement are important determinants of children's health behaviour (Wilfley et al., 2011), the present study aimed to shed light on the family-related mechanisms mediating the effect of the ToyBox-study on pre-school children's consumption of healthy and unhealthy snacks.

METHODS

Participants

The ToyBox-study (www.toybox-study.eu) aimed to develop, implement and evaluate a kindergarten-based, family-involved intervention to prevent obesity in pre-school children in six European countries (Belgium, Bulgaria, Germany, Greece, Poland and Spain). Pre-school children and their families were recruited from 309 kindergartens from three socio-economic groups, following a standardized approach, as described elsewhere by Manios et al. (Manios et al., 2014). The study was registered at clinical_trials.gov (identifier: NCT02116296). The study design has been described in detail elsewhere (Manios et al., 2014; Manios et al., 2012).

Procedure

The ToyBox-intervention had a cluster-randomized design and was conducted during the school year 2012–2013. Four energy balance-related behaviours were targeted, namely drinking, snacking, physical activity and sedentary behaviours, as well as their determinants (Marieke De Craemer et al., 2013; Manios et al., 2014; van Stralen et al., 2012).

Four levels were used for implementation of the snacking component of the ToyBox-intervention. Level 1 included the availability of healthy snacks at class/kindergarten; level 2 included children's daily consumption of a healthy snack; level 3 included the execution of interactive classroom activities using a kangaroo hand-puppet as a role model; and level 4 included the delivery of two newsletters, two tip-cards and one poster to the parents/caregivers via the teachers. These newsletters, tip-cards and poster included key messages and practical

tips on healthy snacking (e.g. F&V) instead of unhealthy choices (e.g. sweets and/or salty snacks) (Manios et al., 2014). Levels 1 and 2 were conducted for the whole duration of the school year 2012–2013, whereas levels 3 and 4 were conducted over six weeks (i.e. during the first focus period between weeks 9 and 12, and during the repetition period between weeks 21 and 22) (Manios et al., 2012). The ToyBox-intervention was implemented by kindergarten teachers, who attended three training sessions by the research staff of minimum one hour per session (Androutsos, Katsarou, et al., 2014).

Instrumentation

The pre-test measurements were conducted in May/June 2012 and the post-test measurements were conducted after one year (i.e. May/June 2013). Parents/caregivers signed a consent form to participate in the study and were asked to fill out the Primary Caregivers' Questionnaire (PCQ) regarding sociodemographic factors, lifestyle behaviours and perinatal factors, as well as an FFQ (Huybrechts et al., 2009).

Snack consumption was assessed by combining the frequency as well as the average consumption for each item. Determinants of pre-schoolers' snack consumption were self-reported by the parents/caregivers in the PQC, using Likert-type questions. More details on the questions used for assessing snack consumption as well as the determinants can be found in the online supplementary material, Supplemental Tables 4.10 and 4.11, while the questionnaire is available online at the ToyBox-study website (www.toybox-study.eu) and was previously shown to be a reliable tool (Gonzalez-Gil et al., 2014).

Supplementary Table 4.10: Snack consumption Questionnaire Items.

| General approach | | |
|---|---|---|
| <p>Snack consumption was assessed by combining the frequency as well as the average consumption for each item. Response categories for assessing frequency 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”, while regarding the average consumption, the response categories depended on the relevant food item (e.g. 1-3 tablespoons for dried fruit, 25-125 g for chocolate).</p> <p>From this data, the average amount of each food item in grams per day was calculated by multiplication of the number of days per week and amount per day in grams (using the midpoint) divided by 7 (total number of days in a full week) and was then calculated as grams/day</p> | | |
| fruits and vegetables | sweet snacks | salty snacks |
| The “fruits and vegetables” variable was calculated as the sum of the following food items: fresh, canned, dried fruits as well as raw and cooked vegetables. | The “sweet snacks” variable was calculated as the sum of the following food items: chocolate, dairy-based desserts, cakes, biscuits, pastries and sugar-based desserts, while | The salty snacks variable was originally included in the questionnaire as such. |

Supplementary Table 4.11: Determinant and Questionnaire Items.

| Determinant/ Question item | Response alternatives |
|---|---|
| Healthy snacking | |
| | |
| "I make fruit or vegetables snacks regularly available for my child" | -2= strongly disagree- +2= strongly agree |
| "I often give fruits or vegetables as snacks to my child" | -2= strongly disagree- +2= strongly agree |
| "My child likes to eat fruits and vegetables as a snack" | -2= strongly agree- +2= strongly disagree |
| Parental fruits and vegetables consumption assessed with the question: "How often do you consume the following items as a snack (in between your main meals)?" with the following subgroups: "fresh fruits", "vegetables" | 0= never 1= 1 or less times per week 3= 2-4 times per week 5,5= 5-6 times per week 1,5= 1-2 times per day 3,5= 3-4 times per day 5= 5 or more times per day |
| My child is allowed to eat fruits or vegetables as snacks without asking | -2= strongly disagree- +2= strongly agree |
| Perceived fruit and vegetable recommendation assessed with the question: "What do you think is an acceptable consumption of the following food items for 4-6-year-old children?" with the following subgroup: "Fruit and vegetables" | 0= never 0= 1 or less times per week 0= 2-4 times per week 1= 5-6 times per week 0= 1-2 times per day 0= 3-4 times per day 0= 5 or more times per day |
| Unhealthy snacking | |
| I think eating sweet or salty snacks is not bad for my child | -2= strongly disagree- +2= strongly agree |
| Parental snack consumption assessed with the question: "How often do you consume the following items as a snack (in | 0= never 1= 1 or less times per week |

| | |
|---|---|
| between your main meals)?” with the following subgroups: “cakes/muffins”, “biscuits/cookies”, “crisps and other similar salty snacks”, “chocolate”, “sweets/candies” | 3= 2-4 times per week 5,5= 5-6 times per week 1,5= 1-2 times per day 3,5= 3-4 times per day 5= 5 or more times per day |
| “I make sweet or salty snacks regularly available for my child” | -2= strongly disagree- +2= strongly agree |
| Parental knowledge on unhealthy snack recommendation consumption assessed with the question: “What do you think is an acceptable consumption of the following food items for 4-6 year old children?” with the following subgroups: “Sweets/candies/ Chocolate”, “Biscuits/cookies/ cakes/muffins”, “Crisps and other similar salty snacks” | 0= never 1= 1 or less times per week 0= 2-4 times per week 0= 5-6 times per week 0= 1-2 times per day 0= 3-4 times per day 0= 5 or more times per day |
| I find it difficult to restrain myself from eating sweet or salty snacks because of the presence of my child | -2= strongly agree- +2= strongly disagree |
| If I prohibit my child to eat sweet/salty snack I find it difficult to stick to my rules if (s)he starts nagging | -2= strongly agree- +2= strongly disagree |
| I give sweet or salty snacks to my child as a reward or to comfort him | -2= strongly disagree- +2= strongly agree |
| My child is allowed to eat sweet or salty snacks only at certain occasions i.e. birthdays | -2= strongly disagree- +2= strongly agree |
| My child is not allowed to snack while watching TV | -2= strongly agree- +2= strongly disagree |

Data analysis

Descriptive statistics describing the baseline characteristics of the participating children per intervention or control group were conducted in the statistical software package IBM SPSS Statistics version 23.0. Differences between these two groups were tested using independent t tests for continuous variables or χ^2 tests for dichotomous variables. Missing data were imputed for the food items under study using the ‘multiple imputation’ macro in IBM SPSS Statistics

version 23.0. Mediation effects were assessed with the bootstrapping procedure of MacKinnon et al. (MacKinnon DP, 2004) via the following mediation analysis steps: (i) estimating the effect of the intervention on unhealthy snacking and F&V consumption (τ coefficient); (ii) estimating the effect of the intervention on the proposed mediator (α coefficient); (iii) estimating the effect of the mediator on unhealthy snacking and F&V consumption (β coefficient) adjusting for the intervention effect (c' coefficient); (iv) computing the indirect effect of the intervention on unhealthy snacking and F&V consumption via the proposed mediator ($\alpha\beta$ coefficient); and (v) bootstrapping the sampling distribution of $\alpha\beta$ and deriving a bias-corrected CI with 5000 bootstrapped sampling distribution. All models were adjusted for age, sex, maternal education, country, baseline level of unhealthy snacking and F&V consumption, and baseline level of the mediator. STDY standardization methods (which mean that standardization was based only on the dependent variable, and not on both the dependent and independent variable because the independent variable (research group) was a binary variable) were applied. Adding a random intercept for kindergarten site did not improve the model fit and was therefore eliminated. Mediation analyses were run in Mplus version 8.0 (Muthén, 1998-2012).

RESULTS

Table 4.12 shows the baseline characteristics of the current study sample. Participating children were on average 4.75 years old, 49 % were female and 61 % had a mother with more than 14 years of education. Intervention and control group participants did not differ in terms of children's age, sex, parental age, unhealthy snack consumption, F&V consumption or any of the baseline values of the potential mediators, with the exception of intervention children having less educated mothers, more parental self-efficacy with a nagging child and higher parental F&V consumption than control participants at baseline ($P = 0.03$).

Table 4.12. Baseline characteristics (mean \pm standard deviation unless otherwise stated) of the participating preschool children and their parents/ caregivers per treatment arm. The ToyBox-study

| | Intervention group (N=3360) | Control group (N=1852) |
|--|--------------------------------|------------------------------|
| Demographics | | |
| Age child | 4.7 \pm .43 | 4.7 \pm .45 |
| Sex (% female) | 48.5 | 48.8 |
| Age parent (years) | 35.7 \pm 5.0 | 35.6 \pm 4.8 |
| Maternal education (%maternal education > 14 years) | 60.0 | 63.1* |
| Behaviours | | |
| Unhealthy snack consumption child (gram/ day) | 85.2 \pm 52.3 | 83.5 \pm 47.8 |
| Fruit and vegetable consumption child (gram/day) | 240.3 \pm 134.2 | 241.64 \pm 131.27 |
| Determinants of healthy snacking | | |
| Child's fruits and vegetables preference [-2,+2] | .85 \pm 1.06 | .88 \pm 1.01 |
| Availability of fruits and vegetables as snacks [-2,+2] | 1.01 \pm .89 | 1.03 \pm .88 |
| Regular availability of fruits and vegetables [-2,+2] | 1.18 \pm .77 | 1.15 \pm .83 |
| Parental rule: allowed to eat fruits and vegetables as snacks without asking [-2,+2] | .56 \pm 1.18 | .50 \pm 1.16 |
| Parental knowledge on fruits and vegetables recommendation [%] | 19 | 19 |
| Fruits and vegetables consumption parent (portions per day) | 2.12 \pm 2.32 | 1.99 \pm 2.17* |
| Determinants of unhealthy snacking | | |
| I think eating sweet or salty snacks is not bad for my child [-2,+2] | -.46 \pm 1.24 | -.41 \pm 1.26 |
| I make sweet or salty snacks regularly available for my child [-2,+2] | -.81 \pm .97 | -.84 \pm .97 |

| | | |
|--|-------------|--------------|
| My child is not allowed to snack while watching TV [-2,+2] | -0.09 ±1.11 | -0.02 ± 1.11 |
| My child is allowed to eat sweet or salty snacks only at certain occasions i.e. birthdays [-2,+2] | -0.12 ±1.05 | -0.09 ± 1.05 |
| I give sweet or salty snacks to my child as a reward or to comfort him [-2,+2] | -0.79 ±1.07 | -0.82 ± 1.06 |
| If I prohibit my child to eat a sweet or salty snack I find it difficult to stick to my rules if he/she starts nagging [-2,+2] | -0.86 ±1.04 | -0.95 ± .97* |
| I find it difficult to restrain myself from eating sweet or salty snacks because of the presence of my child [-2,+2] | -0.70 ±1.14 | -0.73 ± 1.13 |
| Parental knowledge on unhealthy snack recommendation [% 0 recommendations correct] | 51.6 | 50.4 |
| Unhealthy snack consumption parent (portions/ day) | .26 ±.29 | .25 ±.25 |

*Significant differences between intervention and control groups at *p<.05 based on an independent t-test for continuous variables or chi² test for dichotomous variables.*

No significant total intervention effects were found on unhealthy snack consumption (c (unstandardized) = -2.41; 95 % CI -5.40, 0.39 (data not shown for the unstandardized analysis); τ (standardized) = -0.05; 95 % CI -0.12, 0.01) or F&V consumption (c = -1.59; 95 % CI -8.33, 5.00; τ = -0.01; 95 % CI -0.06, 0.04). As shown in Table 4.13, the intervention was effective in improving parental rules on snacking while watching television and snacking recommendation (i.e. permission of unhealthy snacking only during special occasions), parental unhealthy snack consumption, parental knowledge on children's snacking recommendation and child's attitude towards F&V as reported by their parent. Several potential mediators were found to be related to changes in unhealthy snacking and F&V consumption. Changes in parental rules (i.e. restriction) on unhealthy snacking while watching television and in permission of unhealthy snacking only during special occasions, improvement of parental unhealthy snack consumption and improvement of parental knowledge on snacking recommendation mediated the intervention effect on snacking consumption, whereas improvement in child's attitude towards F&V as reported by their parent mediated the intervention effect on F&V consumption.

Table 4.13. Family related mediators of healthy and unhealthy snack consumption The ToyBox-study

| Healthy snacking | α (95%CI) | β (95%CI) | $\alpha\beta$ (95%CI) | τ' (95%CI) |
|--|--------------------------|--------------------------|--------------------------|--------------------------|
| My child likes to eat fruits and vegetables as a snack | .06 (.01; .10) | .18 (.15; .21) | .01 (.00; .02) | -.03 (-.08; .12) |
| I often give fruits or vegetables as snacks to my child | .03 (-.02; .09) | .15 (.13; .18) | .01 (-.00; .01) | -.02 (-.07; .03) |
| I make fruit or vegetables snacks regularly available for my child | -.02 (-.08; .03) | .14 (.12; .17) | -.00; -.01; .00) | -.02 (-.06; .04) |
| My child is allowed to eat fruits or vegetables as snacks without asking | -.02 (-.07; .04) | .04 (.01; .07) | -.00 (-.00; .00) | -.01 (-.06; .04) |
| Parental fruit and vegetable consumption | -.01 (-.07; .04) | .04 (.01; .06) | .00 (-.00; .00) | -.01 (-.06; .04) |
| Knowledge on fruit and vegetable recommendation* | .00 (-.09; .08) | .35 (.29; .39) | .00 (-.03; .03) | -.01 (-.09; .06) |
| Unhealthy snacking | | | | |
| I think eating sweet or salty snacks is not bad for my child | -.13 (-.06; .04) | .08 (.04; .13) | -.00 (-.01; .00) | -.06 (-.12; .00) |
| I make sweet or salty snacks regularly available for my child | -.00 (-.06; .06) | .09 (.06; .12) | .00 (-.01; .01) | -.07 (-.13; -.01) |
| My child is not allowed to snack while watching TV | .11 (.05; .16) | -.03 (-.07; .00) | -.00 (-.01; .00) | -.06 (-.13; .00) |
| My child is allowed to eat sweet or salty snacks only at certain occasions i.e. birthdays | .11 (.05; .17) | -.05 (-.09; -.02) | -.01 (-.01; -.00) | -.06 (-.12; .01) |
| I give sweet or salty snacks to my child as a reward or to comfort him | -.01 (-.07; .05) | .04 (-.00; .07) | .00 (-.00; .00) | -.06 (-.12; .01) |
| If I prohibit my child to eat sweet/salty snack I find it difficult to stick to my rules if (s)he starts nagging | .02 (-.05; .08) | .05 (.02; .09) | .00 (-.00; .01) | -.07 (-.13; -.00) |
| I find it difficult to restrain myself from eating sweet or salty snacks because of the presence of my child | -.01 (-.06; .05) | .05 (.01; .09) | .00 (-.00; .00) | -.06 (-.12; .00) |
| Parental snack consumption | -.07 (-.13; -.01) | .14 (.10; .19) | -.01 (-.02; -.00) | -.05 (-.11; .02) |
| Parental knowledge on snacking recommendation * | .16 (.09; .23) | -.11 (-.16; -.07) | -.02 (-.03; -.01) | -.04 (-.10; .02) |

*All models were single mediation models adjusted for child's gender and age, maternal education, country and baseline values of snacking consumption and the baseline value of the specific mediators. Bias-corrected bootstrapping using 5,000 samples was conducted with Maximum Likelihood estimator (with the exception of categorical mediators indicated with an * which were conducted with WLSMV indicator) using Mplus. Standardized coefficients are shown using STDY Standardization because of a binary independent variable. Significant associations are presented in bold font. The regression coefficients are presented in SDs. The explanation for each coefficient is presented below: α -coefficient: Estimation of the effect of the intervention on the proposed mediator; τ -coefficient: Estimation of the effect of the intervention on unhealthy snacking and FV consumption; β -coefficient: Estimation of the effect of the mediator on unhealthy snacking and FV consumption; τ' -coefficient: Estimation of the effect of the mediator on unhealthy snacking and FV consumption adjusting for the intervention effect; $\alpha\beta$ -coefficient: Computation of the indirect effect of the intervention on unhealthy snacking and FV consumption via the proposed mediator*

Regarding interpretation of the results presented in Table 4.13, an example would be that an increase of 1 SD in the determinant 'If I prohibit my child to eat sweet/salty snack I find it difficult to stick to my rules if (s)he starts nagging' is associated with a decrease in unhealthy snack consumption of 0.07 SD, after adjusting for the intervention effect.

DISCUSSION

The ToyBox-intervention was a kindergarten-based, family- involved intervention aiming to prevent obesity at pre-school age via the promotion of healthy energy balance-related behaviours. The aim of the present study was to examine if the family-related determinants of snack consumption, which were identified and targeted in the ToyBox-study, mediated the effects of the ToyBox-intervention on pre-schoolers' consumption of healthy and unhealthy snacks.

The present study showed that several family-related determinants of snack consumption mediated the effects of the ToyBox-intervention on pre-schoolers' snack consumption. These mediators were parental rules (i.e. restriction) on unhealthy snacking while watching television, parental permission of unhealthy snacking only during special occasions, parental unhealthy snack consumption, parental knowledge on snacking recommendation and child's attitude towards F&V as reported by their parent. Our findings are in line with previous studies. More specifically, a recent review showed that food availability and parental offering of foods have been successfully modified by several interventions and linked to positive changes in child outcomes (Bekelman, 2017). Furthermore, a systematic review conducted by van Stralen et al. found evidence for attitude, knowledge and habit strength as mediators of interventions targeting dietary behaviour (van Stralen et al., 2011). In the case of the ToyBox-study, these determinants referred to the parents and teachers of the pre-school children, due to the children's young age. Moreover, there is accumulated evidence highlighting that parental role modelling, which in the current study is depicted as limited parental F&V consumption, exerts a significant role in children's F&V consumption (Couch, Glanz, Zhou, Sallis, & Saelens, 2014).

The ToyBox-intervention had a positive effect on several family-related determinants regarding children's eating and snacking behaviour. Despite the strategies used to target these determinants being correctly and appropriately used, the ToyBox-intervention did not manage to significantly change children's snack consumption. This observation is in line with similar intervention studies (Freeman & Oliver, 2009). These findings could be attributed to the fact that

dietary behaviour is one of the most complex behaviours and there may be more family-, school- or peer-related determinants than those identified during the preliminary phase of the ToyBox-study (focus groups as well as systematic literature reviews) that might also have an important role in determining dietary choices. Moreover, the results of the process evaluation conducted within the ToyBox-intervention showed that many parents did not read the provided newsletters and the tip-cards, which might explain the non-significant intervention effects regarding pre-schoolers' snack food consumption (report submitted to the European Commission) (Bekelman, 2017; Pinket, De Craemer, Maes, et al., 2016). Furthermore, the duration of the intervention might not be adequate to change children's snacking behaviour. Last but not least, like most school-based interventions, the ToyBox- intervention did not follow a personalized approach, thus was not tailored to individual needs and preferences that might further enhance its effectiveness.

Future intervention developers targeting pre-schoolers' snack consumption are recommended to target the determinants that were found to mediate the intervention effect as well as the intervention strategies used in the ToyBox- intervention to change them, since those strategies succeeded in improving the targeted determinants. However, more extensive research should be done in the field of pre- schoolers' snack food choices to capture the complete panel of determinants influencing pre-schoolers' snacking behaviour. Furthermore, investing more time and effort to follow a more personalized approach in the population subgroups that are at higher risk (e.g. in families with low socio-economic status or in families with medical history of non-communicable diseases) might be more effective. Developing strategies to increase participants' fidelity to the programme, such as making the material less burdensome or providing it via a web-based system, should also be considered in future public health initiatives.

Limitations and strengths

The present study has some strengths and limitations. The strengths include the large study sample, the diversity of countries, regions and socio-economic groups included, the standardization of all study procedures and tools, as well as the assessment of all determinants found to be associated with pre-school children's snack consumption in the preliminary phases of the ToyBox-study. Furthermore, all measurements at pre- and post-test were taken during the same time period (i.e. May/June 2012 and 2013), thus limiting the potential seasonality effects on pre- schoolers' snack consumption. On the other hand, data were self-reported by the

parents, resulting in potential recall bias or social desirability of the responses. However, the reliability of the used questionnaires has been previously tested, before the start of the intervention, and they were found to be reliable tools (Gonzalez-Gil et al., 2014). Furthermore, the data were collected in 2012–2013; however, this is to be expected from multicentre studies, which include complex procedures for data processing, handling and analysis. Even though attention on the health-related behaviours in young children is growing, the literature focusing on the pathways through which interventions such as the ToyBox-study improve health-related behaviours via family-related or other determinants is still scarce. Thus, the current study is strongly related and relevant to current policy and practice in order to improve the effectiveness of childhood obesity prevention programmes.

Conclusions

Even though the total effect of the ToyBox-intervention on pre-school children's healthy and unhealthy snacking was not significant, the intervention was effective in improving parental rules on children's unhealthy snack consumption (i.e. restriction while watching television and permission only at certain occasions) and parental consumption of unhealthy snacks, while it increased parental knowledge on snacking recommendations. Regarding the consumption of healthy snacks, the ToyBox-intervention improved children's attitude towards F&V. All previously mentioned family-related determinants mediated the intervention effect on pre-schoolers' consumption of healthy and unhealthy snacks. These findings imply that future interventions aiming to promote F&V consumption and limit the consumption of unhealthy snacks in pre-schoolers should target these mediators, but also target more determinants and use more strategies, such as personalization, to enhance their effectiveness.

Chapter 5. Conclusions and future steps

The current thesis aimed (a) to evaluate an innovative and evidence-based intervention aiming to prevent obesity in preschool children, aged 4-6 years, (b) to explore the effects of the intervention on family-related factors associated with pre-schoolers' energy-related behaviours, (c) to identify potential associations between changes of these factors and changes of pre-schoolers' energy-related behaviours, and (d) to evaluate the potential mediating role of these factors on the intervention effects on pre-schoolers' energy-related behaviours.

In total, 6290 children and families from 333 kindergartens (179 intervention) participated in the study and out of them 5529 provided complete data (i.e. anthropometric data 100% completed and parents'/caregivers' questionnaire at least 75% completed) at baseline and follow-up. Several statistically significant beneficial intervention effects were observed for most of the EBRBs examined in this study, i.e. daily consumption of plain water, pre-packed/bottled fruit juices, sweet snacks, meat products (e.g. ham, salami, etc.), the percentage of children meeting the threshold of 1 hour/day for screen time on weekdays and those meeting the threshold of 10,000 steps/day on weekend days, while no significant differences were observed for the percentage of overweight/obese children.

Regarding water consumption most of the selected family-related determinants of water consumption mediated the effects of the ToyBox-intervention on pre-schoolers' water consumption. These mediators were water availability during meals, parental water consumption, parental encouragement to the child to drink water, and parental knowledge on water recommendations. In other words, it was observed that the ToyBox-intervention improved the determinants that were identified in the ToyBox-study, linked to specific program goals to form specific change objectives via the IM-protocol and targeted via the intervention material, such as newsletters and tip-cards. Our findings confirm that the selected determinants are relevant in changing pre-schoolers' water consumption and suggest that the intervention strategies (e.g. role modelling) applied were effective.

Regarding snack consumption, it was shown that several family-related determinants mediated the effects of the ToyBox-intervention on pre-schoolers' snack consumption. These mediators were parental rules (i.e. restriction) on unhealthy snacking while watching television, parental permission of unhealthy snacking only during special occasions, parental unhealthy snack

consumption, parental knowledge on snacking recommendation and child's attitude towards F&V as reported by their parent.

Conclusions

The findings of the present study showed that the ToyBox-intervention resulted in positive but small mean effects on children's EBRBs. This might in part be due to large diversity of the actual study sample (including low-, medium- and high- SES groups, as well as high- and low- motivated families and teachers), but also to the fidelity of the programme implementation since it was largely dependent on the motivation and skills of the kindergarten teachers in six European countries. The significant, positive effects observed on children's EBRBs may be explained by the changes of the relevant family-related determinants, indicating that the ToyBox-intervention actively engaged parents/caregivers to change their social and physical environment at home and become role models for their children.

Specifically, regarding water consumption, the ToyBox-intervention increased water availability during meals, parental water consumption, parental encouragement, and parental knowledge on water recommendations. These determinants also mediated the effects of the ToyBox-intervention on preschool children's water consumption. These findings imply that future interventions aiming to promote water consumption in pre-schoolers should target the family and home-related determinants to enhance their effectiveness.

Regarding snack consumption and even though the total effect of the ToyBox-intervention on pre-school children's healthy and unhealthy snacking was not significant, the intervention was effective in improving parental rules on children's unhealthy snack consumption (i.e. restriction while watching television and permission only at certain occasions) and parental consumption of unhealthy snacks, while it increased parental knowledge on snacking recommendations. Regarding the consumption of healthy snacks, the ToyBox-intervention improved children's attitude towards F&V. All previously mentioned family-related determinants mediated the intervention effect on pre-schoolers' consumption of healthy and unhealthy snacks.

Strengths and Limitations

The cluster-randomized design of the study and the large sample size, the diversity of participating regions and socioeconomic groups, the standardization of all study procedures and tools and the objective assessment of children's physical activity levels should be noted as

strengths of this study. All measurements at pre- and post- test were taken in the same time period (i.e. May/June 2012 and 2013), thus limiting the potential seasonality effects.

The parent-reported information of children's food and beverages consumption and screen time are limitations of this study. Although the validity and reliability of the relevant questionnaires were tested before the start of the intervention, this approach is prone to recall bias and social desirability. Still, it should be noted that the reliability of the FFQ and PCQ were tested before the start of the intervention and found to be acceptable (Gonzalez-Gil et al., 2014).

Future Steps

Key strategies of successful interventions, which were considered in the design of the ToyBox-intervention, include the target on both sides of energy balance, i.e. both on dietary behaviour and on physical activity and sedentary behaviour, the creation of a physical and social environment promoting healthy EBRBs, the inclusion of both educational and environmental components, the active involvement of the family and role modelling.

Perhaps more time should be provided to the teachers to focus on four EBRBs utilizing all four levels of implementation per EBRB (i.e. environmental changes, implementation of the actual EBRB, classroom activities and parental involvement via newsletters which were distributed to them by the teachers).

Considering that in most participating countries the parents are those who prepare the snacks consumed by the children at kindergarten and also provide the opportunities to be physically active or sedentary in the afternoons and on weekends, it might be worthwhile putting more emphasis on their actual engagement and participation in the programme.

Moreover, a more intensive co-participatory approach with the involvement of the relevant stakeholders throughout the development as well as implementation and evaluation may improve the relevance, attractiveness and thereby the implementation and effectiveness of the intervention. Engagement of other stakeholders such as parents' associations at schools, municipalities, local organizations of experts (e.g. dietitians, PE-instructors), NGOs etc. may be necessary to create and support environmental changes at the local level.

Future intervention developers targeting pre-schoolers' water consumption and/or snack consumption are recommended to target the determinants and intervention strategies used in

the ToyBox-intervention. Still, it needs to be mentioned that these determinants were identified via focus groups executed with groups of parents with a different SES- background and the ToyBox-intervention was applied in similar population groups, thus tailor-made to a large extent to the actual needs of the targeted population.

Investing more time and effort to follow a more personalized approach in the population subgroups that are at higher risk (e.g. in families with low socio-economic status or in families with medical history of non-communicable diseases) might be more effective. Developing strategies to increase participants' fidelity to the programme, such as making the material less burdensome or providing it via a web-based system, should also be considered in future public health initiatives.

Chapter 6. References

- Amuna, P., & Zotor, F. B. (2008). Epidemiological and nutrition transition in developing countries: impact on human health and development: The epidemiological and nutrition transition in developing countries: evolving trends and their impact in public health and human development. *Proceedings of the Nutrition Society*, 67(1), 82-90.
- Androutsos, O., Apostolidou, E., Iotova, V., Socha, P., Birnbaum, J., Moreno, L., Manios, Y. (2014). Process evaluation design and tools used in a kindergarten-based, family-involved intervention to prevent obesity in early childhood. The ToyBox-study. *Obes Rev*, 15 Suppl 3, 74-80. doi: 10.1111/obr.12185
- Androutsos, O., Katsarou, C., Payr, A., Birnbaum, J., Geyer, C., Wildgruber, A., Manios, Y. (2014). Designing and implementing teachers' training sessions in a kindergarten-based, family-involved intervention to prevent obesity in early childhood. The ToyBox-study. *Obes Rev*, 15 Suppl 3, 48-52. doi: 10.1111/obr.12182
- Bandini, L. G., Must, A., Phillips, S. M., Naumova, E. N., & Dietz, W. H. (2004). Relation of body mass index and body fatness to energy expenditure: longitudinal changes from preadolescence through adolescence. *The American Journal of Clinical Nutrition*, 80(5), 1262-1269.
- Bartholomew, L. K., Parcel, G. S., & Kok, G. (1998). Intervention mapping: a process for developing theory- and evidence-based health education programs. *Health Educ Behav*, 25(5), 545-563. doi: 10.1177/109019819802500502
- Bartholomew LK, P. G., Kok G, Gottlieb NH FN. (2011). *Planning Health Promotion Programs. An Intervention Mapping Approach*. (3rd edn. ed.). San Francisco: Jossey-Bass.
- Bekelman, T. A., Bellows, L.L. & Johnson, S.L. . (2017). Are Family Routines Modifiable Determinants of Preschool Children's Eating, Dietary Intake, and Growth? A Review of Intervention Studies. *Curr Nutr Rep*, 6(2), 171-189.
- Berrington de Gonzalez, A., Hartge, P., Cerhan, J. R., Flint, A. J., Hannan, L., MacInnis, R. J., . . . Freeman, L. B. (2010). Body-mass index and mortality among 1.46 million white adults. *New England Journal of Medicine*, 363(23), 2211-2219.
- Bluford, D. A., Sherry, B., & Scanlon, K. S. (2007). Interventions to prevent or treat obesity in preschool children: a review of evaluated programs. *Obesity*, 15(6), 1356-1372.
- Brug, J., van Stralen, M. M., Chinapaw, M. J., De Bourdeaudhuij, I., Lien, N., Bere, E., . . . Te Velde, S. J. (2012). Differences in weight status and energy-balance related behaviours according to ethnic background among adolescents in seven countries in Europe: the ENERGY-project. *Pediatr Obes*, 7(5), 399-411. doi: 10.1111/j.2047-6310.2012.00067.x
- Campbell, K., & Hesketh, K. (2007). Strategies which aim to positively impact on weight, physical activity, diet and sedentary behaviours in children from zero to five years. A systematic review of the literature. *Obesity reviews*, 8(4), 327-338.
- Castro, F. G., Barrera, M., Jr., & Martinez, C. R., Jr. (2004). The cultural adaptation of prevention interventions: resolving tensions between fidelity and fit. *Prev Sci*, 5(1), 41-45. doi: 10.1023/b:prev.0000013980.12412.cd
- Cole, T. J., & Lobstein, T. (2012). Extended international (IOTF) body mass index cut-offs for thinness, overweight and obesity. *Pediatr Obes*, 7(4), 284-294. doi: 10.1111/j.2047-6310.2012.00064.x
- Control, C. f. D., & Prevention. (2000). Centers for Disease Control and Prevention (CDC) growth charts. *CDC Atlanta GA*.
- Couch, S. C., Glanz, K., Zhou, C., Sallis, J. F., & Saelens, B. E. (2014). Home food environment in relation to children's diet quality and weight status. *J Acad Nutr Diet*, 114(10), 1569-1579.e1561. doi: 10.1016/j.jand.2014.05.015

- Craigie, A. M., Lake, A. A., Kelly, S. A., Adamson, A. J., & Mathers, J. C. (2011). Tracking of obesity-related behaviours from childhood to adulthood: A systematic review. *Maturitas*, 70(3), 266-284. doi: 10.1016/j.maturitas.2011.08.005
- De Bourdeaudhuij, I., Van Cauwenberghe, E., Spittaels, H., Oppert, J. M., Rostami, C., Brug, J., . . . Maes, L. (2011). School-based interventions promoting both physical activity and healthy eating in Europe: a systematic review within the HOPE project. *Obes Rev*, 12(3), 205-216. doi: 10.1111/j.1467-789X.2009.00711.x
- De Bourdeaudhuij, I., Verbestel, V., De Henauw, S., Maes, L., Huybrechts, I., Marild, S., . . . Pigeot, I. (2015). Behavioural effects of a community-oriented setting-based intervention for prevention of childhood obesity in eight European countries. Main results from the IDEFICS study. *Obes Rev*, 16 Suppl 2, 30-40. doi: 10.1111/obr.12347
- De Craemer, M., De Decker, E., De Bourdeaudhuij, I., Deforche, B., Vereecken, C., Duvinage, K., . . . Cardon, G. (2013). Physical activity and beverage consumption in preschoolers: focus groups with parents and teachers. *BMC Public Health*, 13(1), 278. doi: 10.1186/1471-2458-13-278
- De Craemer, M., De Decker, E., De Bourdeaudhuij, I., Verloigne, M., Duvinage, K., Koletzko, B., . . . Cardon, G. (2014). Applying the Intervention Mapping protocol to develop a kindergarten-based, family-involved intervention to increase European preschool children's physical activity levels: the ToyBox-study. *Obes Rev*, 15 Suppl 3, 14-26. doi: 10.1111/obr.12180
- De Craemer, M., Lateva, M., Iotova, V., De Decker, E., Verloigne, M., De Bourdeaudhuij, I., . . . the ToyBox-study, g. (2015). Differences in Energy Balance-Related Behaviours in European Preschool Children: The ToyBox-Study. *PLOS ONE*, 10(3), e0118303. doi: 10.1371/journal.pone.0118303
- De Decker, E., De Craemer, M., De Bourdeaudhuij, I., Verbestel, V., Duvinage, K., Iotova, V., . . . Cardon, G. (2014). Using the intervention mapping protocol to reduce European preschoolers' sedentary behavior, an application to the ToyBox-Study. *Int J Behav Nutr Phys Act*, 11, 19. doi: 10.1186/1479-5868-11-19
- De Decker, E., De Craemer, M., De Bourdeaudhuij, I., Wijndaele, K., Duvinage, K., Androutsos, O., . . . Cardon, G. (2013). Influencing factors of sedentary behavior in European preschool settings: an exploration through focus groups with teachers. *J Sch Health*, 83(9), 654-661. doi: 10.1111/josh.12078
- De Miguel-Etayo, P., Mesana, M. I., Cardon, G., De Bourdeaudhuij, I., Gozdz, M., Socha, P., . . . Moreno, L. A. (2014). Reliability of anthropometric measurements in European preschool children: the ToyBox-study. *Obes Rev*, 15 Suppl 3, 67-73. doi: 10.1111/obr.12181
- De Onis, M., Blössner, M., & Borghi, E. (2010). Global prevalence and trends of overweight and obesity among preschool children—. *The American Journal of Clinical Nutrition*, 92(5), 1257-1264.
- Dennison, B. A., Rockwell, H. L., & Baker, S. L. (1998). Fruit and vegetable intake in young children. *J Am Coll Nutr*, 17(4), 371-378.
- Derbyshire, E. (2016). "Drink as I do" The influence of parents' drink choices on children: Natural Hydration Council
- Dietz, W. H., & Bellizzi, M. C. (1999). Introduction: the use of body mass index to assess obesity in children. *The American Journal of Clinical Nutrition*, 70(1), 123S-125S. doi: 10.1093/ajcn/70.1.123s
- Durao, C., Severo, M., Oliveira, A., Moreira, P., Guerra, A., Barros, H., & Lopes, C. (2015). Evaluating the effect of energy-dense foods consumption on preschool children's body

- mass index: a prospective analysis from 2 to 4 years of age. *Eur J Nutr*, 54(5), 835-843. doi: 10.1007/s00394-014-0762-4
- Ells, L. J., Demaio, A., & Farpour-Lambert, N. (2018). Diet, genes, and obesity. *BMJ: British Medical Journal (Online)*, 360.
- Ezzati, M., Lopez, A. D., Rodgers, A., & Murray, C. J. (2004). *Comparative quantification of health risks: global and regional burden of disease attributable to selected major risk factors*: OMS.
- Fitzgibbon, M. L., Stolley, M. R., Schiffer, L., Van Horn, L., KauferChristoffel, K., & Dyer, A. (2005). Two-year follow-up results for Hip-Hop to Health Jr.: a randomized controlled trial for overweight prevention in preschool minority children. *The Journal of pediatrics*, 146(5), 618-625.
- Flynn, M. A., McNeil, D. A., Maloff, B., Mutasingwa, D., Wu, M., Ford, C., & Tough, S. C. (2006). Reducing obesity and related chronic disease risk in children and youth: a synthesis of evidence with 'best practice' recommendations. *Obes Rev*, 7 Suppl 1, 7-66. doi: 10.1111/j.1467-789X.2006.00242.x
- Freeman, R., & Oliver, M. (2009). Do school break-time policies influence child dental health and snacking behaviours? An evaluation of a primary school programme. *Br Dent J*, 206(12), 619-625; discussion 616. doi: 10.1038/sj.bdj.2009.518
- Fund, W. C. R., & Research, A. I. f. C. (2007). *Food, nutrition, physical activity, and the prevention of cancer: a global perspective* (Vol. 1): Amer Inst for Cancer Research.
- Goldfield, G. S., Harvey, A., Grattan, K., & Adamo, K. B. (2012). Physical activity promotion in the preschool years: a critical period to intervene. *International journal of environmental research and public health*, 9(4), 1326-1342.
- Gonzalez-Gil, E. M., Mouratidou, T., Cardon, G., Androutsos, O., De Bourdeaudhuij, I., Gozdz, M., . . . Moreno, L. A. (2014). Reliability of primary caregivers reports on lifestyle behaviours of European pre-school children: the ToyBox-study. *Obes Rev*, 15 Suppl 3, 61-66. doi: 10.1111/obr.12184
- Grimm, G. C., Harnack, L., & Story, M. (2004). Factors associated with soft drink consumption in school-aged children. *J Am Diet Assoc*, 104(8), 1244-1249. doi: 10.1016/j.jada.2004.05.206
- Hafeman, D. M., & Schwartz, S. (2009). Opening the Black Box: a motivation for the assessment of mediation. *Int J Epidemiol*, 38(3), 838-845. doi: 10.1093/ije/dyn372
- Hales, C. M., Fryar, C. D., Carroll, M. D., Freedman, D. S., & Ogden, C. L. (2018). Trends in obesity and severe obesity prevalence in us youth and adults by sex and age, 2007-2008 to 2015-2016. *Jama*, 319(16), 1723-1725. doi: 10.1001/jama.2018.3060
- Hart, K., Herriot, A., Bishop, J., & Truby, H. (2003). Promoting healthy diet and exercise patterns amongst primary school children: a qualitative investigation of parental perspectives. *Journal of Human Nutrition and Dietetics*, 16(2), 89-96.
- Hesketh, K. D., & Campbell, K. J. (2010). Interventions to prevent obesity in 0–5 year olds: an updated systematic review of the literature. *Obesity*, 18(S1), S27-S35.
- Huybrechts, I., De Backer, G., De Bacquer, D., Maes, L., & De Henauw, S. (2009). Relative validity and reproducibility of a food-frequency questionnaire for estimating food intakes among Flemish preschoolers. *Int J Environ Res Public Health*, 6(1), 382-399. doi: 10.3390/ijerph6010382
- Huybrechts, I., & De Henauw, S. (2007). Energy and nutrient intakes by pre-school children in Flanders-Belgium. *Br J Nutr*, 98(3), 600-610. doi: 10.1017/S000711450773458X
- Iglesia, I., Guelinckx, I., De Miguel-Etayo, P. M., Gonzalez-Gil, E. M., Salas-Salvado, J., Kavouras, S. A., . . . Moreno, L. A. (2015). Total fluid intake of children and adolescents: cross-

- sectional surveys in 13 countries worldwide. *Eur J Nutr*, 54 Suppl 2, 57-67. doi: 10.1007/s00394-015-0946-6
- Inc., S. ([2010-08-29].). webcite SPSS (Statistical Package for the Social Sciences) for Windows computer software, version 17. 0 from <http://www.spss.com/>
- Jackson-Leach, R., & Lobstein, T. (2006). Estimated burden of paediatric obesity and co-morbidities in Europe. Part 1. The increase in the prevalence of child obesity in Europe is itself increasing. *International Journal of Pediatric Obesity*, 1(1), 26-32.
- Jacques, E. (2012). Promoting healthy drinking habits in children. *Nurs Times*, 108(41), 20-21.
- James, W. P. T., Jackson-Leach, R., Mhurchu, C. N., Kalamara, E., Shayeghi, M., Rigby, N. J., . . . Rodgers, A. (2004). Overweight and obesity (high body mass index). *Comparative quantification of health risks: global and regional burden of disease attributable to selected major risk factors*, 1, 497-596.
- Jequier, E., & Constant, F. (2010). Water as an essential nutrient: the physiological basis of hydration. *Eur J Clin Nutr*, 64(2), 115-123. doi: 10.1038/ejcn.2009.111
- Kelder, S. H., Perry, C. L., Klepp, K. I., & Lytle, L. L. (1994). Longitudinal tracking of adolescent smoking, physical activity, and food choice behaviors. *Am J Public Health*, 84(7), 1121-1126.
- Khattar, P. (2015). 'How effective are the interventions related to physical activities and nutrition in the school-based health promotion programmes: A Review of literature.' *International Journal of Sports and Physical Education (IOSR-JSPE)*. Volume 2 Issue-1. 2015. Pg.1-6.
- Kleiner, S. M. (1999). Water: an essential but overlooked nutrient. *J Am Diet Assoc*, 99(2), 200-206. doi: 10.1016/s0002-8223(99)00048-6
- Klesges, R. C., Klesges, L. M., Eck, L. H., & Shelton, M. L. (1995). A longitudinal analysis of accelerated weight gain in preschool children. *Pediatrics*, 95(1), 126-130.
- Latomme, J., Cardon, G., De Bourdeaudhuij, I., Iotova, V., Koletzko, B., Socha, P., . . . De Craemer, M. (2017). Effect and process evaluation of a kindergarten-based, family-involved intervention with a randomized cluster design on sedentary behaviour in 4- to 6- year old European preschool children: The ToyBox-study. *PLOS ONE*, 12(4), e0172730. doi: 10.1371/journal.pone.0172730
- Lien, N., Lytle, L. A., & Klepp, K. I. (2001). Stability in consumption of fruit, vegetables, and sugary foods in a cohort from age 14 to age 21. *Prev Med*, 33(3), 217-226. doi: 10.1006/pmed.2001.0874
- Ling, J., Robbins, L. B., & Wen, F. (2016). Interventions to prevent and manage overweight or obesity in preschool children: A systematic review. *Int J Nurs Stud*, 53, 270-289. doi: 10.1016/j.ijnurstu.2015.10.017
- Lobstein, T., Baur, L., & Uauy, R. (2004). Obesity in children and young people: a crisis in public health. *Obesity reviews*, 5, 4-85.
- Lobstein, T., Jackson-Leach, R., Moodie, M. L., Hall, K. D., Gortmaker, S. L., Swinburn, B. A., . . . McPherson, K. (2015). Child and adolescent obesity: part of a bigger picture. *Lancet*, 385(9986), 2510-2520. doi: 10.1016/s0140-6736(14)61746-3
- MacKinnon DP, L. C. W. J. (2004). Confidence limits for the indirect effect: distribution of the product and resampling methods. *Multivariate Behav Res*, 39, 99.
- Manios, Y., Androutsos, O., Katsarou, C., Iotova, V., Socha, P., Geyer, C., . . . De Bourdeaudhuij, I. (2014). Designing and implementing a kindergarten-based, family-involved intervention to prevent obesity in early childhood: the ToyBox-study. *Obes Rev*, 15 Suppl 3, 5-13. doi: 10.1111/obr.12175
- Manios, Y., Grammatikaki, E., Androutsos, O., Chinapaw, M. J., Gibson, E. L., Buijs, G., . . . de Bourdeaudhuij, I. (2012). A systematic approach for the development of a kindergarten-


- based intervention for the prevention of obesity in preschool age children: the ToyBox-study. *Obes Rev*, 13 Suppl 1, 3-12. doi: 10.1111/j.1467-789X.2011.00974.x
- Mo-suwan, L., Pongprapai, S., Junjana, C., & Puetpaiboon, A. (1998). Effects of a controlled trial of a school-based exercise program on the obesity indexes of preschool children. *The American Journal of Clinical Nutrition*, 68(5), 1006-1011.
- Moller, J. H., Taubert, K. A., Allen, H. D., Clark, E. B., & Lauer, R. M. (1994). Cardiovascular health and disease in children: current status. A Special Writing Group from the Task Force on Children and Youth, American Heart Association. *Circulation*, 89(2), 923-930.
- Moschonis, G., Kalliora, A. C., Costarelli, V., Papandreou, C., Koutoukidis, D., Lionis, C., . . . Manios, Y. (2014). Identification of lifestyle patterns associated with obesity and fat mass in children: the Healthy Growth Study. *Public Health Nutr*, 17(3), 614-624. doi: 10.1017/s1368980013000323
- Mouratidou, T., Miguel, M. L., Androutsos, O., Manios, Y., De Bourdeaudhuij, I., Cardon, G., . . . Moreno, L. A. (2014). Tools, harmonization and standardization procedures of the impact and outcome evaluation indices obtained during a kindergarten-based, family-involved intervention to prevent obesity in early childhood: the ToyBox-study. *Obes Rev*, 15 Suppl 3, 53-60. doi: 10.1111/obr.12183
- Muthén, L. K. a. M., B.O. . (1998-2012). Mplus User's Guide. (Seventh Edition. ed.). Los Angeles, CA: Muthén & Muthén.
- Nicklas, T., & Johnson, R. (2004). Position of the American Dietetic Association: Dietary guidance for healthy children ages 2 to 11 years. *J Am Diet Assoc*, 104(4), 660-677. doi: 10.1016/j.jada.2004.01.030
- Ogden, C. L., Carroll, M. D., Curtin, L. R., Lamb, M. M., & Flegal, K. M. (2010). Prevalence of high body mass index in US children and adolescents, 2007-2008. *Jama*, 303(3), 242-249.
- Ogden, C. L., Flegal, K. M., Carroll, M. D., & Johnson, C. L. (2002). Prevalence and trends in overweight among US children and adolescents, 1999-2000. *Jama*, 288(14), 1728-1732.
- Olstad, D. L., & McCargar, L. (2009). Prevention of overweight and obesity in children under the age of 6 years. *Applied Physiology, Nutrition, and Metabolism*, 34(4), 551-570.
- Osei-Assibey, G., Dick, S., Macdiarmid, J., Semple, S., Reilly, J. J., Ellaway, A., . . . McNeill, G. (2012). The influence of the food environment on overweight and obesity in young children: a systematic review. *BMJ open*, 2(6), e001538.
- Patterson, B. H., Block, G., Rosenberger, W. F., Pee, D., & Kahle, L. L. (1990). Fruit and vegetables in the American diet: data from the NHANES II survey. *American Journal of Public Health*, 80(12), 1443-1449.
- Pigeot, I., Barba, G., Chadigeorgiou, C., De Henauw, S., Kourides, Y., Lissner, L., . . . Tornaritis, M. (2009). Prevalence and determinants of childhood overweight and obesity in European countries: pooled analysis of the existing surveys within the IDEFICS Consortium. *International journal of obesity*, 33(10), 1103.
- Pil, L., Putman, K., Cardon, G., De Bourdeaudhuij, I., Manios, Y., Androutsos, O., . . . Annemans, L. (2014). Establishing a method to estimate the cost-effectiveness of a kindergarten-based, family-involved intervention to prevent obesity in early childhood. The ToyBox-study. *Obes Rev*, 15 Suppl 3, 81-89. doi: 10.1111/obr.12179
- Pinket, A. S., De Craemer, M., Huybrechts, I., De Bourdeaudhuij, I., Deforche, B., Cardon, G., . . . Van Lippevelde, W. (2016). Diet quality in European pre-schoolers: evaluation based on diet quality indices and association with gender, socio-economic status and overweight, the ToyBox-study. *Public Health Nutr*, 19(13), 2441-2450. doi: 10.1017/s1368980016000604
- Pinket, A. S., De Craemer, M., Maes, L., De Bourdeaudhuij, I., Cardon, G., Androutsos, O., . . . Van Lippevelde, W. (2016). Water intake and beverage consumption of pre-schoolers

- from six European countries and associations with socio-economic status: the ToyBox-study. *Public Health Nutr*, 19(13), 2315-2325. doi: 10.1017/s1368980015003559
- Pinket, A. S., Van Lippevelde, W., De Bourdeaudhuij, I., Deforche, B., Cardon, G., Androutsos, O., . . . De Craemer, M. (2016). Effect and Process Evaluation of a Cluster Randomized Control Trial on Water Intake and Beverage Consumption in Preschoolers from Six European Countries: The ToyBox-Study. *PLOS ONE*, 11(4), e0152928. doi: 10.1371/journal.pone.0152928
- Prentice, A. M., & Jebb, S. A. (2001). Beyond body mass index. *Obesity reviews*, 2(3), 141-147.
- Reilly, J. J., Coyle, J., Kelly, L., Burke, G., Grant, S., & Paton, J. Y. (2003). An objective method for measurement of sedentary behavior in 3-to 4-year olds. *Obesity research*, 11(10), 1155-1158.
- Reilly, J. J., Jackson, D., Montgomery, C., Kelly, L., Slater, C., Grant, S., & Paton, J. (2004). Total energy expenditure and physical activity in young Scottish children: mixed longitudinal study. *The Lancet*, 363(9404), 211-212.
- Rey-Lopez, J. P., Vicente-Rodríguez, G., Biosca, M., & Moreno, L. A. (2008). Sedentary behaviour and obesity development in children and adolescents. *Nutrition, Metabolism and Cardiovascular Diseases*, 18(3), 242-251.
- Romieu, I., Dossus, L., Barquera, S., Blottière, H. M., Franks, P. W., Gunter, M., . . . Obesity. (2017). Energy balance and obesity: what are the main drivers? *Cancer causes & control : CCC*, 28(3), 247-258. doi: 10.1007/s10552-017-0869-z
- Schwartz, A. E., Leardo, M., Aneja, S., & Elbel, B. (2016). Effect of a School-Based Water Intervention on Child Body Mass Index and Obesity. *JAMA Pediatr*, 170(3), 220-226. doi: 10.1001/jamapediatrics.2015.3778
- Singh, A. S., Mulder, C., Twisk, J. W., van Mechelen, W., & Chinapaw, M. J. (2008). Tracking of childhood overweight into adulthood: a systematic review of the literature. *Obes Rev*, 9(5), 474-488. doi: 10.1111/j.1467-789X.2008.00475.x
- Skouteris, H., Dell'Aquila, D., Baur, L. A., Dwyer, G. M., McCabe, M. P., Ricciardelli, L. A., & Fuller-Tyszkiewicz, M. (2012). Physical activity guidelines for preschoolers: a call for research to inform public health policy. *Med J Aust*, 196(3), 174-176.
- Skouteris, H., McCabe, M., Swinburn, B., Newgreen, V., Sacher, P., & Chadwick, P. (2011). Parental influence and obesity prevention in pre-schoolers: a systematic review of interventions. *Obesity reviews*, 12(5), 315-328.
- Steinbeck, K. S. (2001). The importance of physical activity in the prevention of overweight and obesity in childhood: a review and an opinion. *Obesity reviews*, 2(2), 117-130.
- Summerbell, C., Moore, H., Vögele, C., Kreichauf, S., Wildgruber, A., Manios, Y., (2012). Evidence-based recommendations for the development of obesity prevention programs targeted at preschool children. *Obesity reviews*, 13, 129-132.
- te Velde, S. J., van Nassau, F., Uijtdewilligen, L., van Stralen, M. M., Cardon, G., De Craemer, M., . . . Chinapaw, M. J. (2012). Energy balance-related behaviours associated with overweight and obesity in preschool children: a systematic review of prospective studies. *Obes Rev*, 13 Suppl 1, 56-74. doi: 10.1111/j.1467-789X.2011.00960.x
- Timmons, B. W., Naylor, P.-J., & Pfeiffer, K. A. (2007). Physical activity for preschool children—how much and how? *Applied Physiology, Nutrition, and Metabolism*, 32(S2E), S122-S134.
- Trost, S. G., Kerr, L., Ward, D. S., & Pate, R. R. (2001). Physical activity and determinants of physical activity in obese and non-obese children. *International journal of obesity*, 25(6), 822.

- Tsiros, M. D., Olds, T., Buckley, J. D., Grimshaw, P., Brennan, L., Walkley, J., Coates, A. M. (2009). Health-related quality of life in obese children and adolescents. *International journal of obesity*, 33(4), 387.
- van Daele, T., van Audenhove, C., Hermans, D., van den Bergh, O., & van den Broucke, S. (2014). Empowerment implementation: enhancing fidelity and adaptation in a psycho-educational intervention. *Health Promot Int*, 29(2), 212-222. doi: 10.1093/heapro/das070
- van Stralen, M. M., te Velde, S. J., van Nassau, F., Brug, J., Grammatikaki, E., Maes, L., ToyBox-study, g. (2012). Weight status of European preschool children and associations with family demographics and energy balance-related behaviours: a pooled analysis of six European studies. *Obes Rev*, 13 Suppl 1, 29-41. doi: 10.1111/j.1467-789X.2011.00959.x
- van Stralen, M. M., Yildirim, M., te Velde, S. J., Brug, J., van Mechelen, W., Chinapaw, M. J., & consortium, E. (2011). What works in school-based energy balance behaviour interventions and what does not? A systematic review of mediating mechanisms. *Int J Obes (Lond)*, 35(10), 1251-1265. doi: 10.1038/ijo.2011.68
- Vieux, F., Maillot, M., Constant, F., & Drewnowski, A. (2016). Water and beverage consumption among children aged 4-13 years in France: analyses of INCA 2 (Etude Individuelle Nationale des Consommations Alimentaires 2006-2007) data. *Public Health Nutr*, 19(13), 2305-2314. doi: 10.1017/S1368980015003614
- Wang, Y., & Lim, H. (2012). The global childhood obesity epidemic and the association between socio-economic status and childhood obesity. *International review of psychiatry (Abingdon, England)*, 24(3), 176-188. doi: 10.3109/09540261.2012.688195
- Whincup, P. H., Gilg, J. A., Papacosta, O., Seymour, C., Miller, G. J., Alberti, K. G., & Cook, D. G. (2002). Early evidence of ethnic differences in cardiovascular risk: cross sectional comparison of British South Asian and white children. *Bmj*, 324(7338), 635.
- WHO, W. H. O. (1990). Diet, Nutrition and The Prevention of Chronic Diseases. . Geneva: WHO.
- WHO, W. H. O. (2000). *Obesity: preventing and managing the global epidemic*: World Health Organization.
- WHO, W. H. O. (2005). *Preventing chronic diseases: a vital investment*: World Health Organization.
- WHO, W. H. O. (2011). Global status report on noncommunicable diseases 2010: Geneva: World Health Organization.
- WHO. (2005). Nutrients in Drinking Water: WHO Press.
- Wilfley, D. E., Kass, A. E., & Kolko, R. P. (2011). Counseling and behavior change in pediatric obesity. *Pediatric Clinics*, 58(6), 1403-1424.
- Williams, J., Wake, M., Hesketh, K., Maher, E., & Waters, E. (2005). Health-related quality of life of overweight and obese children. *Jama*, 293(1), 70-76.
- Winkleby, M. A., Jatulis, D. E., Frank, E., & Fortmann, S. P. (1992). Socioeconomic status and health: how education, income, and occupation contribute to risk factors for cardiovascular disease. *Am J Public Health*, 82(6), 816-820.

RESEARCH ARTICLE

Mediators of the Effectiveness of an Intervention Promoting Water Consumption in Preschool Children: The ToyBox Study

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ABSTRACT

BACKGROUND: The ToyBox-intervention has increased preschool children's water consumption. This study aimed to examine if family-related determinants mediate the effects of the ToyBox-intervention on preschoolers' water consumption.

METHODS: Overall, 6290 preschoolers and their families from 6 European countries participated in the ToyBox-intervention and returned parental questionnaires in May/June 2012 and 2013. This study included the 3725 preschoolers/families who had complete data on water consumption, all mediators, and confounders. Mediation effects were assessed with bootstrapping procedure.

RESULTS: Regarding the intervention effects on family-related determinants, the ToyBox-intervention significantly increased water availability during meals, parental water consumption, parental encouragement to their children to drink water, and parental knowledge on water recommendations. In the multiple mediator model, all factors were independently associated with preschoolers' water consumption and mediated the intervention effect on preschoolers' water consumption (total mediation effect = 40%). After including all mediators into the model, the direct intervention effect remained significant.

CONCLUSIONS: The effect of the ToyBox-intervention on preschool children's water consumption was mediated by most family-related determinants examined in this study (ie, availability, parental modeling, parental encouragement, and parental knowledge). Interventions aiming to promote water in preschoolers should target these mediators to enhance their effectiveness.

Keywords: water consumption; mediation; family determinants; preschool, obesity; prevention, ToyBox-study.

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The health benefits of adequate water consumption are well established.^{1,2} Especially at preschool age, meeting the recommendations for water intake is vital, since children at this age are more vulnerable to dehydration compared to adults.³⁻⁵ Furthermore, drinking water instead of sugar-sweetened beverages (SSBs) may be an effective approach to control preschoolers' energy intake and body weight, since SSBs consumption has been found to be associated with higher body mass index (BMI) in this age group.⁶

Recent studies have shown that a large percentage of preschool and primary school children in Europe do not meet the recommendations for water intake.^{7,8} In line with these observations, the ToyBox-study

revealed that only 28.1% of European preschool children meet the European Food Safety Authority (EFSA) recommendations regarding water intake (ie, 1280 mL water from beverages), with preschoolers of lower socioeconomic (SES) families having lower consumption of plain water compared to their higher-SES peers.⁹

In the preliminary phases of the ToyBox-study focus groups with parents and teachers of preschool children were executed in 6 European countries to explore the determinants of water consumption at preschool age. According to the findings of this study, parental modeling, water availability and parental knowledge, and self-efficacy were identified

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as determinants of preschoolers' water consumption.¹⁰ These findings were translated into practical strategies following the intervention mapping (IM) protocol¹¹ and were included in the design of the ToyBox-intervention.¹² The results of the ToyBox-intervention showed that the intervention had a small but significant effect on increasing preschool children's water consumption and decreasing their consumption of prepacked fruit juices.¹³ To increase the effectiveness of the ToyBox and future interventions, knowledge of effective mechanisms underlying changes in water consumption is needed. By conducting mediation analysis one can gain insight into the mechanisms that are critical for influencing children's water consumption, eg, insight into whether the intervention affected the potential mediators and whether this in turn affected the behavior. This insight into what works and what does not work in interventions informs future intervention development and can improve their (cost)-effectiveness.¹⁴

Hence, the aims of the current study were: (1) to explore the effects of the ToyBox-intervention on family-related factors associated with preschoolers' water consumption, (2) to identify potential associations between changes of these factors and changes of preschoolers' water consumption, and (3) to evaluate the potential mediating role of these factors on the ToyBox-intervention effects on preschoolers' water consumption.

METHODS

Participants

The detailed study design has been published elsewhere.^{12,15} In brief, the ToyBox-study (www.toybox-study.eu) aimed to develop, implement, and evaluate a kindergarten-based, family-involved intervention to prevent obesity in preschool children in 6 European countries (Belgium, Bulgaria, Germany, Greece, Poland, and Spain). Preschool children and their families were recruited from 3 socioeconomic groups, following a standardized approach.¹²

The study has been registered in the clinical trials registry clinicaltrials.gov (ID: NCT02116296). Moreover, it was approved by Ethical Committees in the 6 participating countries (ie, Ethical committee of Ghent University Hospital [Belgium], Committee for the Ethics of the Scientific Studies [KENI] at the Medical University of Varna [Bulgaria], Ethikkommission der Ludwig Maximilians Universität München [Germany], the Ethics Committee of Harokopio of Athens [Greece], Ethical Committee of Children's Memorial Health Institute [Poland], and CEICA [Comité Ético de Investigación Clínica de Aragón, Spain]), in line with national regulations.¹² All procedures were in accordance with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Parents/caregivers signed an informed consent for the participation of their child and their family prior to their enrollment in the study.

Procedure

The ToyBox-intervention had a clustered randomized design and was conducted during the school year 2012-2013. It targeted the energy balance-related behaviors (EBRBs) that in the preliminary phases of the program were found to be associated with overweight/obesity at preschool age, ie, drinking-, snacking-, physical activity-, and sedentary-behaviors, as well as their determinants.^{6,10,12} The implementation of the ToyBox-intervention was conducted at 4 levels. The first 3 levels were implemented in the kindergarten setting, while the fourth level addressed parents/caregivers aiming to induce certain changes at children's social and physical environment at home in order to promote the 4 targeted EBRBs. The relative intervention material can be found in the study's website (www.toybox-study.eu) while details on the development of the intervention have been described elsewhere.^{12,15}

More specifically, regarding the component of "drinking behavior" level 1 included the installation of water stations at class/kindergarten, level 2 the daily consumption of water by the children, level 3 the

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execution of interactive classroom activities using the kangaroo hand-puppet as role model, and level 4 the delivery of 2 newsletters, 2 tip-cards, and 1 poster to the parents/caregivers via the teachers which included key messages and practical tips on consumption of water instead of SSBs.¹² Levels 1 and 2 were conducted from the beginning until the end of the school year 2012-2013, whereas levels 3 and 4 were conducted overall for 6 weeks (ie, during the first focus period between weeks 1 and 4 and during the repetition period between weeks 17 and 18).¹⁵

The ToyBox-intervention was implemented by kindergarten teachers, who received 3 training sessions by the research staff, of minimum 1 hour per session.¹⁶ The first 2 training sessions were implemented prior to the first focus period and the third training session was implemented prior to the repetition period. During the first training session, the teachers were informed about the goals and the materials of the ToyBox-study. During the second training session, the teachers received the ToyBox-material (ie, 9 newsletters, 8 tip cards, 4 posters, a hand puppet, 1 teachers' general guide, and 1 classroom activity guide for each of the targeted EBRBs). The third session aimed at recall and consolidation of the intervention. More information on how the Toybox-Intervention aimed to change water consumption determinants via theoretical methods can be found in Table 1.

Instrumentation

The pretest measurements were conducted in May/June 2012, and the posttest measurements were conducted 1 year later during May/June 2013. All parents/caregivers who agreed to participate in the study were asked to fillout the Primary Caregivers' Questionnaire (PCQ) measuring sociodemographic factors, lifestyle behaviors, and perinatal factors, as well as a food frequency questionnaire (FFQ) that was developed based on a previously validated FFQ.¹⁷

Water intake was assessed by combining the frequency as well as the average consumption. Response categories for assessing frequency 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," while regarding the average consumption, the response categories were "100 mL or less," "100-200 mL," "200-300 mL," "300-400 mL," "400-500 mL," "500-600 mL," "600-700 mL," "700-800 mL," "800-900 mL," "900-1000 mL," and "1000 mL or more." From these data, the average amount of water in milliliter per day was calculated by multiplication of the number of days per week and amount per day in mL (using the midpoint) divided by 7 (total number of days in a full week) and was then calculated as cups/day (1 cup = 240 mL of water).

Determinants of preschoolers' water consumption were self-reported by one of the parents/caregivers,

using Likert-type questions, in the PCQ. More specifically, based on the question "How many portions of water (include tap water, still and sparkling mineral water) do YOU usually consume," parental consumption of water was reported. Availability of water was assessed via 2 questions: "I make water always available for my child" and "During meals, water is always available on the table." Regarding parental encouragement to their children to drink water, the following question was included in the PCQ: "I encourage my child to drink water." Regarding parental self-efficacy, parents replied to the question: "I find it difficult to give my child water if he/she wants soft drinks or prepacked juices" while regarding child's enjoyment they replied to the question: "My child does not enjoy drinking water" and regarding parental perceived water recommendation they responded to the following question: "How many glasses of water do you think your child should drink daily?" The response alternatives to each question item are depicted in Table 2.

Preschool children's age was computed based on the date of birth and the date when the PCQ was completed. Preschoolers' sex and the educational level of the parents/caregivers were self-reported by one of the parents/caregivers in the PCQ. The educational level of the mother was used as SES indicator.¹⁸ For this analysis, the education level was dichotomized into "medium/low" (≤ 14 years of education) and "high" (> 14 years of education) SES, which distinguishes families with a mother who has completed medium or higher education, college, or university training from other families and has been used in previous European projects.¹⁹

Data Analysis

Descriptive statistics describing the baseline characteristics of the participating children per intervention or control condition were conducted in SPSS 23.0 (IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp). Differences between intervention and control groups were tested using independent *t* test for continuous variables or chi-square test for dichotomous variables. Missing data analysis was conducted with logistic regression analysis, to test whether missing was dependent on children's age, sex, water consumption, maternal education, and treatment condition.

Mediation effects were assessed with bootstrapping procedure following mediation analysis steps (Figure 1): (1) estimating the effect of the intervention on water consumption (*c*-coefficient); (2) estimating the effect of the intervention on the proposed mediator (*a*-coefficient); (3) estimating the effect of the mediator on water consumption (*b*-coefficient) adjusting for the intervention effect (*c'*-coefficient);

Table 1. The Toybox-Intervention, Determinants, Theoretical Methods, and Program Components to Change Water Consumption

| Determinant | Theoretical Method | Example of Program Component |
|--|---|---|
| Parental consumption (portion/day) (how many portions of water (include tap water, still and sparkling mineral water) do you usually consume?) | Guided practice, modeling SCT, TSR, TL | |
| Availability of water (I make water always available for my child) | Direct experience, modeling, facilitation, focused perception SCT, TL | <i>Individual level—preschool child</i> Drinking station, Kangaroo stories, Kangaroo hand puppet, sensory perception games, experiments, excursion |
| Availability of water during meals (during meals, water is always available on the table) | Direct experience, modeling, facilitation, focused perception SCT, TL | <i>Interpersonal level—parents/caregivers</i> Newsletters, tip cards, poster, parents' evening |
| Encouragement (I encourage my child to drink water) | Consciousness raising (providing information), modeling, guided practice, active learning, elaboration, discussion HBM, SCT, TL, TSR, ELM, TIP | <i>Organizational level—Teachers</i> Teachers' training, Teachers' guide, classroom activities guide |
| Self-efficacy (I find it difficult to give my child water if he/she wants soft drinks or prepacked juices) | Consciousness raising (providing information), guided practice, discussion, modeling, reinforcement HBM, SCT, TSR, TIP, TTM | |
| Enjoyment (my child does not enjoy drinking water) | Guided practice, modeling, reinforcement, facilitation SCT, TSR, TL | |
| Perceived recommendation water (glasses/day) (how many glasses of water do you think your child should drink daily?) | Consciousness raising (providing information), active learning, elaboration, discussion HBM, PCM, ELM, SCT, TIP | |

ELM, elaboration likelihood model; HBM, health-belief model; PCM, Persuasion-communication matrix; SCT, social cognitive theory; TL, theories of learning; TSR, theory of self-regulation; TIP, theories of information processing.

(4) computing the indirect effect of the intervention on water consumption via the proposed mediator (ab-coefficient); and (5) bootstrapping the sampling distribution of ab and deriving a bias corrected confidence interval (CI) with 5000 bootstrapped sampling distribution.

We assessed both single and multiple mediator models. All models were adjusted for age, sex, maternal education, country, baseline level of water consumption, and baseline level of the mediator. Adding a random intercept for kindergarten site did not improve the model fit and was therefore not eliminated. Mediation analysis were run in Mplus 8.0. (Muthen, L. K., & Muthen, B. O. (1998-2011). Mplus User's Guide. Sixth Edition. Los Angeles, CA: Muthen & Muthen)²⁰

RESULTS

Participant Characteristics

Out of the 6290 children who participated in the ToyBox-intervention, 3725 completed the study and had complete data on water consumption, potential mediators, and covariates at baseline and follow-up. Missing data analysis showed that the children included in the analysis did not differ in terms of age, sex, maternal education or treatment condition, but consumed slightly more water at baseline than the children who initially enrolled in the study (2.48 vs 2.38 cups/day, $p < .05$). Table 3 shows the baseline

characteristics of the European children participating in the Toybox-study. Participating children were on average 4.75 years old, 48% were girls and 63.9% had a mother with more than 14 years of education. Intervention and control group participants did not differ in terms of children's age, sex, weight status, parental age, education, weight status or water consumption, or any of the baseline values of the potential mediators, with the exception of intervention children consuming slightly more water at baseline than control participants ($p = .03$).

Intervention Effect on Water Consumption (c-Coefficient)

Table 4 shows that increases were found in water consumption in both the intervention (2.72 ± 1.28 cups/day) and control (2.52 ± 1.32 cups/day) participants after the intervention. The increases in water consumption over time in the intervention group were significantly higher compared to the control group (c-coefficient: .12; 95% CI: .05, .19).

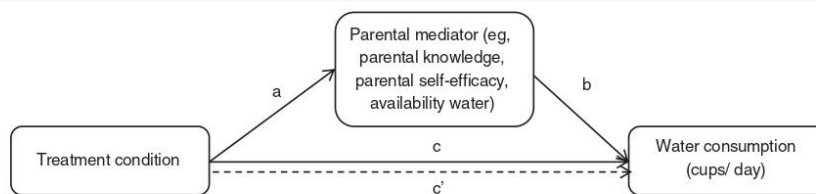
Intervention Effect on Potential Mediators (a-Coefficient)

Table 4 also shows the intervention effect on each potential mediator in single mediation analysis. Compared to the control group, the intervention group significantly increased availability of water during meals ($a = .06$; 95% CI: .01, .11), parental water consumption ($a = .09$; 95% CI: .00, .18),

Table 2. Determinant and Questionnaire Items

| Determinant | Question Item | Response Alternatives |
|--|---|--|
| Parental consumption (portion/day) | How many portions of water (include tap water, still and sparkling mineral water) do YOU usually consume? | 0 = never 0.14 = 1 portion or less per week 0.53 = 2-4 portions per week 0.79 = 5-6 portions per week 1.5 = 1-2 portions per day 3.5 = 3-4 portions per day 5 = 5 or more portions per day |
| Availability of water | I make water always available for my child | -2 = strongly disagree to +2 = strongly agree |
| Availability of water during meals | During meals, water is always available on the table | -2 = strongly disagree to +2 = strongly agree |
| Encouragement | I encourage my child to drink water | -2 = strongly disagree to +2 = strongly agree |
| Self-efficacy | I find it difficult to give my child water if he/she wants soft drinks or prepacked juices | -2 = strongly agree to +2 = strongly disagree |
| Enjoyment | My child does not enjoy drinking water | -2 = strongly agree to +2 = strongly disagree |
| Perceived recommendation water (glasses/day) | How many glasses of water do you think your child should drink daily? | 0 = less than 5, more than 6 glasses per day or I don't know 1 = 5-6 glasses per day |

Figure 1. Conceptual ToyBox Mediation Model



encouragement of drinking water ($a = .06$; 95% CI: .01, .11) and parental knowledge on the water recommendation ($a = .11$; 95% CI: .02, .20; odds ratio [OR] = 1.11).

No statistically significant intervention effects were found on availability of water during the day, parental self-efficacy, and child's enjoyment in drinking water.

Effect of Potential Mediator on Water Consumption (b-Coefficient)

As Table 4 shows, increases in availability of water during the day ($b = .19$; 95% CI: .13, .25), availability of water during meals ($b = .20$; 95% CI: .15, .25), parental water consumption ($b = .14$; 95% CI: .11, .17), parental encouragement ($b = .15$; 95% CI: .09, .20), parental self-efficacy to serve water ($b = .16$; 95% CI: .12, .20), and parental knowledge on water recommendation ($b = .19$; 95% CI: .14, .23) were

associated with increases in water consumption. No association was found between parental perceived children's enjoyment to drink water and changes in water consumption.

Mediated Effects (ab): Single-Mediated Models

As Table 4 shows, in the single mediator models, changes in availability of water during meals ($ab = .01$; 95% CI: .00, .02), parental water consumption ($ab = .01$; 95% CI: .00, .03), parental encouragement ($ab = .01$; 95% CI: .00, .02), and parental knowledge on water consumption ($ab = .02$; 95% CI: .00, .04) mediated the intervention effect on water consumption. The proportion of the intervention effect on children's water consumption that could be explained by the mediator ranged from 7% by parental encouragement to 16% by parental knowledge on water consumption.

Table 3. Baseline Characteristics of the European Children in the Intervention and Control Group (Mean, SD Unless Otherwise Stated)

| | Total (N = 3725) | Intervention Group (N = 2388) | Control Group (N = 1337) |
|--|------------------|-------------------------------|--------------------------|
| Demographics | | | |
| Age child | 4.75 (.43) | 4.76 (.42) | 4.75 (.44) |
| Sex (% girls) | 48.1 | 48.2 | 47.9 |
| Child weight status (% overweight) | 13.9 | 14.4 | 13.1 |
| Age parent (years) | 35.83 (.479) | 35.88 (.486) | 35.73 (.467) |
| Maternal education (% maternal education > 14 years) | 63.9 | 63.1 | 65.1 |
| Parental weight status (% ≥ 1 parent overweight) | 70.3 | 71.1 | 68.7 |
| Behaviors | | | |
| Water consumption child (cups/day) | 2.48 (1.33) | 2.52 (1.34)* | 2.42 (1.31) |
| Water consumption parent (portions per day) | 3.45 (1.56) | 3.43 (1.54) | 3.46 (1.57) |
| Determinants | | | |
| Availability of water [−2,+2] | 1.69 (.62) | 1.69 (.63) | 1.69 (.61) |
| Availability of water during meals [−2,+2] | 1.25 (1.02) | 1.26 (1.01) | 1.23 (1.04) |
| Encouragement [−2,+2] | 1.54 (.72) | 1.54 (.72) | 1.54 (.72) |
| Parental self-efficacy [−2,+2] | .72 (1.16) | .72 (1.16) | .73 (1.18) |
| Child's enjoyment [−2,+2] | .21 (1.51) | .24 (1.50) | .16 (1.52) |
| Knowledge on recommendation water (%) | 34.2 | 34.2 | 34.2 |

Significant differences between intervention and control groups at *p < .05 based on an independent t test for continuous variables or chi-square test for dichotomous variables.

Table 4. Potential Family-Related Mediators of Water Consumption: Single Mediator Model

| | a | b | ab | c' | % Mediation |
|------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-------------|
| Availability of water | .02 (−.02; .06) | .19 (.13; .25) | .00 (−.00; .01) | .12 (.05; .19) | — |
| Availability of water during meals | .06 (.01; .11) | .20 (.15; .25) | .01 (.00; .02) | .11 (.04; .18) | 9 |
| Water consumption parents | .09 (.00; .18) | .14 (.11; .17) | .01 (.00; .03) | .11 (.04; .18) | 10 |
| Encouragement | .06 (.01; .11) | .15 (.09; .20) | .01 (.00; .02) | .12 (.05; .18) | 7 |
| Self-efficacy | .04 (−.02; .10) | .16 (.12; .20) | .01 (−.00; .02) | .12 (.06; .19) | — |
| Knowledge on recommendation | .11 (.02; .20) | .19 (.14; .23) | .02 (.00; .04) | .10 (.04; .17) | 16 |
| Enjoyment | −.04 (−.09; .02) | .02 (−.03; .06) | −.00 (−.01; .00) | .12 (.05; .19) | — |

All analysis were adjusted for child's sex and age, maternal education, country and baseline values of water consumption and the baseline value of the specific mediators. Bias-corrected bootstrapping using 5000 samples was conducted using Mplus version 8 (Muthén & Muthén). Bold fonts are significant associations.

Mediator Effects (ab): Multiple Mediator Models

Table 5 shows the finding of the multiple mediator model, including all mediators as found to be significant in the single mediator models. In the multiple mediator model, all included parent-related factors remained significant mediators of the intervention effect on children's water consumption. The total mediated effect (ab = .048; 95% CI: .02, .08) mediated 40% of the total intervention effect on water consumption. After including all mediators into the model, the direct intervention effect on water consumption remained significant (c' = .07; 95% CI: .01, .14).

DISCUSSION

The ToyBox-intervention was a kindergarten-based, family-involved intervention aiming to prevent obesity at preschool age via the promotion of healthy EBRBs. The aim of the present study was to examine if selected family-related determinants of water consumption mediated the effects of the ToyBox-intervention on one of the targeted EBRBs, namely preschoolers' water consumption.

Our previous findings showed that the ToyBox-intervention led to small but significant increase of preschoolers' water consumption.²¹ The present study showed that the majority of the selected family-related determinants of water consumption mediated the effects of the ToyBox-intervention on preschoolers' water consumption. These mediators were water availability during meals, parental water consumption, parental encouragement to the child to drink water, and parental knowledge on water recommendations. In other words, we observed that the ToyBox-intervention improved the determinants that were identified in the ToyBox-study, linked to specific program goals to form specific change objectives via the IM-protocol and targeted via the intervention material, such as newsletters and tip-cards.^{10,12} Our findings confirm that the selected determinants are relevant in changing preschoolers' water consumption and suggest that the intervention strategies (eg, role modeling) we applied were effective.

Our findings concur with previous studies conducted in this field. More specifically, a recent study

Table 5. Potential Family-Related Mediators of Water Consumption: Multiple Mediator Model

| | a | b | ab | % Mediation |
|------------------------------------|--------------------------|-----------------------|-----------------------|-------------|
| Availability of water during meals | .05 (.01; .11) | .19 (.15; .24) | .01 (.00; .02) | 9 |
| Water consumption parents | .08 (—; .00; .17) | .13 (.11; .16) | .01 (.00; .02) | 9 |
| Encouragement | .06 (.01; .11) | .13 (.08; .19) | .01 (.00; .02) | 6 |
| Knowledge on recommendation | .11 (.02; .19) | .18 (.14; .22) | .02 (.00; .04) | 16 |

All analysis were adjusted for child's sex and age, maternal education, country and baseline values of water consumption and the baseline value of the included mediators. Bias-corrected bootstrapping using 5000 samples was conducted using Mplus version 8 (Muthén & Muthén). Bold fonts are significant associations.

showed that increasing water availability in older children may be an effective approach to increase children's water consumption and improve their BMI.²² Although focusing on different age group, our study showed similar to that, that the ToyBox-intervention increased water availability during children's meals, which partially mediated the ToyBox-intervention effects on children's water consumption. Furthermore, the systematic review conducted by van Stralen et al found some evidence for attitude, knowledge, and habit strength as mediators of interventions targeting dietary behavior.²³ In the case of the ToyBox-study, these determinants referred to the parents and teachers of the preschool children, due to the very young age of the children. Our findings are in line with the review as the ToyBox-intervention increased parental knowledge on water recommendations, parental encouragement, and parental water consumption. Especially regarding the latter, there is accumulated evidence highlighting that parental role modeling, which in our case is depicted as parental water consumption, exerts a significant role in children's water consumption.^{24,25} Future intervention developers targeting preschoolers' water consumption are recommended to target these determinants and the intervention strategies used in the ToyBox-intervention to change them. Availability of water during the day (not during the meals), parental self-efficacy to provide water and child's enjoyment in drinking water as perceived by the parent did not mediate the intervention effect; mainly because the intervention was not effective in changing these determinants. To the authors' knowledge no previous study focused on these specific determinants to improve preschoolers' drinking behavior, so no comparison can be made taking into account previous interventions. Still, it needs to be mentioned that these determinants were identified via focus groups executed with groups of parents with a different SES-background and the ToyBox-intervention was applied in similar population groups, thus tailor-made to a large extent to the actual needs of the targeted population.

It should be noted that the results of the process evaluation conducted in the ToyBox-intervention showed that many parents did not read the newsletters and the tip-cards provided to them, which might explain that the intervention effects regarding

preschoolers' water consumption were rather small.²¹ On the other hand, our previous findings showed that in the families that complied most with the ToyBox-intervention (ie, received/read the ToyBox material, implemented ToyBox-activities at home, and reported satisfaction with the intervention overall), the children had a higher increase of water consumption after the intervention.²¹ Therefore, it could be hypothesized that these families probably improved the relevant determinants which in turn resulted in their children's increase of water consumption. Future interventions should aim developing strategies to increase participants' compliance with the program to increase its potential effectiveness.

Limitations and Strengths

The findings of the present study should be interpreted in light of its strengths and limitations. The large study sample, the diversity of participating regions and socioeconomic groups, the standardization of all study procedures and tools, and the assessment of all determinants found to be associated with preschool children's water consumption in the early phases of the ToyBox-study comprise some of the strengths of the present study. Moreover, all measurements at pre- and posttest were taken during the same time period (ie, May/June 2012 and 2013), thus limiting any potential seasonality effects regarding preschoolers' water consumption. On the other hand, data were self-reported by the parents, thus may be prone to recall bias or social desirability responses. Still, it should be noted that the reliability of the FFQ and PCQ were tested before the start of the intervention and found to be acceptable.²⁶ Furthermore, the vast majority of questionnaires were reported by mothers, which does not allow the extraction of useful results regarding paternal- and grandparental-related factors mediating the effects of the ToyBox-intervention on preschoolers' water consumption.

Conclusion

In conclusion, the current study showed that the ToyBox-intervention increased water availability during meals, parental water consumption, parental encouragement, and parental knowledge on water

recommendations. Next, these determinants mediated the effects of the ToyBox-intervention on preschool children's water consumption. These findings imply that future interventions aiming to promote water consumption in preschoolers should target the family and home-related determinants to enhance their effectiveness.

IMPLICATIONS FOR SCHOOL HEALTH

The current study showed that the ToyBox-intervention may be an effective approach to increase preschool children's water consumption. These effects may be attributed to a large extent to the improvement of several mediating family-related factors that were targeted in the ToyBox-intervention. Kindergartens interested in promoting water consumption in preschoolers could:

- Use the ToyBox-intervention material available in 7 languages (Bulgarian, Flemish, German, Greek, English, Polish, Spanish),
- Adapt the relative material to the local social, political, and economic conditions,
- Incorporate the ToyBox intervention in the regular school curriculum considering that its implementation does not require intensive training of the teachers or the use of extra equipment/materials.

Human Subjects Approval Statement

Ethical approval was taken by the Ethics Committees and other relevant authorities, such as Ministries, in all participating countries.¹² More specifically, the Ethical committee of Ghent University Hospital in Belgium (review number: B670201213485), Committee for the Ethics of the Scientific Studies (KENI) at the Medical University of Varna in Bulgaria (review number: 15), Ethikkommission der Ludwig Maximilians Universität München in Germany (review number: 400-11), the Ethics Committee of Harokopio of Athens in Greece (review number: 28/02-12-2010), Ethical Committee of Children's Memorial Health Institute in Poland (review number: 1/KBE/2012), and CEICA (Comité Ético de Investigación Clínica de Aragón in Spain (review number: C.P.-C.I. PI11/056). All participants (school headmasters, parents/caregivers) signed an informed consent form prior to their enrollment in the study.

REFERENCES

1. Jequier E, Constant F. Water as an essential nutrient: the physiological basis of hydration. *Eur J Clin Nutr.* 2010;64(2):115-123.
2. Kleiner SM. Water: an essential but overlooked nutrient. *J Am Diet Assoc.* 1999;99(2):200-206.

3. Iglesia I, Guelinckx I, De Miguel-Etayo PM, et al. Total fluid intake of children and adolescents: cross-sectional surveys in 13 countries worldwide. *Eur J Nutr.* 2015;54(suppl 2):57-67.
4. Jacques E. Promoting healthy drinking habits in children. *Nurs Times.* 2012;108(41):20-21.
5. World Health Organization (WHO). *Nutrients in Drinking Water.* Geneva, Switzerland: WHO Press; 2005.
6. van Stralen MM, te Velde SJ, van Nassau F, et al. Weight status of European preschool children and associations with family demographics and energy balance-related behaviours: a pooled analysis of six European studies. *Obes Rev.* 2012;13(suppl 1):29-41.
7. Huybrechts I, De Henauw S. Energy and nutrient intakes by pre-school children in Flanders-Belgium. *Br J Nutr.* 2007;98(3):600-610.
8. Vieux F, Maillot M, Constant F, Drewnowski A. Water and beverage consumption among children aged 4-13 years in France: analyses of INCA 2 (Etude Individuelle Nationale des Consommations Alimentaires 2006-2007) data. *Public Health Nutr.* 2016;19(13):2305-2314.
9. Pinket AS, De Craemer M, Maes L, et al. Water intake and beverage consumption of pre-schoolers from six European countries and associations with socio-economic status: the ToyBox-study. *Public Health Nutr.* 2016;19(13):2315-2325.
10. De Craemer M, De Decker E, De Bourdeaudhuij I, et al. Physical activity and beverage consumption in preschoolers: focus groups with parents and teachers. *BMC Public Health.* 2013;13(1):278.
11. Bartholomew LK, Parcel GS, Kok G. Intervention mapping: a process for developing theory- and evidence-based health education programs. *Health Educ Behav.* 1998;25(5):545-563.
12. Manios Y, Androustos O, Katsarou C, et al. Designing and implementing a kindergarten-based, family-involved intervention to prevent obesity in early childhood: the ToyBox-study. *Obes Rev.* 2014;15(suppl 3):5-13.
13. Pinket AS, De Craemer M, Huybrechts I, et al. Diet quality in European pre-schoolers: evaluation based on diet quality indices and association with gender, socio-economic status and overweight, the ToyBox-study. *Public Health Nutr.* 2016;19(13):2441-2450.
14. Hafeman DM, Schwartz S. Opening the black box: a motivation for the assessment of mediation. *Int J Epidemiol.* 2009;38(3):838-845.
15. Manios Y, Grammatikaki E, Androustos O, et al. A systematic approach for the development of a kindergarten-based intervention for the prevention of obesity in preschool age children: the ToyBox-study. *Obes Rev.* 2012;13(suppl 1):3-12.
16. Androustos O, Katsarou C, Payr A, et al. Designing and implementing teachers' training sessions in a kindergarten-based, family-involved intervention to prevent obesity in early childhood. The ToyBox-study. *Obes Rev.* 2014;15(suppl 3):48-52.
17. Huybrechts I, De Backer G, De Bacquer D, Maes L, De Henauw S. Relative validity and reproducibility of a food-frequency questionnaire for estimating food intakes among Flemish preschoolers. *Int J Environ Res Public Health.* 2009;6(1):382-399.
18. Winkleby MA, Jatulis DE, Frank E, Fortmann SP. Socio-economic status and health: how education, income, and occupation contribute to risk factors for cardiovascular disease. *Am J Public Health.* 1992;82(6):816-820.
19. Brug J, van Stralen MM, Chinapaw MJ, et al. Differences in weight status and energy-balance related behaviours according to ethnic background among adolescents in seven countries in Europe: the ENERGY-project. *Pediatr Obes.* 2012;7(5):399-411.

20. Muthén LK, Muthén BO. *Mplus User's Guide*. Los Angeles, CA: Muthén & Muthén; 1998-2012.
21. Pinket AS, Van Lippevelde W, De Bourdeaudhuij I, et al. Effect and process evaluation of a cluster randomized control trial on water intake and beverage consumption in preschoolers from six European countries: the ToyBox-study. *PLoS One*. 2016;11(4):e0152928.
22. Schwartz AE, Leardo M, Aneja S, Elbel B. Effect of a school-based water intervention on child body mass index and obesity. *JAMA Pediatr*. 2016;170(3):220-226.
23. van Stralen MM, Yildirim M, te Velde SJ, et al. What works in school-based energy balance behaviour interventions and what does not? A systematic review of mediating mechanisms. *Int J Obes*. 2011;35(10):1251-1265.
24. Emma D. "Drink as I Do." *The Influence of Parents' Drink Choices on Children*. London, UK: Natural Hydration Council; 2016.
25. Grimm GC, Hamack L, Story M. Factors associated with soft drink consumption in school-aged children. *J Am Diet Assoc*. 2004;104(8):1244-1249.
26. Gonzalez-Gil EM, Mouratidou T, Cardon G, et al. Reliability of primary caregivers reports on lifestyle behaviours of European pre-school children: the ToyBox-study. *Obes Rev*. 2014;15(suppl 3):61-66.

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Short Communication

Mediators of the effectiveness of a kindergarten-based, family-involved intervention on pre-schoolers' snacking behaviour: the ToyBox-study

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Abstract

Objective: The present study aimed to explore the mediating role of family-related determinants on the effects of the ToyBox-intervention on pre-school children's consumption of healthy and unhealthy snacks.

Design: The ToyBox-intervention was a kindergarten-based, family-involved intervention with a cluster-randomized design, aiming to promote healthy lifestyle behaviours to prevent obesity at pre-school age.

Setting: Kindergartens (*n* 309) in six European countries.

Subjects: A total of 6290 pre-schoolers and their families participated in the ToyBox-intervention in 2012–2013 and data from 5212 pre-schoolers/families were included in the current analyses.

Results: Even though the total effect of the ToyBox-intervention on healthy and unhealthy snacking was not significant, the ToyBox-intervention significantly improved parental rule setting on children's unhealthy snack consumption (i.e. restriction of snacking while watching television and permission only at certain occasions) and parental consumption of unhealthy snacks, while it increased parental knowledge on snacking recommendations. Regarding healthy snacking, the ToyBox-intervention improved children's attitude towards fruit and vegetables (F&V). All previously mentioned family-related determinants mediated the intervention effects on pre-schoolers' consumption of healthy and unhealthy snacks. Almost all family-related determinants examined in the study were independently associated with pre-schoolers' consumption of healthy and unhealthy snacks.

Conclusions: The intervention was effective in improving relevant family-related determinants. Interventions aiming to promote F&V consumption and limit the consumption of unhealthy snacks in pre-schoolers should target on these mediators, but also identify new family-, school- or peer-related determinants, to enhance their effectiveness.

Keywords
Snacking
Fruits and vegetables
Mediation
Family determinants
ToyBox-study

Several studies have shown an association between the consumption of energy-dense foods, such as sweets and

salty snacks, and excessive weight in pre-school children⁽¹⁾. On the other hand, diets high in fruits and vegetables (F&V)

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have been associated with reduced risk for obesity in children⁽²⁾. The WHO and the US Department of Agriculture suggest the sparing consumption of unhealthy snacks, while the recommendation for F&V is at least five servings (approximately 400 g) daily⁽³⁾. However, intake seems to fall well short of these guidelines, both in the case of unhealthy snacks⁽⁴⁾, as well as in the case of vegetables⁽⁵⁾, with consumption among young children being particularly low⁽⁶⁾. In line with these observations, the ToyBox-study revealed that European pre-school children's intake exceeds the recommendation regarding unhealthy snacks, with consumption varying from 53.3 g/d in Greece to 73.1 g/d in Belgium⁽⁷⁾.

Improving children's dietary habits as early as possible is particularly important. Eating behaviour is formed in childhood, tracks over childhood⁽⁸⁾ and persists into adulthood⁽⁹⁾. Thus, the adoption of healthy instead of unhealthy food choices early in life could provide lifelong benefits. In addition, there is growing evidence that poor diet in childhood can lead to health problems commonly observed in adults, such as diabetes⁽¹⁰⁾, obesity⁽¹¹⁾ and CVD⁽¹²⁾. As a result, interventions targeting early childhood, such as the Toy-Box study, could offer the maximum health benefits. Furthermore, consuming healthy snacks such as F&V instead of unhealthy snacks may contribute in controlling pre-schoolers' energy intake and body weight, since energy-dense food consumption has been found to be associated with higher BMI in young children⁽¹³⁾.

In the ToyBox-study, focus groups with parents and teachers of pre-school children were executed in six European countries. The findings of the focus groups identified parental modelling, availability of healthy snacks and certain parenting practices as determinants of pre-schoolers' dietary habits (report submitted to the European Commission). Following the intervention mapping protocol⁽¹⁴⁾, these findings were translated into practical strategies and were considered in the design of the ToyBox-intervention⁽¹⁵⁾.

So far, analysis of the results of the ToyBox-intervention has shown significant improvements in pre-schoolers' diet quality⁽¹⁶⁾. Because family dynamics including family rules, modelling support and encouragement are important determinants of children's health behaviour⁽¹⁷⁾, the present study aimed to shed light on the family-related mechanisms mediating the effect of the ToyBox-study on pre-school children's consumption of healthy and unhealthy snacks.

Methods

Participants

The ToyBox-study (www.toybox-study.eu) aimed to develop, implement and evaluate a kindergarten-based, family-involved intervention to prevent obesity in pre-school children in six European countries (Belgium, Bulgaria, Germany, Greece, Poland and Spain). Pre-school children and their families were recruited from 309 kindergartens from three socio-economic groups, following a standardized approach, as described

elsewhere by Manios *et al.*⁽¹⁵⁾. The study was registered at clinicaltrials.gov (identifier: NCT02116296). The study design has been described in detail elsewhere^(15,18).

Procedure

The ToyBox-intervention had a cluster-randomized design and was conducted during the school year 2012–2013. Four energy balance-related behaviours were targeted, namely drinking, snacking, physical activity and sedentary behaviours, as well as their determinants^(13,15,19).

Four levels were used for implementation of the snacking component of the ToyBox-intervention. Level 1 included the availability of healthy snacks at class/kindergarten; level 2 included children's daily consumption of a healthy snack; level 3 included the execution of interactive classroom activities using a kangaroo hand-puppet as a role model; and level 4 included the delivery of two newsletters, two tip-cards and one poster to the parents/caregivers via the teachers. These newsletters, tip-cards and poster included key messages and practical tips on healthy snacking (e.g. F&V) instead of unhealthy choices (e.g. sweets and/or salty snacks)⁽¹⁵⁾. Levels 1 and 2 were conducted for the whole duration of the school year 2012–2013, whereas levels 3 and 4 were conducted over six weeks (i.e. during the first focus period between weeks 9 and 12, and during the repetition period between weeks 21 and 22)⁽¹⁸⁾. The ToyBox-intervention was implemented by kindergarten teachers, who attended three training sessions by the research staff of minimum one hour per session⁽²⁰⁾.

Instrumentation

The pre-test measurements were conducted in May/June 2012 and the post-test measurements were conducted after one year (i.e. May/June 2013). Parents/caregivers signed a consent form to participate in the study and were asked to fill out the Primary Caregivers' Questionnaire (PCQ) regarding sociodemographic factors, lifestyle behaviours and perinatal factors, as well as an FFQ⁽²¹⁾.

Snack consumption was assessed by combining the frequency as well as the average consumption for each item. Determinants of pre-schoolers' snack consumption were self-reported by the parents/caregivers in the PCQ, using Likert-type questions. More details on the questions used for assessing snack consumption as well as the determinants can be found in the online supplementary material, Supplemental Tables 1 and 2, while the questionnaire is available online at the ToyBox-study website (www.toybox-study.eu) and was previously shown to be a reliable tool⁽²²⁾.

Data analysis

Descriptive statistics describing the baseline characteristics of the participating children per intervention or control group were conducted in the statistical software package



IBM SPSS Statistics version 23.0. Differences between these two groups were tested using independent *t* tests for continuous variables or χ^2 tests for dichotomous variables. Missing data were imputed for the food items under study using the 'multiple imputation' macro in IBM SPSS Statistics version 23.0.

Mediation effects were assessed with the bootstrapping procedure of MacKinnon *et al.*⁽²³⁾ via the following mediation analysis steps: (i) estimating the effect of the intervention on unhealthy snacking and F&V consumption (τ coefficient); (ii) estimating the effect of the intervention on the proposed mediator (α coefficient); (iii) estimating the effect of the mediator on unhealthy snacking and F&V consumption (β coefficient) adjusting for the intervention effect (τ' coefficient); (iv) computing the indirect effect of the intervention on unhealthy snacking and F&V consumption via the proposed mediator ($\alpha\beta$ coefficient); and (v) bootstrapping the sampling distribution of $\alpha\beta$ and deriving a bias-corrected CI with 5000 bootstrapped sampling distribution. All models were adjusted for age, sex, maternal education, country, baseline level of unhealthy snacking and F&V consumption, and baseline level of the mediator. STDY standardization methods (which mean that standardization was based only on the dependent variable, and not on both the dependent and

independent variable because the independent variable (research group) was a binary variable) were applied. Adding a random intercept for kindergarten site did not improve the model fit and was therefore eliminated. Mediation analyses were run in Mplus version 8.0⁽²⁰⁾.

Results

Table 1 shows the baseline characteristics of the current study sample. Participating children were on average 4.75 years old, 49% were female and 61% had a mother with more than 14 years of education. Intervention and control group participants did not differ in terms of children's age, sex, parental age, unhealthy snack consumption, F&V consumption or any of the baseline values of the potential mediators, with the exception of intervention children having less educated mothers, more parental self-efficacy with a nagging child and higher parental F&V consumption than control participants at baseline ($P=0.03$).

No significant total intervention effects were found on unhealthy snack consumption (c (unstandardized) = -2.41; 95% CI -5.40, 0.39 (data not shown for the unstandardized analysis); τ (standardized) = -0.05; 95% CI -0.12, 0.01) or

Table 1 Baseline characteristics (mean and standard deviation unless otherwise stated) of the participating pre-school children and their parents/caregivers per treatment arm. The ToyBox-study, May/June 2012

| | Intervention group (n 3360) | | Control group (n 1852) | |
|---|-----------------------------|-------|------------------------|-------|
| | Mean | SD | Mean | SD |
| Demographics | | | | |
| Age, child (years) | 4.7 | 0.43 | 4.7 | 0.45 |
| Sex (% female) | 48.5 | | 48.8 | |
| Age, parent (years) | 35.7 | 5.0 | 35.6 | 4.8 |
| Maternal education (% with maternal education >14 years) | 60.0 | | 63.1* | |
| Behaviours | | | | |
| Unhealthy snack consumption, child (g/d) | 85.2 | 52.3 | 83.5 | 47.8 |
| F&V consumption, child (g/d) | 240.3 | 134.2 | 241.6 | 131.3 |
| Determinants of healthy snacking | | | | |
| Child's F&V preference (-2, +2) | 0.85 | 1.06 | 0.88 | 1.01 |
| Availability of F&V as snacks (-2, +2) | 1.01 | 0.89 | 1.03 | 0.88 |
| Regular availability of F&V (-2, +2) | 1.18 | 0.77 | 1.15 | 0.83 |
| Parental rule: allowed to eat F&V as snacks without asking (-2, +2) | 0.56 | 1.18 | 0.50 | 1.16 |
| Parental knowledge on F&V recommendation (% indicating correct recommendation, i.e. 5 portions or ~400 g daily) | 19.0 | | 19.0 | |
| F&V consumption, parent (portions/d) | 2.12 | 2.32 | 1.99* | 2.17 |
| Determinants of unhealthy snacking | | | | |
| I think eating sweet or salty snacks is not bad for my child (-2, +2) | -0.46 | 1.24 | -0.41 | 1.26 |
| I make sweet or salty snacks regularly available for my child (-2, +2) | -0.81 | 0.97 | -0.84 | 0.97 |
| My child is not allowed to snack while watching television (-2, +2) | -0.09 | 1.11 | -0.02 | 1.11 |
| My child is allowed to eat sweet or salty snacks only at certain occasions, i.e. birthdays (-2, +2) | -0.12 | 1.05 | -0.09 | 1.05 |
| I give sweet or salty snacks to my child as a reward or to comfort him (-2, +2) | -0.79 | 1.07 | -0.82 | 1.06 |
| If I prohibit my child to eat a sweet or salty snack I find it difficult to stick to my rules if he/she starts nagging (-2, +2) | -0.86 | 1.04 | -0.95* | 0.97 |
| I find it difficult to restrain myself from eating sweet or salty snacks because of the presence of my child (-2, +2) | -0.70 | 1.14 | -0.73 | 1.13 |
| Parental knowledge on unhealthy snack recommendation (% indicating correct recommendation, i.e. none) | 51.6 | | 50.4 | |
| Unhealthy snack consumption parent (portions/d) | 0.26 | 0.29 | 0.25 | 0.25 |

F&V, fruit(s) and vegetable(s).

*Significant difference between intervention and control groups based on independent *t* test for continuous variables or χ^2 test for dichotomous variables: $P < 0.05$.

F&V consumption ($c = -1.59$; 95% CI -8.33 , 5.00 ; $r = -0.01$; 95% CI -0.06 , 0.04). As shown in Table 2, the intervention was effective in improving parental rules on snacking while watching television and snacking recommendation (i.e. permission of unhealthy snacking only during special occasions), parental unhealthy snack consumption, parental knowledge on children's snacking recommendation and child's attitude towards F&V as reported by their parent. Several potential mediators were found to be related to changes in unhealthy snacking and F&V consumption. Changes in parental rules (i.e. restriction) on unhealthy snacking while watching television and in permission of unhealthy snacking only during special occasions, improvement of parental unhealthy snack consumption and improvement of parental knowledge on snacking recommendation mediated the intervention effect on snacking consumption, whereas improvement in child's attitude towards F&V as reported by their parent mediated the intervention effect on F&V consumption. Regarding interpretation of the results presented in Table 2, an example would be that an increase of 1 SD in the determinant 'If I prohibit my child to eat sweet/salty snack I find it difficult to stick to my rules if (s)he starts nagging' is associated with a decrease in unhealthy snack consumption of 0.07 SD, after adjusting for the intervention effect.

Discussion

The ToyBox-intervention was a kindergarten-based, family-involved intervention aiming to prevent obesity at pre-school age via the promotion of healthy energy balance-related behaviours. The aim of the present study was to examine if the family-related determinants of snack consumption, which were identified and targeted in the ToyBox-study, mediated the effects of the ToyBox-intervention on pre-schoolers' consumption of healthy and unhealthy snacks.

The present study showed that several family-related determinants of snack consumption mediated the effects of the ToyBox-intervention on pre-schoolers' snack consumption. These mediators were parental rules (i.e. restriction) on unhealthy snacking while watching television, parental permission of unhealthy snacking only during special occasions, parental unhealthy snack consumption, parental knowledge on snacking recommendation and child's attitude towards F&V as reported by their parent. Our findings are in line with previous studies. More specifically, a recent review showed that food availability and parental offering of foods have been successfully modified by several interventions and linked to positive changes in child outcomes⁽²⁴⁾. Furthermore, a systematic review conducted by van Stralen *et al.* found evidence for attitude, knowledge and habit strength as mediators of interventions targeting dietary behaviour⁽²⁵⁾. In the case of the ToyBox-study, these determinants referred to the parents and teachers of the pre-school children, due to the children's young age. Moreover, there is accumulated

evidence highlighting that parental role modelling, which in the current study is depicted as limited parental F&V consumption, exerts a significant role in children's F&V consumption⁽²⁶⁾.

The ToyBox-intervention had a positive effect on several family-related determinants regarding children's eating and snacking behaviour. Despite the strategies used to target these determinants being correctly and appropriately used, the ToyBox-intervention did not manage to significantly change children's snack consumption. This observation is in line with similar intervention studies⁽²⁷⁾. These findings could be attributed to the fact that dietary behaviour is one of the most complex behaviours and there may be more family-, school- or peer-related determinants than those identified during the preliminary phase of the ToyBox-study (focus groups as well as systematic literature reviews) that might also have an important role in determining dietary choices. Moreover, the results of the process evaluation conducted within the ToyBox-intervention showed that many parents did not read the provided newsletters and the tip-cards, which might explain the non-significant intervention effects regarding pre-schoolers' snack food consumption (report submitted to the European Commission)^(24,28). Furthermore, the duration of the intervention might not be adequate to change children's snacking behaviour. Last but not least, like most school-based interventions, the ToyBox-intervention did not follow a personalized approach, thus was not tailored to individual needs and preferences that might further enhance its effectiveness.

Future intervention developers targeting pre-schoolers' snack consumption are recommended to target the determinants that were found to mediate the intervention effect as well as the intervention strategies used in the ToyBox-intervention to change them, since those strategies succeeded in improving the targeted determinants. However, more extensive research should be done in the field of pre-schoolers' snack food choices to capture the complete panel of determinants influencing pre-schoolers' snacking behaviour. Furthermore, investing more time and effort to follow a more personalized approach in the population subgroups that are at higher risk (e.g. in families with low socio-economic status or in families with medical history of non-communicable diseases) might be more effective. Developing strategies to increase participants' fidelity to the programme, such as making the material less burdensome or providing it via a web-based system, should also be considered in future public health initiatives.

Limitations and strengths

The present study has some strengths and limitations. The strengths include the large study sample, the diversity of countries, regions and socio-economic groups included, the standardization of all study procedures and tools, as well as the assessment of all determinants found to be associated with pre-school children's snack consumption

Table 2 Family-related mediators of healthy and unhealthy snack consumption (standardized). The ToyBox-study, May/June 2013

| | α | 95% CI | β | 95% CI | $q\beta$ | 95% CI | τ | 95% CI |
|--|--------------|---------------------|-------------|-------------------|--------------|---------------------|--------------|---------------------|
| Healthy snacking | | | | | | | | |
| My child likes to eat F&V as a snack | 0.06 | 0.01, 0.10 | 0.18 | 0.15, 0.21 | 0.01 | 0.00, 0.02 | -0.03 | -0.08, 0.12 |
| I often give F&V as snacks to my child | 0.03 | -0.02, 0.09 | 0.15 | 0.13, 0.18 | 0.01 | -0.00, 0.01 | -0.02 | -0.07, 0.03 |
| I make F&V snacks regularly available for my child | -0.02 | -0.08, 0.03 | 0.14 | 0.12, 0.17 | -0.00 | -0.01, 0.00 | -0.02 | -0.06, 0.04 |
| My child is allowed to eat F&V as snacks without asking | -0.02 | -0.07, 0.04 | 0.04 | 0.01, 0.07 | -0.00 | -0.00, 0.00 | -0.01 | -0.06, 0.04 |
| Parental F&V consumption | -0.01 | -0.07, 0.04 | 0.04 | 0.01, 0.06 | 0.00 | -0.00, 0.00 | -0.01 | -0.06, 0.04 |
| Parental knowledge on F&V recommendation† | 0.00 | -0.09, 0.08 | 0.35 | 0.29, 0.39 | 0.00 | -0.03, 0.03 | -0.01 | -0.09, 0.06 |
| Unhealthy snacking | | | | | | | | |
| I think eating sweet or salty snacks is not bad for my child | -0.13 | -0.06, 0.04 | 0.08 | 0.04, 0.13 | -0.00 | -0.01, 0.00 | -0.06 | -0.12, 0.00 |
| I make sweet or salty snacks regularly available for my child | -0.00 | -0.06, 0.06 | 0.09 | 0.06, 0.12 | 0.00 | -0.01, 0.01 | -0.07 | -0.13, -0.01 |
| My child is not allowed to snack while watching television | 0.11 | 0.05, 0.16 | -0.03 | -0.07, 0.00 | -0.00 | -0.01, 0.00 | -0.06 | -0.13, 0.00 |
| My child is allowed to eat sweet or salty snacks only at certain occasions, i.e. birthdays | 0.11 | 0.05, 0.17 | -0.05 | -0.09, -0.02 | -0.01 | -0.01, -0.00 | -0.06 | -0.12, 0.01 |
| I give sweet or salty snacks to my child as a reward or to comfort him | -0.01 | -0.07, 0.05 | 0.04 | 0.00, 0.07 | 0.00 | -0.00, 0.00 | -0.06 | -0.12, 0.01 |
| If I prohibit my child to eat sweet/salty snack I find it difficult to stick to my rules if (s)he starts nagging | 0.02 | -0.05, 0.08 | 0.05 | 0.02, 0.09 | 0.00 | -0.00, 0.01 | -0.07 | -0.13, -0.00 |
| I find it difficult to restrain myself from eating sweet or salty snacks because of the presence of my child | -0.01 | -0.06, 0.05 | 0.05 | 0.01, 0.09 | 0.00 | -0.00, 0.00 | -0.06 | -0.12, 0.00 |
| Parental snack consumption | -0.07 | -0.13, -0.01 | 0.14 | 0.10, 0.19 | -0.01 | -0.02, -0.00 | -0.05 | -0.11, 0.02 |
| Parental knowledge on snacking recommendation† | 0.16 | 0.09, 0.23 | -0.11 | -0.16, -0.07 | -0.02 | -0.03, -0.01 | -0.04 | -0.10, 0.02 |

α , estimation of the effect of the intervention on the proposed mediator; β , estimation of the effect of the mediator on unhealthy snacking and F&V consumption; $q\beta$, computation of the indirect effect of the intervention on unhealthy snacking and F&V consumption via the proposed mediator; τ , estimation of the effect of the mediator on unhealthy snacking and F&V consumption adjusting for the intervention effect; F&V, fruit(s) and vegetable(s). All models were single mediation models adjusted for child's sex and age, maternal education, country, baseline values of snacking consumption and baseline values of the specific mediators. Bias-corrected bootstrapping using 5000 samples was conducted with the maximum likelihood estimator (except for categorical mediators indicated with †, which were conducted with the VLSMV indicator) using Mplus version 8.0. Standardized coefficients are shown using STDY standardization because of a binary independent variable. Significant associations are presented in bold font. The regression coefficients are presented in SD.



in the preliminary phases of the ToyBox-study. Furthermore, all measurements at pre- and post-test were taken during the same time period (i.e. May/June 2012 and 2013), thus limiting the potential seasonality effects on pre-schoolers' snack consumption. On the other hand, data were self-reported by the parents, resulting in potential recall bias or social desirability of the responses. However, the reliability of the used questionnaires has been previously tested, before the start of the intervention, and they were found to be reliable tools⁽²²⁾. Furthermore, the data were collected in 2012–2013; however, this is to be expected from multicentre studies, which include complex procedures for data processing, handling and analysis. Even though attention on the health-related behaviours in young children is growing, the literature focusing on the pathways through which interventions such as the ToyBox-study improve health-related behaviours via family-related or other determinants is still scarce. Thus, the current study is strongly related and relevant to current policy and practice in order to improve the effectiveness of childhood obesity prevention programmes.

Conclusions

Even though the total effect of the ToyBox-intervention on pre-school children's healthy and unhealthy snacking was not significant, the intervention was effective in improving parental rules on children's unhealthy snack consumption (i.e. restriction while watching television and permission only at certain occasions) and parental consumption of unhealthy snacks, while it increased parental knowledge on snacking recommendations. Regarding the consumption of healthy snacks, the ToyBox-intervention improved children's attitude towards F&V. All previously mentioned family-related determinants mediated the intervention effect on pre-schoolers' consumption of healthy and unhealthy snacks. These findings imply that future interventions aiming to promote F&V consumption and limit the consumption of unhealthy snacks in pre-schoolers should target these mediators, but also target more determinants and use more strategies, such as personalization, to enhance their effectiveness.

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Supplementary material

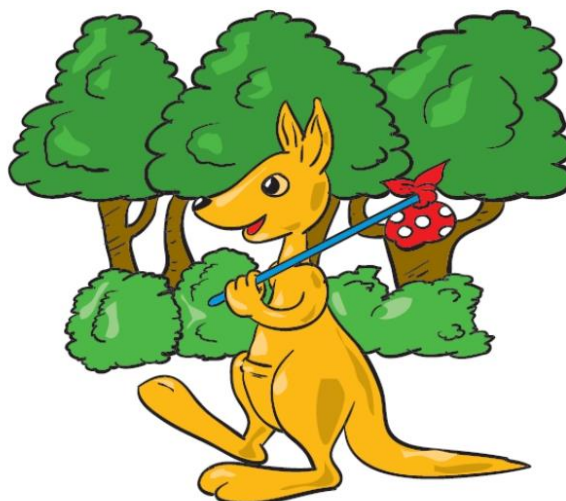
To view supplementary material for this article, please visit <https://doi.org/10.1017/S1368980018002653>

References

- Durao C, Severo M, Oliveira A *et al.* (2015) Evaluating the effect of energy-dense foods consumption on preschool children's body mass index: a prospective analysis from 2 to 4 years of age. *Eur J Nutr* **54**, 835–843.
- Moschos G, Kalliora AC, Costarelli V *et al.* (2014) Identification of lifestyle patterns associated with obesity and fat mass in children: the Healthy Growth Study. *Public Health Nutr* **17**, 614–624.
- World Health Organization (1990) *Diet, Nutrition and the Prevention of Chronic Diseases. Joint WHO/FAO Expert Consultation. WHO Technical Report Series no. 916*. Geneva: WHO.
- Nicklas T & Johnson R (2004) Position of the American Dietetic Association: Dietary guidance for healthy children ages 2 to 11 years. *J Am Diet Assoc* **104**, 660–677.
- Patterson BH, Block G, Rosenberger WF *et al.* (1990) Fruit and vegetables in the American diet: data from the NHANES II survey. *Am J Public Health* **80**, 1443–1449.
- Dennison BA, Rockwell HL & Baker SL (1998) Fruit and vegetable intake in young children. *J Am Coll Nutr* **17**, 371–378.
- De Craemer M, Lateva M, Iotova V *et al.* (2015) Differences in energy balance-related behaviours in European pre-school children: the ToyBox-study. *PLoS One* **10**, e0118303.
- Kelder SH, Perry CL, Klepp KI *et al.* (1994) Longitudinal tracking of adolescent smoking, physical activity, and food choice behaviors. *Am J Public Health* **84**, 1121–1126.
- Lien N, Lytle LA & Klepp KI (2001) Stability in consumption of fruit, vegetables, and sugary foods in a cohort from age 14 to age 21. *Prev Med* **33**, 217–226.
- Whincup PH, Gilg JA, Papacosta O *et al.* (2002) Early evidence of ethnic differences in cardiovascular risk: cross sectional comparison of British South Asian and white children. *BMJ* **324**, 635.
- Klesges RC, Klesges LM, Eck LH *et al.* (1995) A longitudinal analysis of accelerated weight gain in preschool children. *Pediatrics* **95**, 126–130.
- Moller JH, Taubert KA, Allen HD *et al.* (1994) Cardiovascular health and disease in children: current status. A Special Writing Group from the Task Force on Children and Youth, American Heart Association. *Circulation* **89**, 923–930.
- van Stralen MM, te Velde SJ, van Nassau F *et al.* (2012) Weight status of European preschool children and associations with family demographics and energy balance-related behaviours: a pooled analysis of six European studies. *Obes Rev* **13**, Suppl. 1, 29–41.
- Bartholomew LK, Parcel GS & Kok G (1998) Intervention mapping: a process for developing theory- and evidence-based health education programs. *Health Educ Behav* **25**, 545–563.
- Manios Y, Androustos O, Katsarou C *et al.* (2014) Designing and implementing a kindergarten-based, family-involved intervention to prevent obesity in early childhood: the ToyBox-study. *Obes Rev* **15**, Suppl. 3, 5–13.
- Pinket AS, De Craemer M, Huybrechts I *et al.* (2016) Diet quality in European pre-schoolers: evaluation based on diet quality indices and association with gender, socio-economic status and overweight, the ToyBox-study. *Public Health Nutr* **19**, 2441–2450.
- Wilfley DE, Kass AE & Kolko RP (2011) Counseling and behavior change in pediatric obesity. *Pediatr Clin North Am* **58**, 1403–1424.
- Manios Y, Grammatikaki E, Androustos O *et al.* (2012) A systematic approach for the development of a kindergarten-based intervention for the prevention of obesity in pre-school age children: the ToyBox-study. *Obes Rev* **13**, Suppl. 1, 3–12.
- De Craemer M, De Decker E, De Bourdeaudhuij I *et al.* (2013) Physical activity and beverage consumption in pre-schoolers: focus groups with parents and teachers. *BMC Public Health* **13**, 278.
- Androustos O, Katsarou C, Payr A *et al.* (2014) Designing and implementing teachers' training sessions in a kindergarten-based, family-involved intervention to prevent obesity in early childhood. The ToyBox-study. *Obes Rev* **15**, Suppl. 3, 48–52.
- Huybrechts I, De Backer G, De Bacquer D *et al.* (2009) Relative validity and reproducibility of a food-frequency questionnaire for estimating food intakes among Flemish preschoolers. *Int J Environ Res Public Health* **6**, 382–399.
- Gonzalez-Gil EM, Mouratidou T, Cardon G *et al.* (2014) Reliability of primary caregivers reports on lifestyle behaviours of European pre-school children: the ToyBox-study. *Obes Rev* **15**, Suppl. 3, 61–66.
- MacKinnon DP, Lockwood CM & Williams J (2004) Confidence limits for the indirect effect: distribution of the product and resampling methods. *Multivariate Behav Res* **39**, 99.
- Bekelman TA, Bellows LL & Johnson SL (2017) Are family routines modifiable determinants of preschool children's eating, dietary intake, and growth? A review of intervention studies. *Curr Nutr Rep* **6**, 171–189.
- van Stralen MM, Yildirim M, te Velde SJ *et al.* (2011) What works in school-based energy balance behaviour interventions and what does not? A systematic review of mediating mechanisms. *Int J Obes (Lond)* **35**, 1251–1265.
- Couch SC, Glanz K, Zhou C *et al.* (2014) Home food environment in relation to children's diet quality and weight status. *J Acad Nutr Diet* **114**, 1569–1579.e1.
- Freeman R & Oliver M (2009) Do school break-time policies influence child dental health and snacking behaviours? An evaluation of a primary school programme. *Br Dent J* **206**, 619–625.
- Pinket AS, De Craemer M, Maes L *et al.* (2016) Water intake and beverage consumption of pre-schoolers from six European countries and associations with socio-economic status: the ToyBox-study. *Public Health Nutr* **19**, 2315–2325.

Chapter 8. Appendix

EBRB questionnaire



Primary Caregiver's Questionnaire

| Country code | Preschool number | Class number | Code number |
|----------------------|----------------------|----------------------|----------------------|
| <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |

Today's date

| | | |
|----------------------|----------------------|----------------------|
| <input type="text"/> | <input type="text"/> | <input type="text"/> |
| Day | Month | Year |

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Dear Parents/Caregivers,

You and your child are participating in a large European study that investigates dietary and physical activity patterns of around 5000 children from Belgium, Bulgaria, Germany, Greece, Spain and Poland. We very much hope that you are willing to fill in this questionnaire. Your participation is voluntary. All answers will be treated in strict confidence in accordance with the regulations regarding data protection, and the information will only be used for research purposes. No one will be given access to your answers except for the researchers.



You do not need to put your name on the questionnaire. When you have answered the questionnaire put it in the envelope provided, and give it back to your child in order to take it back to preschool or hand it in yourself to the teacher. If you have any other queries or want further information please contact <name of contact person country specific> at <Institute name country specific> on <Phone number country specific> or visit the ToyBox website: <http://www.toybox-study.eu/> add country-specific ext

Yours sincerely,

Name & Signature of Professor in charge of the ToyBox intervention in each country

❓ How to complete the questionnaire ❓

- In sections **B, C, D AND E** we ask firstly questions about **YOU** and then for **YOUR** child.

When you see , this refers to **YOU** and when you see , this refers to **YOUR** child

- Please complete the questionnaire using a **blue or black pen**.
- Most of the questions can be answered by placing a clear **X** in the answer box. Mark only one box per question unless multiple answers can be given. This will be indicated next to the question.
- In some questions we ask you to write your own answer.

EXAMPLES:

How far is your child's preschool located from your home?

- ☐₁ Up to 500 metres
☐₂ From 500 metres to <1 kilometre
☒₃ From 1 kilometre to <2 kilometres
☐₄ From 2 kilometres to <3 kilometres
☐₅ From 3 kilometres to <4 kilometres
☐₆ 4 kilometres or more

How much time does your child spend doing sports in a sports club per week?

hours minutes

If you wish to change an answer, leave the incorrect answer box marked 'X' and make the correct answer box completely black:

How far is your child's preschool located from your home?

- ☐₁ Up to 500 metres
☐₂ From 500 metres to <1 kilometre
☒₃ From 1 kilometre to <2 kilometres
☐₄ From 2 kilometres to <3 kilometres
☐₅ From 3 kilometres to <4 kilometres
☐₆ 4 kilometres or more

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A. Socio-demographic Questions

The following questions are for the person who is answering this questionnaire. Ideally this person must be the child's primary caregiver. Please answer all questions and fill in what applies to you or your situation. It is important to remember that there are no right or wrong answers.

This questionnaire is filled in by...

- ☐₁ The mother
- ☐₂ The stepmother
- ☐₃ The father
- ☐₄ The stepfather
- ☐₅ Other (please state by whom

A1. Was your child born in <insert country> ?

- ☐₁ Yes ☐₂ No, he/she was born in:

A2. Was the biological mother of your child born in <insert country> ?

- ☐₁ Yes ☐₂ No, she was born in: ☐₃ I don't know

A3. Was the biological father of your child born in <insert country> ?

- ☐₁ Yes ☐₂ No, he was born in: ☐₃ I don't know

A4. In what language(s) do you usually/mainly speak with your child at home?

- ☐₁ <insert national language>
- ☐₂ Other language, please specify:

A5. Which adults does your child live with? (You can mark more than one box)

- ☐₁ With both his/her mother and father
- ☐₂ Only with his/her mother
- ☐₃ Only with his/her father
- ☐₄ With his/her mother and her new partner
- ☐₅ With his/her father and his new partner
- ☐₆ With his/her grandparents
- ☐₇ Other adults (please specify).....

How many persons live permanently in the household where your child usually lives?

A6. Number of persons 18 years or above: person(s).

A7. Number of persons below 18 years: person(s).

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How many years of school education did you and your spouse/partner complete? Please mark one option for you and one option for your spouse/partner (do not count years in preschool and start from age 6)

| | A8. Me | A9. Spouse/partner | A10. I do not have a spouse/partner |
|--------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| Less than 7 years | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₁ |
| 7-12 years | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₂ | |
| 13-14 years | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₃ | |
| 15-16 years | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₄ | |
| More than 16 years | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₅ | |

What is the main occupation of you and your spouse/ partner over the last 6 months?

| | A11. Me | A12. Spouse/partner | A13. I do not have a spouse/partner |
|----------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| Full time housework | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₁ |
| Work full-time | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₂ | |
| Work part-time | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₃ | |
| Unemployed | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₄ | |
| Full-time education | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₅ | |
| Sick/disabled | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₆ | |
| Something else | <input type="checkbox"/> ₇ | <input type="checkbox"/> ₇ | |

A14. What is the gender of your child?

☐₁ Male ☐₂ Female

A15. On which day/month/year your child was born?

Day Month Year

A16. How many days per week does your child usually attend childcare?

Days

A17. How many hours per day does your child usually attend childcare?

Hours

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A18. What do you think about your child's weight?

- ☐₁ My child's weight is very low
☐₂ My child's weight is low
☐₃ My child's weight is not too low/ not too high
☐₄ My child's weight is high
☐₅ My child's weight is very high

How many hours of sleep does your child usually have during the night? (Please mark one box for weekdays and one box for weekend days)

| A19. Weekdays (average per night) | A20. Weekend days (average per night) |
|--|--|
| <input type="checkbox"/> ₁ Less than 6 hours | <input type="checkbox"/> ₁ Less than 6 hours |
| <input type="checkbox"/> ₂ 6-7 hours | <input type="checkbox"/> ₂ 6-7 hours |
| <input type="checkbox"/> ₃ 8-9 hours | <input type="checkbox"/> ₃ 8-9 hours |
| <input type="checkbox"/> ₄ 10-11 hours | <input type="checkbox"/> ₄ 10-11 hours |
| <input type="checkbox"/> ₅ 12-13 hours | <input type="checkbox"/> ₅ 12-13 hours |
| <input type="checkbox"/> ₆ 14 hours | <input type="checkbox"/> ₆ 14 hours |
| <input type="checkbox"/> ₇ More than 14 hours | <input type="checkbox"/> ₇ More than 14 hours |
| <input type="checkbox"/> ₈ I don't know | <input type="checkbox"/> ₈ I don't know |

Thinking on the number of times and the duration of naps your child usually takes; Please indicate the TOTAL TIME SPEND TAKING NAPS PER DAY. (Please mark one box for weekdays and one box for weekend days)

| A21. Weekdays (average per week day) | A22. Weekend days (average per weekend day) |
|---|---|
| <input type="checkbox"/> ₁ My child does not take naps on weekdays | <input type="checkbox"/> ₁ My child does not take naps on weekend days |
| <input type="checkbox"/> ₂ Less than 1 hour | <input type="checkbox"/> ₂ Less than 1 hour |
| <input type="checkbox"/> ₃ 1-2 hours | <input type="checkbox"/> ₃ 1-2 hours |
| <input type="checkbox"/> ₄ 3-4 hours | <input type="checkbox"/> ₄ 3-4 hours |
| <input type="checkbox"/> ₅ 5-6 hours | <input type="checkbox"/> ₅ 5-6 hours |
| <input type="checkbox"/> ₆ 7-8 hours | <input type="checkbox"/> ₆ 7-8 hours |
| <input type="checkbox"/> ₇ 9 or more hours | <input type="checkbox"/> ₇ 9 or more hours |
| <input type="checkbox"/> ₈ I don't know | <input type="checkbox"/> ₈ I don't know |

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Which member of the family is usually in charge of the following tasks?

| | Me | Spouse/partner | Grandparents | Others |
|--|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| A23. Prepare your child for preschool | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ |
| A24. Drop your child at preschool | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ |
| A25. Picks your child up after preschool | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ |
| A26. Cooks for your child | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ |
| A27. Supervises/Feeds your child | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ |
| A28. Supervises outdoor activities | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ |

What is the age, height and weight of parents/caregivers with whom your child lives with?

| | | |
|-------------|--|--|
| | Me | Spouse/partner |
| A29. Age | <input type="text"/> <input type="text"/> <input type="text"/> years | <input type="text"/> <input type="text"/> <input type="text"/> years |
| A30. Height | <input type="text"/> <input type="text"/> <input type="text"/> (cm) | <input type="text"/> <input type="text"/> <input type="text"/> (cm) |
| A31. Weight | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> (kg) | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> (kg) |

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B. Drinking behaviour

The following part of the questionnaire aims to assess the drinking behaviour of you and your child. Please answer all questions. It is important to remember that there are no right or wrong answers. Fill in what applies to you or your situation.

When we say:

- Water: we mean tap water, mineral water, natural sparkling or still water
- Soft drinks: we mean all sugared or sweet-flavored beverages, carbonated or not, plain or light e.g. Cola and Cola light/zero, Ice Tea, 7-up, Pepsi, Fanta, Fanta non-carbonated, Sprite, Orangina etc
- Pre-packed juices: we mean all fruit juice-based products including 100% fresh juice bottled or in paper-pack, 30% fruit-juice with added sugared (nectar), sports drinks, smoothies, canned juices e.g. Life, Tropicana, Lemonade, Lucozade

➤ QUESTIONS ABOUT YOU



How many portions of the following drinks do YOU usually consume? 'please note that portions per week is the same as times per week'

| Beverage | Portion Size | Never | 1 portion or less per week | 2-4 portions per week | 5-6 portions per week | 1-2 portions per day | 3-4 portions per day | 5 or more portions per day |
|--|--|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| B1. Water (includes tap water, still and sparkling mineral water) | 1 cup = 250 ml 1 small plastic bottle = 500ml 1 glass water = 250 ml | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ |
| B2. Fruit juice, home-made, freshly squeezed | 1 glass fruit juice = 250ml | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ |
| B3. Fruit juice, pre-packed/ bottled (100%, nectar etc.) | 1 small plastic bottle = 500ml | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ |

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| Beverage | Portion Size | Never | 1 portion or less per week | 2-4 portions per week | 5-6 portions per week | 1-2 portions per day | 3-4 portions per day | 5 or more portions per day |
|---|--|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| B4. Light beverages (light soda drinks, light Cola, ...) | 1 cup = 250 ml 1 can = 330ml 1 small plastic bottle = 500ml 1 glass lemonade = 250 ml | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ |
| B5. Sugared beverages (soda drinks like Cola, limonade, Ice Tea, ...) | 1 cup = 250 ml 1 can = 330ml 1 small plastic bottle = 500ml 1 glass lemonade = 250 ml | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ |

➤ QUESTIONS ABOUT YOUR CHILD



Please read the following statements and tick the boxes most appropriate to your situation:

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| B6. My child is allowed to drink soft drinks or pre-packed juices whenever he/she asks for | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| B7. I make water always available for my child | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| B8. It is bad for my child to drink soft drinks everyday | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| B9. It is bad for my child to drink pre-packed juices everyday | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| B10. I encourage my child to drink water | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| B11. If I would like to drink soft drinks or pre-packed juices, I would try to restrain myself because of the presence of my child | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| B12. I am pleased with my child's water consumption | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| B13. My child prefers to drink soft drinks or pre-packed juices instead of water | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| B14. During meals, water is always available on the table | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |

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| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| B15. I find it difficult to give my child water if he/she wants soft drinks or pre-packed juices | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| B16. My child does not enjoy drinking water | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| B17. I make soft drinks or pre-packed juices always available for my child | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| B18. My child's water consumption is within the appropriate recommendations | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| B19. My child can drink soft drinks or pre-packed juices as much as he/she likes | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| B20. I give soft drinks or pre-packed juices to my child as a reward or to comfort him/her | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| B21. During meals, soft drinks or pre-packed juices are always available on the table | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| B22. My child drinks soft drinks or pre-packed juices only on certain occasions e.g., birthdays | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |

B23. How often do you think your child should drink soft drinks and pre-packed juices? 'please note that portions per week is the same as times per week'

- ☐₁ Never
- ☐₂ On certain occasions e.g., birthdays
- ☐₃ 1 glass or less per week
- ☐₄ 2-4 glasses per week
- ☐₅ 5-6 glasses per week
- ☐₆ 1-2 glasses per day
- ☐₇ 3-4 glasses per day
- ☐₈ 5 or more glasses per day
- ☐₉ I don't know

B24. How many glasses of water do you think your child should drink daily?

- ☐₁ None or scarce
- ☐₂ 1 glass per day
- ☐₃ 2 glasses per day
- ☐₄ 3 glasses per day
- ☐₅ 4 glasses per day
- ☐₆ 5 glasses per day
- ☐₇ 6 glasses per day
- ☐₈ 7 glasses per day
- ☐₉ 8 or more glasses per day
- ☐₉ I don't know

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C. Snacking behaviour

The following part of the questionnaire aims to assess the snacking behaviour of you and of your child. Please answer all questions. It is important to remember that there are no right or wrong answers.

When we say **SNACKING**, we mean all food items consumed as snacks in between the main meals of the day i.e. between breakfast and lunch (morning snack), between lunch and dinner (afternoon snack) and before going to bed (evening snack).

Examples of snacks include:

- pieces of fruits or vegetables, biscuits, yogurt (plain and flavored), cereal bar, bread, packet of crisps, bar of chocolate etc

➤ QUESTIONS ABOUT YOU



How often do you usually have something to eat as snack between the meals during weekdays?

| On weekdays | Never | On 1 day | On 2 days | On 3 days | On 4 days | On 5 days |
|--|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| C1. Breakfast | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ |
| C2. Morning Snack (between Breakfast and Lunch) | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ |
| C3. Afternoon Snack (between Lunch and Dinner) | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ |
| C4. An evening snack (after dinner) | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ |

How often do you usually have something to eat as snack between the meals during weekends?

| On weekends | Never | On 1 day | On 2 days |
|--|---------------------------------------|---------------------------------------|---------------------------------------|
| C5. Breakfast | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ |
| C6. Morning Snack (between Breakfast and Lunch) | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ |
| C7. Afternoon Snack (between Lunch and Dinner) | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ |
| C8. An evening snack (after dinner) | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ |

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How often do you consume the following items as a snack (in between your main meals)?

| | Never | 1 or less times per week | 2-4 times per week | 5-6 times per week | 1-2 times per day | 3-4 times per day | 5 or more times per day |
|--|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| C9. Nuts/peanuts | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ |
| C10. Cakes/muffins | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ |
| C11. Wholemeal Bread | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ |
| C12. Biscuits/cookies | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ |
| C13. Crisps and other similar salty snacks | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ |
| C14. Crackers, breadsticks | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ |
| C15. Chocolate | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ |
| C16. Sweets/candies | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ |
| C17. Cheese | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ |
| C18. Cheese pies/meat pies | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ |
| C19. Yogurt/Fresh cheeses | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ |
| C20. Pizza | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ |
| C21. Fresh Fruits | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ |
| C22. Vegetables | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ |

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➤ QUESTIONS ABOUT YOUR CHILD

Please read the following statements and tick the boxes most appropriate to your situation for morning, afternoon and evening snacks

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|--|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| C23. My child likes to eat fruits or vegetables as a snack | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| C24. My child likes to eat dairy as a snack | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| C25. My child likes to eat cereals/bread as a snack | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| C26. I often give fruits or vegetables as snacks to my child | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| C27. I often give dairy as snacks to my child | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| C28. I often give cereals/bread as snacks to my child | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| C29. I make fruit or vegetables snacks regularly available for my child | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| C30. I make dairy snacks regularly available for my child | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| C31. I make cereals/bread snacks regularly available for my child | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| C32. My child chooses sweet or salty snacks, when fruit or vegetables snacks are available | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| C33. My child chooses sweet or salty snacks when other children eat fruit or vegetables snacks | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| C34. I think eating sweet or salty snacks is not bad for my child | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| C35. I make sweet or salty snacks regularly available for my child | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| C36. My child is not allowed to snack while watching TV | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| C37. My child is allowed to eat fruits or vegetables as snacks without asking | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |

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| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| C38. My child is allowed to eat dairy or cereals/bread as snacks without asking | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| C39. My child is allowed to eat sweet or salty snacks only at certain occasions i.e., birthdays | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| C40. I give sweet or salty snacks to my child as a reward or to comfort him/her | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| C41. If I prohibit my child to eat a sweet or salty snack, I find it difficult to stick to my rules if he/she starts nagging | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| C42. I find it difficult to restrain myself from eating sweet or salty snacks because of the presence of my child | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| C43. I am pleased with my child's snacking behaviour | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |

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When we say:

- **Fruits or Vegetables:** we mean pieces of fruits or vegetables (do not include juices)
- **Bread or Cereals:** we mean any kind of bread or breakfast cereals or cereal products
- **Dairy products:** we mean any kind of milk (plain and flavored), yogurt (plain and flavored) or cheese.
- **Sweet or salty snacks:** we mean any kind of chocolate, biscuits, candy, crisps, croissants, pizza or ice cream etc

What do you think is an acceptable consumption of the following food items for 4-6 year old children?

| | Never | On certain occasions i.e. birthdays | 1 or less times per week | 2-4 times per week | 5-6 times per week | 1-2 times per day | 3-4 times per day | 5 or more times per day |
|---|---------------------------------------|--|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| C44. Sweets/candies/ chocolate | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ | <input type="checkbox"/> ₈ |
| C45. Biscuits/cookies/ cakes/muffins | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ | <input type="checkbox"/> ₈ |
| C46. Crisps and other similar salty snacks | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ | <input type="checkbox"/> ₈ |
| C47. Fruit and vegetables | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ | <input type="checkbox"/> ₈ |
| C48. Pizza, cheese pies/ meat pies | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ | <input type="checkbox"/> ₈ |
| C49. Milk (plain) | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ | <input type="checkbox"/> ₈ |
| C50. Yogurt (plain) | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ | <input type="checkbox"/> ₈ |
| C51. Milk (flavored) | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ | <input type="checkbox"/> ₈ |
| C52. Yogurt (flavored) | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ | <input type="checkbox"/> ₈ |
| C53. Cheese | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ | <input type="checkbox"/> ₈ |

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D. Physical Activity

The following part of the questionnaire is to assess the physical activity behaviour of you and of your child. Please answer all questions. It is important to remember that there are no right or wrong answers. Fill in what applies to you or your situation.

In the following questions, when we say **PHYSICAL ACTIVITY** we mean:
Activities that you do including practicing a sport or exercising

➤ QUESTIONS ABOUT YOU



Think about the time you spent walking in the last 7 days. This includes walking at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

D1. During the last 7 days, on how many days did you **walk** for at least 10 minutes at a time?

Yes ☐₁ days per week

No walking ☐₂ ➔➔ continue with question D3

D2. How much time did you usually spend walking on one of those days?

hours per day

and

minutes per day

Think about all the moderate activities that you did in the last 7 days. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

D3. During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis?

Yes ☐₁ days per week

No moderate physical activities ☐₂ ➔➔ continue with question D5

D4. How much time did you usually spend doing moderate physical activities on one of those days?

hours per day

and

minutes per day

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Think about all the vigorous activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

D5. During the **last 7 days**, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?

Yes ☐ ₁ days per week

No vigorous physical activities ☐ ₂ ➔➔
continue with question D7

D6. How much time did you usually spend doing vigorous physical activities on one of those days?

hours per day

and

minutes per day

Think about the time you spent sitting on weekdays during the last 7 days. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

D7. During the last 7 days, how much time did you spend sitting on a week day?

hours per day and minutes per day

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3. González-Gil EM, Mouratidou T, Cardon G et al. Reliability of primary caregivers reports on lifestyle behaviours of European preschool children. The ToyBox-study. Obes Rev. 2014 Aug;15 Suppl S3:61-66. doi: 10.1111/obr.12184.

In the following questions, when we say **PHYSICAL ACTIVITY** including practicing a **sport or exercising** we mean:

Activities that YOUR CHILD does before and after school and that make him/her breathe harder or sweat

Examples of physical activities are: walking, cycling, playing in the playground, team sports like football and organized activities such as swimming or dance lessons

➤ QUESTIONS ABOUT YOUR CHILD



D8. Is your child member in a sports club?

☐₁ Yes

☐₂ No ➔➔➔ Please continue with question D11

D9. How much time does your child spend doing sport in a sports club per week?

____|____| hours ____|____| minutes

D10. What kind of sport does your child do in a sports club?

Please tick all appropriate.

☐₁ <country-specific categories>

☐₂ <country-specific categories>

☐₃ <country-specific categories>

☐₄ <country-specific categories>

☐₅ Other, please specify: _____

D11. How does your child usually get to/from preschool and how long does it take him/her?

| | D12. Travel forth | D12a.Time (minutes) | D13. Travel home | D13a.Time (minutes) |
|---------------------------------------|---------------------------------------|---------------------|---------------------------------------|---------------------|
| Walking | <input type="checkbox"/> ₁ | | <input type="checkbox"/> ₁ | |
| Cycling (himself/herself) | <input type="checkbox"/> ₂ | | <input type="checkbox"/> ₂ | |
| By guardians bicycle | <input type="checkbox"/> ₃ | | <input type="checkbox"/> ₃ | |
| By school bus and/or public transport | <input type="checkbox"/> ₄ | | <input type="checkbox"/> ₄ | |
| By car/motorbike | <input type="checkbox"/> ₅ | | <input type="checkbox"/> ₅ | |
| Other, please specify: | <input type="checkbox"/> ₆ | | <input type="checkbox"/> ₆ | |

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Think about where your child spent his/her time *YESTERDAY*.
Note: If yesterday was a Saturday or Sunday, then this question refers to the *last WEEK DAY* (i.e. Friday)

D14. What was the weather like *YESTERDAY*? (please tick *one* response)

- ☐₁ Fine to play outdoors
☐₂ Too wet to play outdoors
☐₃ Too hot or humid to play outdoors
☐₄ Too cold to play outdoors

D15. How much time did your child spend outdoors in active play (skipping, cycling) *YESTERDAY*?
 (record "0" if your child did not spend time playing outside)

____ hours ____ minutes

Think about where your child spent his/her time on the *last WEEKEND DAY*
(Saturday or Sunday)

D16. What was the weather like on that *WEEKEND-DAY*? (please tick *one* response)

- ☐₁ Fine to play outdoors
☐₂ Too wet to play outdoors
☐₃ Too hot or humid to play outdoors
☐₄ Too cold to play outdoors

D17. How much time did your child spend outdoors in active play *IN THE LAST WEEKEND DAY*?
 (record "0" if your child did not spend time playing outside)

____ hours ____ minutes

D18. How far is your child's preschool located from your home?

- ☐₁ Up to 500 metres
☐₂ From 500 metres to <1 kilometre
☐₃ From 1 kilometre to <2 kilometres
☐₄ From 2 kilometres to <3 kilometres
☐₅ From 3 kilometres to <4 kilometres
☐₆ 4 kilometres or more

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D19. I think that the recommendations on PHYSICAL ACTIVITY for 4-6 year old children are

- ☐₁ To be physically active one day a week
☐₂ To be physically active 2-3 days a week
☐₃ To be physically active every day for 30 minutes to 1 hour
☐₄ To be physically active every day for 1-2 hours
☐₅ To be physically active every day for 3-4 hours
☐₆ To be physically active every day for 5-6 hours
☐₇ To be physically active every day for 7-8 hours
☐₈ To be physically active every day for more than 8 hours
☐₉ I don't know

Please read the following statements and tick the boxes most appropriate to your situation:

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| D20. My child likes to be physically active | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| D21. My child enjoys taking part in sports | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| D22. My child prefers doing passive activities (like playing with cars, dolls, drawing,...) rather than physical activities | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| D23. If my child has the choice, he/she rather chooses to go somewhere in a passive (e.g. by car) rather than an active (walking, cycling) way | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| D24. Being physically active is good for my child | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| D25. I plan physical activity for my child on a regular basis | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| D26. I find it difficult to organize our family so that we have enough time for active transport. | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| D27. Toys or equipment/material (ball, rope, bike, swing, ...) are available for my child to play actively outside or inside | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |

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| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| D28. I find it difficult to let my child be physically active if I want my child to be quiet so that I can do my household or work | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| D29. I find it difficult to let my child be physically active if the weather conditions are bad or it is very cold/hot outside. | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| D30. I find it difficult to let my child be physically active outside as I always have to be there to supervise him/her | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| D31. I encourage my child to be physically active | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| D32. I like doing physical activities together with my child | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| D33. I reward my child or comfort him/her by being physically active together with him/her | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| D34. I find it difficult to insist that my child is physically active if he/she does not want to and starts nagging | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| D35. I try to be physically active together with my child regularly | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| D36. My child is allowed to run around and be physically active inside our house | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| D37. I am pleased with my child's physical activity level | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |

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E. Sedentary activities

The following part of the questionnaire aims to assess the sedentary behaviour of you and of your child. Please answer all questions. It is important to remember that there are no right or wrong answers. Fill in what applies to you or your situation.

When we say **SEDENTARY** activities, we mean all sitting and lying activities, such as watching television and/or DVD, using the computer, drawing and looking into books.

➤ QUESTIONS ABOUT YOU



About how many hours a day do **YOU** usually watch television (including DVDs and videos) in your free time? (Please mark one box for weekdays and one box for weekend days)

| E1. Weekdays (average all weekdays) | E2. Weekend days (average per weekend days) |
|--|--|
| <input type="checkbox"/> ₁ Never | <input type="checkbox"/> ₁ Never |
| <input type="checkbox"/> ₂ Less than 30 minutes/day | <input type="checkbox"/> ₂ Less than 30 minutes/day |
| <input type="checkbox"/> ₃ 30 minutes to <1 hr/day | <input type="checkbox"/> ₃ 30 minutes to <1 hr/day |
| <input type="checkbox"/> ₄ 1- 2 hrs/ day | <input type="checkbox"/> ₄ 1- 2 hrs/ day |
| <input type="checkbox"/> ₅ 3-4 hrs/ day | <input type="checkbox"/> ₅ 3-4 hrs/ day |
| <input type="checkbox"/> ₆ 5-6 hrs/ day | <input type="checkbox"/> ₆ 5-6 hrs/ day |
| <input type="checkbox"/> ₇ 7-8 hrs/ day | <input type="checkbox"/> ₇ 7-8 hrs/ day |
| <input type="checkbox"/> ₈ 8 hrs/ day | <input type="checkbox"/> ₈ 8 hrs/ day |
| <input type="checkbox"/> ₉ More than 8 hrs/ day | <input type="checkbox"/> ₉ More than 8 hrs/ day |
| <input type="checkbox"/> ₁₀ I don't know | <input type="checkbox"/> ₁₀ I don't know |

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About how many hours a day do **YOU** usually use your computer for activities like chatting online, internet, emailing, playing games and/or do you play game consoles (e.g. Playstation, Xbox, GameCube) during leisure time? **Please do not count hours of computer use for work-related issues even when it is done at home**

| E3. Weekdays (average all weekdays) | E4. Weekend days (average per weekend days) |
|--|--|
| <input type="checkbox"/> ₁ Never | <input type="checkbox"/> ₁ Never |
| <input type="checkbox"/> ₂ Less than 30 minutes/day | <input type="checkbox"/> ₂ Less than 30 minutes/day |
| <input type="checkbox"/> ₃ 30 minutes to <1 hr/day | <input type="checkbox"/> ₃ 30 minutes to <1 hr/day |
| <input type="checkbox"/> ₄ 1- 2 hrs/ day | <input type="checkbox"/> ₄ 1- 2 hrs/ day |
| <input type="checkbox"/> ₅ 3-4 hrs/ day | <input type="checkbox"/> ₅ 3-4 hrs/ day |
| <input type="checkbox"/> ₆ 5-6 hrs/ day | <input type="checkbox"/> ₆ 5-6 hrs/ day |
| <input type="checkbox"/> ₇ 7-8 hrs/ day | <input type="checkbox"/> ₇ 7-8 hrs/ day |
| <input type="checkbox"/> ₈ 8 hrs/ day | <input type="checkbox"/> ₈ 8 hrs/ day |
| <input type="checkbox"/> ₉ More than 8 hrs/ day | <input type="checkbox"/> ₉ More than 8 hrs/ day |
| <input type="checkbox"/> ₁₀ I don't know | <input type="checkbox"/> ₁₀ I don't know |

E5. How often do you or your spouse/partner watch television, DVD/video together with your child?

- ☐₁ Never
☐₂ Less than once a week
☐₃ Once a week
☐₄ 2-4 days a week
☐₅ 5-6 days a week
☐₆ Every day, once a day
☐₇ Every day, more than once a day

E6. Is there internet connection available in your household?

- ☐₁ Yes
☐₂ No

Are the following devices available in your child's room?

| | Yes | No |
|--|---------------------------------------|---------------------------------------|
| E7. TV | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ |
| E8. DVD player | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ |
| E9. Game consoles i.e., Play Station | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ |
| E10. Computer | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ |

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➤ QUESTIONS ABOUT YOUR CHILD

In the following questions, when we say **SEDENTARY BEHAVIOUR** we mean:

All sitting and lying activities, such as television viewing, playing games on a computer, game consoles and quiet play (drawing, construction, dolls), looking into books

By screen viewing activities, we refer to the usual time spend in a range of activities including TV/DVD/Video, electronic games and recreational computer use per day.

About how many hours a day does your child usually watch television (including DVDs and videos) in his/her free time? (Please mark one box for weekdays and one box for weekend days)

| E11. Weekdays (average all weekdays) | E12. Weekend days (average per weekend days) |
|--|--|
| <input type="checkbox"/> ₁ Never | <input type="checkbox"/> ₁ Never |
| <input type="checkbox"/> ₂ Less than 30 minutes/day | <input type="checkbox"/> ₂ Less than 30 minutes/day |
| <input type="checkbox"/> ₃ 30 minutes to <1 hr/day | <input type="checkbox"/> ₃ 30 minutes to <1 hr/day |
| <input type="checkbox"/> ₄ 1- 2 hrs/ day | <input type="checkbox"/> ₄ 1- 2 hrs/ day |
| <input type="checkbox"/> ₅ 3-4 hrs/ day | <input type="checkbox"/> ₅ 3-4 hrs/ day |
| <input type="checkbox"/> ₆ 5-6 hrs/ day | <input type="checkbox"/> ₆ 5-6 hrs/ day |
| <input type="checkbox"/> ₇ 7-8 hrs/ day | <input type="checkbox"/> ₇ 7-8 hrs/ day |
| <input type="checkbox"/> ₈ 8 hrs/ day | <input type="checkbox"/> ₈ 8 hrs/ day |
| <input type="checkbox"/> ₉ More than 8 hrs/ day | <input type="checkbox"/> ₉ More than 8 hrs/ day |
| <input type="checkbox"/> ₁₀ I don't know | <input type="checkbox"/> ₁₀ I don't know |

About how many hours a day does your child use the computer for activities like playing games on a computer, game consoles (e.g. Playstation, Xbox, GameCube) during leisure time?

| E13. Weekdays (average all weekdays) | E14. Weekend days (average per weekend days) |
|--|--|
| <input type="checkbox"/> ₁ Never | <input type="checkbox"/> ₁ Never |
| <input type="checkbox"/> ₂ Less than 30 minutes/day | <input type="checkbox"/> ₂ Less than 30 minutes/day |
| <input type="checkbox"/> ₃ 30 minutes to <1 hr/day | <input type="checkbox"/> ₃ 30 minutes to <1 hr/day |
| <input type="checkbox"/> ₄ 1- 2 hrs/ day | <input type="checkbox"/> ₄ 1- 2 hrs/ day |
| <input type="checkbox"/> ₅ 3-4 hrs/ day | <input type="checkbox"/> ₅ 3-4 hrs/ day |
| <input type="checkbox"/> ₆ 5-6 hrs/ day | <input type="checkbox"/> ₆ 5-6 hrs/ day |
| <input type="checkbox"/> ₇ 7-8 hrs/ day | <input type="checkbox"/> ₇ 7-8 hrs/ day |
| <input type="checkbox"/> ₈ 8 hrs/ day | <input type="checkbox"/> ₈ 8 hrs/ day |
| <input type="checkbox"/> ₉ More than 8 hrs/ day | <input type="checkbox"/> ₉ More than 8 hrs/ day |
| <input type="checkbox"/> ₁₀ I don't know | <input type="checkbox"/> ₁₀ I don't know |

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About how many hours a day does your child have quiet play (looking into books, playing with blocks, playing with dolls, drawing, construction) during leisure time?

| E15. Weekdays (average all weekdays) | E16. Weekend days (average per weekend days) |
|--|--|
| <input type="checkbox"/> ₁ Never | <input type="checkbox"/> ₁ Never |
| <input type="checkbox"/> ₂ Less than 30 minutes/day | <input type="checkbox"/> ₂ Less than 30 minutes/day |
| <input type="checkbox"/> ₃ 30 minutes to <1 hr/day | <input type="checkbox"/> ₃ 30 minutes to <1 hr/day |
| <input type="checkbox"/> ₄ 1- 2 hrs/ day | <input type="checkbox"/> ₄ 1- 2 hrs/ day |
| <input type="checkbox"/> ₅ 3-4 hrs/ day | <input type="checkbox"/> ₅ 3-4 hrs/ day |
| <input type="checkbox"/> ₆ 5-6 hrs/ day | <input type="checkbox"/> ₆ 5-6 hrs/ day |
| <input type="checkbox"/> ₇ 7-8 hrs/ day | <input type="checkbox"/> ₇ 7-8 hrs/ day |
| <input type="checkbox"/> ₈ 8 hrs/ day | <input type="checkbox"/> ₈ 8 hrs/ day |
| <input type="checkbox"/> ₉ More than 8 hrs/ day | <input type="checkbox"/> ₉ More than 8 hrs/ day |
| <input type="checkbox"/> ₁₀ I don't know | <input type="checkbox"/> ₁₀ I don't know |

Please read the following statements and tick the boxes most appropriate to your situation:

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| E17. I think screen viewing activities are beneficial and educational for my child | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| E18. My child likes to watch TV/DVD/ Video | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| E19. My child prefers to watch TV for a long time instead of doing other activities | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| E20. I find it difficult to limit my child's screen viewing activities if he/she does not want to and starts nagging | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| E21. I like watching TV/DVD/Video together with my child | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| E22. I make sure that there are other activities available for my child to do instead of screen viewing | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| E23. My child does not like to do activities while standing up | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| E24. My child's TV viewing levels are within the appropriate recommendations | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| E25. I think it is necessary to limit the screen viewing activities for my child | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |

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3. González-Gil EM, Mouratidou T, Cardon G et al. Reliability of primary caregivers reports on lifestyle behaviours of European preschool children. The ToyBox-study. Obes Rev. 2014 Aug;15 Suppl S3:61-66. doi: 10.1111/obr.12184.

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| E26. I encourage my child to do something else instead of watching TV/DVD/Video | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| E27. It is a habit to organise my family so that we can see programs we like at TV | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| E28. I try to restrain myself from watching TV/DVD/Video while my child is present | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| E29. My child is allowed to watch TV for as long as he/she wants | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| E30. I punish my child by forbidding him/her to watch TV | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| E31. I do not think it is necessary to limit TV viewing for my child if he/she look at the appropriate children programs | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| E32. I am pleased with my child's screen viewing activities | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |

E33. I think that the recommendation for TV VIEWING for 4-6 year old children is:

- ☐₁ Not to watch television at all
☐₂ To watch television not more than a few times per week
☐₃ To watch television for maximum 1 hour per day
☐₄ To watch television for 1 to 2 hour per day
☐₅ To watch television for 3 to 4 hours per day
☐₆ To watch television for 5 to 6 hours per day
☐₇ To watch television for 7 to 8 hours per day
☐₈ To watch television for more than 8 hours per day
☐₉ To watch television as often as he/she likes
☐₁₀ I don't know

How often does your child watch television during the following meals?

| | Never | Rarely | Sometimes | Often | Always |
|-----------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| E34. Breakfast | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| E35. Morning snack | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| E36. Lunch | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| E37. Afternoon snack | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| E38. Dinner | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| E39. Evening snack | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |

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F. General questions about your child
Please answer the following questions only for your child who brought the questionnaire from school



| | | | |
|---|--|--|--|
| F1. Pre-gestational maternal weight (2-3 months prior to conception) | Please specify <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> (kg) | | |
| F2. How much weight (kg) did the mother gain during pregnancy? | Please specify <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> (kg) | | |
| F3. Was the gestation multiparous? | <input type="checkbox"/> ₁ No <input type="checkbox"/> ₂ Yes, carrying <input type="text"/> children | | |
| F4. Weeks of gestation (max 40 weeks) | Please specify <input type="text"/> <input type="text"/> weeks | | |
| Smoking during gestation | F5. 1st trimester | F6. 2nd trimester | F7. 3rd trimester |
| | <input type="checkbox"/> ₁ No <input type="checkbox"/> ₂ Yes F5.1. If yes, give number of cigarettes <input type="text"/> <input type="text"/> per day | <input type="checkbox"/> ₁ No <input type="checkbox"/> ₂ Yes F5.2. If yes, give number of cigarettes <input type="text"/> <input type="text"/> per day | <input type="checkbox"/> ₁ No <input type="checkbox"/> ₂ Yes F5.3. If yes, give number of cigarettes <input type="text"/> <input type="text"/> per day |

Please record the weight and length of your child at birth and performed on the 6th, 7th, 11th and 12th month of your child's life (please have a look at the recorded infant's growth chart/medical record)



| | Weight (kg) | Length (cm) |
|----------------------|--|---|
| F8. At birth | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> (kg) | <input type="text"/> <input type="text"/> <input type="text"/> (cm) |
| F9. Month 6 | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> (kg) | <input type="text"/> <input type="text"/> <input type="text"/> (cm) |
| F10. Month 7 | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> (kg) | <input type="text"/> <input type="text"/> <input type="text"/> (cm) |
| F11. Month 11 | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> (kg) | <input type="text"/> <input type="text"/> <input type="text"/> (cm) |
| F12. Month 12 | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> (kg) | <input type="text"/> <input type="text"/> <input type="text"/> (cm) |

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Breastfeeding and nutrition over the first 12 months of your child's life

| Please tick ✓ all the months during which the child systematically received breastfeeding: | | | | | | | | | | | | | |
|--|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|--|--|--|--|
| | 1 st | 2 nd | 3 rd | 4 th | 5 th | 6 th | 7 th | 8 th | 9 th | 10 th | 11 th | 12 th | >12th |
| F13. Breastfeeding | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ | <input type="checkbox"/> ₈ | <input type="checkbox"/> ₉ | <input type="checkbox"/> ₁₀ | <input type="checkbox"/> ₁₁ | <input type="checkbox"/> ₁₂ | <input type="checkbox"/> ₁₃ |

| At which month did you introduce in your child's routine diet the following (Please tick ✓ only the month of introduction): | | | | | | | | | | | | | |
|---|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|--|--|--|--|
| | 1 st | 2 nd | 3 rd | 4 th | 5 th | 6 th | 7 th | 8 th | 9 th | 10 th | 11 th | 12 th | >12th |
| F14. Formula milk | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ | <input type="checkbox"/> ₈ | <input type="checkbox"/> ₉ | <input type="checkbox"/> ₁₀ | <input type="checkbox"/> ₁₁ | <input type="checkbox"/> ₁₂ | <input type="checkbox"/> ₁₃ |
| F15. Tea, chamomile (e.g. for baby colic) | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ | <input type="checkbox"/> ₈ | <input type="checkbox"/> ₉ | <input type="checkbox"/> ₁₀ | <input type="checkbox"/> ₁₁ | <input type="checkbox"/> ₁₂ | <input type="checkbox"/> ₁₃ |
| F16. Liquid food (e.g. diluted fruit juice) | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ | <input type="checkbox"/> ₈ | <input type="checkbox"/> ₉ | <input type="checkbox"/> ₁₀ | <input type="checkbox"/> ₁₁ | <input type="checkbox"/> ₁₂ | <input type="checkbox"/> ₁₃ |
| F17. Solid and semi-solid food (e.g. farin lactee, vanilla cream, biscuit cream, fruit cream, vegetable soup) | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ | <input type="checkbox"/> ₆ | <input type="checkbox"/> ₇ | <input type="checkbox"/> ₈ | <input type="checkbox"/> ₉ | <input type="checkbox"/> ₁₀ | <input type="checkbox"/> ₁₁ | <input type="checkbox"/> ₁₂ | <input type="checkbox"/> ₁₃ |

THANK YOU VERY MUCH FOR FILLING IN THE QUESTIONNAIRE!

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FFQ questionnaire



| Country code | School number | Class number | Code number |
|----------------------|----------------------|----------------------|----------------------|
| <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |

Food Frequency Questionnaire for Young Children

We would like you to describe the child's usual food habits over the last 12 months. Therefore it is important that this questionnaire is completed by the person who spends most of the time with the child (beyond the school time). This should include all main meals, snacks, and drinks consumed during this period. You should also include any foods and drinks your child consumed outside home, including at the nursery, at out of school clubs, at restaurants or cafes or with other family members.

1. Meal patterns

Please, mark with a ✓ the most appropriate choice which describes how often the child consumes the following meals:

Note: A drink alone (e.g. a cup of milk, a piece of fruit or one chocolate) cannot be considered as a meal.

| How often does the child consume | (almost) never | 1-3 times a month | 1 day a week | 2-4 days a week | 5-6 days a week | Every day |
|--|-------------------|----------------------|-----------------|--------------------|--------------------|-----------|
| Breakfast | | | | | | |
| Lunch | | | | | | |
| Dinner | | | | | | |

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2. How to complete the questionnaire

Please take a few minutes to read the instructions carefully. The following table provides an example:

1. The **first column** presents the food groups most commonly consumed by children. Specific examples of food groups and in some cases food brands are provided.
2. The **second column** provides the options of the monthly/weekly frequency with which the child is consuming the respective food group. You need to fill in this column by marking the circle next to the most appropriate answer.
3. You need to fill in the **third column** by marking the circle next to the answer that better describes the average (usual) consumption of your child for each food group **per day of consumption**.
4. To estimate the amounts of foods please refer to the **fourth column** which provides a number of directive weights and measures. Options provided are in grams for solid and mls for liquid food. The **food photographs appendix** present you with characteristic food portion sizes (e.g. a typical orange or slice of cheese) or most usually used containers (e.g. various sizes of glasses). You can refer to these photos in order to be assisted in estimating/calculating your child's consumption.
5. For certain food groups you need to fill in **column five** which includes options on most frequently used types of the specified food item.

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Example

If the child consumes one bowl of cereals without added sugar every day, two beakers of chocolate milk 5-6 times a week, two pieces of fruit every day i.e., one medium banana and a small apple, but never or less than once a month eats 4 fried fish fingers, your answers should look like this:

| 1. Food groups | 2. How often does the child consume the following foods? | 3. and which is the AVERAGE AMOUNT PER DAY? | 4. Example of portion size | 5. Mark an X on the most common choice |
|--|---|--|---|--|
| Breakfast cereals (without added sugar) Porridge (Quaker), Shreddies, Rice Krispies, Weetabix | <input type="radio"/> ₁ Never or less than once a month <input type="radio"/> ₂ 1-3 days a month <input type="radio"/> ₃ 1 day a week <input type="radio"/> ₄ 2-4 days a week <input type="radio"/> ₅ 5-6 days a week <input checked="" type="radio"/> ₆ Every day | <input type="radio"/> ₁ 15 g or less <input checked="" type="radio"/> ₂ between 15 g to 45g <input type="radio"/> ₃ 45g or more | <i>1 bowl of cereals = 30– 40g</i> <i>1 individual box = 30– 40g</i> <i>1 tablespoon = 10g</i> <i>For examples of different portion sizes consult Appendix</i> | <input type="radio"/> ₁ with added sugar <input checked="" type="radio"/> ₂ without added sugar |
| Sugared or chocolate milk (e.g. MILKO) | <input type="radio"/> ₁ Never or less than once a month <input type="radio"/> ₂ 1-3 days a month <input type="radio"/> ₃ 1 day a week <input type="radio"/> ₄ 2-4 days a week <input checked="" type="radio"/> ₅ 5-6 days a week <input type="radio"/> ₆ Every day | <input type="radio"/> ₁ 100 ml or less <input type="radio"/> ₂ between 100 to 200 ml <input type="radio"/> ₃ between 200 to 300 ml <input type="radio"/> ₄ between 300 to 400 ml <input checked="" type="radio"/> ₅ between 400 to 500 ml <input type="radio"/> ₆ between 500 to 600 ml <input type="radio"/> ₇ between 600 to 700 ml <input type="radio"/> ₈ between 700 to 800 ml <input type="radio"/> ₉ between 800 to 900 ml <input type="radio"/> ₁₀ between 900 to 1000ml <input type="radio"/> ₁₁ 1000 ml or more | <i>1 carton = 200ml/ 500ml</i> <i>1 bottle = 330 ml/ 500ml</i> <i>1 glass = 250ml</i> <i>1 beaker = 225 ml</i> <i>For the size of glasses, cups and cartons consult the food photographs appendix</i> | |
| Fresh fruit | <input type="radio"/> ₁ Never or less than once a month <input type="radio"/> ₂ 1-3 days a month <input type="radio"/> ₃ 1 day a week <input type="radio"/> ₄ 2-4 days a week <input type="radio"/> ₅ 5-6 days a week <input checked="" type="radio"/> ₆ Every day | <input type="radio"/> ₁ 30g or less <input type="radio"/> ₂ between 30 to 60g <input type="radio"/> ₃ between 60 to 90g <input type="radio"/> ₄ between 90 to 120g <input type="radio"/> ₅ between 120 to 150g <input type="radio"/> ₆ between 150 to 180g <input type="radio"/> ₇ between 180 to 210g <input checked="" type="radio"/> ₈ between 210 to 240g <input type="radio"/> ₉ between 240 to 270g <input type="radio"/> ₁₀ 270g or more | <i>1 kiwi = 75 g</i> <i>1 orange = 140 g</i> <i>1 mandarin = 60 g</i> <i>1 small apple = 125 g</i> <i>Other fruit = 130 g</i> <i>1 medium banana = 90 g</i> <i>10 grapes = 20 g</i> <i>1 cup of melon/ watermelon = 150 g</i> <i>5 strawberries = 50 g</i> <i>For examples of different kinds of fresh fruit consult the food photographs appendix</i> | |

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| 1. Food groups | 2. How often does the child consume the following foods? | 3. and which is the AVERAGE AMOUNT PER DAY? | 4. Example of portion size | 5. Mark an X on the most common choice |
|--|--|--|--|---|
| Fish and sea food (fresh or frozen fish, fish fingers, shellfish) | X₁ Never or less than once a month ○ ₂ 1-3 days a month ○ ₃ 1 day a week ○ ₄ 2-4 days a week ○ ₅ 5-6 days a week ○ ₆ Every day | ○ ₁ 25g or less ○ ₂ between 25 to 50g ○ ₃ between 50 to 75g ○ ₄ between 75 to 90g ○ ₅ between 90 to 115g X₆ 115g or more | <i>1 herring = 80g</i> <i>4 tablespoon shrimps = 80g</i> <i>1 fillet of fresh cod = 200g</i> <i>1 fish finger = 30g</i> <i>For examples of different kinds and portion sizes of fish and seafood consult the food photographs appendix</i> | ○ ₁ Grilled or barbequed or boiled X₂ Fried |

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| Food groups | How often does your child consume the following products? | and what is the average amount per day? | Example portion sizes | Choose the one most frequently used |
|---|--|--|--|-------------------------------------|
| Juice and other drinks | | | | |
| Water (not in other drinks) | <ul style="list-style-type: none"> ○ 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 ○ every day | <ul style="list-style-type: none"> ○ 100 ml or less ○ between 100 and 200 ml ○ between 200 and 300 ml ○ between 300 and 400 ml ○ between 400 and 500 ml ○ between 500 and 600 ml ○ between 600 and 700 ml ○ between 700 and 800 ml ○ between 800 and 900 ml ○ between 900 and 1000 ml ○ 1000 ml or more | <i>1 beaker = 225 ml</i> <i>1 small plastic bottle= 500ml</i> <i>For glass and cup sizes please see Appendix.</i> | |
| Sugared beverages <i>(Coca Cola, Pepsi, Fanta, Sprite, Nestea)</i> | <ul style="list-style-type: none"> ○ 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 ○ every day | <ul style="list-style-type: none"> ○ 100 ml or less ○ between 100 and 200 ml ○ between 200 and 300 ml ○ between 300 and 400 ml ○ between 400 and 500 ml ○ between 500 and 600 ml ○ between 600 and 700 ml ○ between 700 and 800 ml ○ between 800 and 900 ml ○ between 900 and 1000 ml ○ 1000 ml or more | <i>1 beaker = 225 ml</i> <i>1 can= 330ml</i> <i>1 small plastic bottle= 500ml</i> <i>For glass and cup sizes please see Appendix.</i> | |

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| Food groups | How often does your child consume the following products? | and what is the average amount per day? | Example portion sizes | Choose the one most frequently consumed |
|---|--|--|--|---|
| Light beverages <i>(Cola light, Coca cola zero, Pepsi max, Fanta zero)</i> | <ul style="list-style-type: none"> ○ 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 ○ every day | <ul style="list-style-type: none"> ○ 100 ml or less ○ between 100 and 200 ml ○ between 200 and 300 ml ○ between 300 and 400 ml ○ between 400 and 500 ml ○ between 500 and 600 ml ○ between 600 and 700 ml ○ between 700 and 800 ml ○ between 800 and 900 ml ○ between 900 and 1000 ml ○ 1000 ml or more | <i>1 beaker = 225 ml</i> <i>1 can = 330ml</i> <i>1 small plastic bottle = 500ml</i> <i>For glass and cup sizes please see Appendix.</i> | |
| Fruit juice, home-made, freshly squeezed | <ul style="list-style-type: none"> ○ 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 ○ every day | <ul style="list-style-type: none"> ○ 100 ml or less ○ between 100 and 200 ml ○ between 200 and 300 ml ○ between 300 and 400 ml ○ between 400 and 500 ml ○ between 500 and 600 ml ○ between 600 and 700 ml ○ between 700 and 800 ml ○ between 800 and 900 ml ○ between 900 and 1000 ml ○ 1000 ml or more | <i>1 beaker = 225 ml</i> <i>For glass and cup sizes please see Appendix.</i> | |

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| Food groups | How often does your child consume the following products? | and what is the average amount per day? | Example portion sizes | Choose the one most frequently consumed |
|---|--|--|--|---|
| Fruit juice, pre-packed/ bottled <i>(Don Simon, Juver/Disfruta, own brands (marcas blancas))</i> | <ul style="list-style-type: none"> ○ 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 ○ every day | <ul style="list-style-type: none"> ○ 100 ml or less ○ between 100 and 200 ml ○ between 200 and 300 ml ○ between 300 and 400 ml ○ between 400 and 500 ml ○ between 500 and 600 ml ○ between 600 and 700 ml ○ between 700 and 800 ml ○ between 800 and 900 ml ○ between 900 and 1000 ml ○ 1000 ml or more | <i>1 beaker = 225 ml</i> <i>1 small plastic bottle= 500ml</i> <i>1 carton= 1l</i> <i>For glass, cup and carton sizes please see Appendix.</i> | |
| Tea <i>(herbal tea, black tea, green tea, chamomile, etc)</i> | <ul style="list-style-type: none"> ○ 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 ○ every day | <ul style="list-style-type: none"> ○ 100 ml or less ○ between 100 and 200 ml ○ between 200 and 300 ml ○ between 300 and 400 ml ○ between 400 and 500 ml ○ between 500 and 600 ml ○ between 600 and 700 ml ○ between 700 and 800 ml ○ between 800 and 900 ml ○ between 900 and 1000 ml ○ 1000 ml or more | <i>1 beaker = 225 ml</i> <i>For glass and cup sizes please see Appendix.</i> | <ul style="list-style-type: none"> ○ with sugar ○ without sugar |

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| Food groups | How often does your child consume the following products? | and what is the average amount per day? | Example portion sizes | Choose the one most frequently consumed |
|---|--|--|--|--|
| Smoothies (all kinds) (Solo Fruta (Hero), FruitSimply (Sunnydelight), Invo smoothie) | <ul style="list-style-type: none"> ○ 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 ○ every day | <ul style="list-style-type: none"> ○ 100 ml or less ○ between 100 and 200 ml ○ between 200 and 300 ml ○ between 300 and 400 ml ○ between 400 and 500 ml ○ between 500 and 600 ml ○ between 600 and 700 ml ○ between 700 and 800 ml ○ between 800 and 900 ml ○ between 900 and 1000 ml ○ 1000 ml or more | <i>1 beaker = 225 ml</i> <i>1 can= 330ml</i> <i>1 carton=1l</i> <i>1 small plastic bottle= 500ml</i> <i>For glass and cup sizes please see Appendix.</i> | |
| Milk, yogurt and cheese | | | | |
| Plain milk | <ul style="list-style-type: none"> ○ 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 ○ every day | <ul style="list-style-type: none"> ○ 100 ml or less ○ between 100 and 200 ml ○ between 200 and 300 ml ○ between 300 and 400 ml ○ between 400 and 500 ml ○ between 500 and 600 ml ○ between 600 and 700 ml ○ between 700 and 800 ml ○ between 800 and 900 ml ○ between 900 and 1000 ml ○ 1000 ml or more | <i>1 beaker = 225 ml</i> <i>1 small plastic bottle= 500ml</i> <i>For glass, cup and carton sizes please see Appendix.</i> | <ul style="list-style-type: none"> ○ Full fat ○ Semi skimmed ○ Skimmed ○ Fortified/ enriched (e.g. with calcium,iron,vitamins) |

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| Food groups | How often does your child consume the following products? | and what is the average amount per day? | Example portion sizes | Choose the one most frequently consumed |
|--|--|--|---|---|
| Sugared or chocolate milk (Puleva, Central Lechera Asturiana, own brands) | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day | <input type="radio"/> 100 ml or less <input type="radio"/> between 100 and 200 ml <input type="radio"/> between 200 and 300 ml <input type="radio"/> between 300 and 400 ml <input type="radio"/> between 400 and 500 ml <input type="radio"/> between 500 and 600 ml <input type="radio"/> between 600 and 700 ml <input type="radio"/> between 700 and 800 ml <input type="radio"/> between 800 and 900 ml <input type="radio"/> between 900 and 1000 ml <input type="radio"/> 1000 ml or more | <i>1 beaker = 225 ml</i> <i>1 can = 200ml</i> <i>1 small plastic bottle = 300ml</i> <i>1 large plastic bottle = 500ml</i> <i>For glass, cup and carton sizes please see Appendix.</i> | |
| Plain yoghurt (without sugar addition, with artificially sweetened yoghurt) (Danone, Danonino, Petit-suisse, own brands) | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day | <input type="radio"/> 65 g or less <input type="radio"/> between 65 and 195 g <input type="radio"/> 195 g or more | <i>1 cup = 125 mg</i> <i>1 petit-suisse = 50 g</i> <i>For cup, bowl and pot sizes please see Appendix</i> | <input type="radio"/> Strained <input type="radio"/> Full fat <input type="radio"/> Semi skimmed <input type="radio"/> Skimmed <input type="radio"/> Fortified/enriched (e.g. with calcium, iron, vitamins) <input type="radio"/> Children's yoghurt |
| Fruit, sugared or aromatised yoghurt (fruit yoghurt, yoghurt where you yourself add the sugar, ...) (Danone, Danonino, Petit-suisse, own brands) | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day | <input type="radio"/> 65 g or less <input type="radio"/> between 65 and 195 g <input type="radio"/> 195 g or more | <i>1 cup = 125 mg</i> <i>1 petit-suisse = 50 g</i> <i>For cup, bowl and pot sizes please see Appendix</i> | <input type="radio"/> Full fat <input type="radio"/> Semi skimmed <input type="radio"/> Skimmed <input type="radio"/> Fortified/enriched (e.g. with calcium, iron, vitamins) <input type="radio"/> Children's yoghurt |
| Cheese [Cheese spread/ melt cheese (fondue, melt cheese slices), Gouda, Emmental, Gruyère, Cottage cheese, feta cheese] | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day | <input type="radio"/> 10 g or less <input type="radio"/> between 10 and 20 g <input type="radio"/> between 20 and 30 g <input type="radio"/> between 30 and 40 g <input type="radio"/> between 40 and 50 g <input type="radio"/> 50 g or more | <i>1 triangle = 20 g</i> <i>1 slice of cheese (10 by 10 cm) = 25 g</i> <i>1 tablespoon grated cheese = 10g</i> | |

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| Food groups | How often does your child consume the following products? | and what is the average amount per day? | Example portion sizes | Choose the one most frequently consumed |
|-------------------------------------|--|--|--|---|
| <i>Fruits and vegetables</i> | | | | |
| Dried fruit | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day | <input type="radio"/> 1 tablespoon <input type="radio"/> 1 - 3 tablespoons <input type="radio"/> 3 tablespoons | <i>1 tablespoon dried fruit (~20gr)</i> <i>-2 dried figs</i> <i>-40 raisins</i> <i>-2 dried prunes</i> | |
| Canned fruit | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day | <input type="radio"/> 35 g or less <input type="radio"/> between 35 and 70 g <input type="radio"/> between 70 and 105 g <input type="radio"/> between 105 and 140 g <input type="radio"/> between 140 and 175 g <input type="radio"/> 175 g or more | <i>1 slice canned pine-apple=35 g</i> <i>10 canned black cherries= 90 g</i> <i>1 half apricot canned with syrup = 17 g</i> | |
| Fresh fruit | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day | <input type="radio"/> 30 g or less <input type="radio"/> between 30 and 60 g <input type="radio"/> between 60 and 90 g <input type="radio"/> between 90 and 120 g <input type="radio"/> between 120 and 150 g <input type="radio"/> between 150 and 180 g <input type="radio"/> between 180 and 210 g <input type="radio"/> between 210 and 240 g <input type="radio"/> between 240 and 270 g <input type="radio"/> 270 g or more | <i>1 kiwi = 75 g</i> <i>1 orange = 140 g</i> <i>1 mandarin orange= 60 g</i> <i>1 small apple = 125 g</i> <i>other fruit = 130 g</i> <i>1 medium banana= 90gr</i> <i>10 grapes= 20g</i> <i>1 cup melon/watermelon= 150g</i> <i>5 strawberries= 50g</i> <i>For examples of different types of fresh fruit , please see Appendix</i> | |

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| Food groups | How often does your child consume the following products? | and what is the average amount per day? | Example portion sizes | Choose the one most frequently consumed |
|---|--|--|--|---|
| Raw Vegetables | <ul style="list-style-type: none"> ○ 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 ○ every day | <ul style="list-style-type: none"> ○ 30 g or less ○ between 30 and 60 g ○ between 60 and 90 g ○ between 90 and 120 g ○ between 120 and 150 g ○ between 150 and 180 g ○ between 180 and 210 g ○ between 210 and 240 g ○ between 240 and 270 g ○ 270 g or more | <p>1 tablespoon carrots = 20 g 1 tomato = 150 g 1 tablespoon shredded lettuce or cabbage= 10g</p> <p><i>For examples of different types of raw vegetables, please see Appendix</i></p> | |
| Cooked Vegetables (steamed, boiled, grilled, stewed) | <ul style="list-style-type: none"> ○ 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 ○ every day | <ul style="list-style-type: none"> ○ 30 g or less ○ between 30 and 60 g ○ between 60 and 90 g ○ between 90 and 120 g ○ between 120 and 150 g ○ between 150 and 180 g ○ between 180 and 210 g ○ between 210 and 240 g ○ between 240 and 270 g ○ 270 g or more | <p>1 tablespoon prepared vegetables = 30 g</p> <p><i>For examples of different types of cooked vegetables, please see Appendix</i></p> | |
| Chocolate | | | | |
| Chocolate (plain chocolate bar, chocolate bar with almonds, hazelnuts or other nuts, candy bars such as Mars, Twix, Bounty, Snickers, Milky Way, Huevo Kinder, Kinder Bueno etc) | <ul style="list-style-type: none"> ○ 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 ○ every day | <ul style="list-style-type: none"> ○ 25 g or less ○ between 25 and 50 g ○ between 50 and 75 g ○ between 75 and 100 g ○ between 100 and 125 g ○ 125 g or more | <p>1 large chocolate bar= 100g 1 medium chocolate bar=50gr 1 small chocolate bar=25-30gr 1 slice/ small chocolate= 10g 1candy bar (e.g. Mars, Twix)=60g 1 kinder surprise egg= 22g</p> <p><i>For examples of different types of chocolate, please see Appendix</i></p> | |

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| Food groups | How often does your child consume the following products? | and what is the average amount per day? | Example portion sizes | Choose the one most frequently consumed |
|---|--|--|---|---|
| Desserts | | | | |
| Dairy-based desserts <i>(Chocolate mousse (e.g Danone), ice cream (e.g. Magnum Frigo)/ ice lolly, puddings, rice pudding, custard)</i> | <ul style="list-style-type: none"> ○ 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 ○ every day | <ul style="list-style-type: none"> ○ 50 g or less ○ between 50 and 100 g ○ between 100 and 150 g ○ between 150 and 200 g ○ 200 g or more | <i>1 ball of ice cream = 50 g</i> <i>For cup, bowl and pot sizes please see Appendix</i> | |
| Biscuits, cakes and pastries | | | | |
| Cakes <i>(plain vanilla cake, fruit cake, jam cake, chocolate cake, etc) e.g. Kinder delice, Bollycao, Donut, Phoskitos/Tigretón)</i> | <ul style="list-style-type: none"> ○ 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 ○ every day | <ul style="list-style-type: none"> ○ 35 g or less ○ between 35 and 70 g ○ between 70 and 105 g ○ between 105 and 140 g ○ between 140 and 175 g ○ between 175 and 210 g ○ between 210 and 245 g ○ 245 g or more | <i>For examples of different types of cakes and cake sizes please see Appendix.</i> | |
| Biscuits <i>(butter biscuits, sandwich crème biscuits, whole grain biscuits, Digestive, shortbread, etc, e.g. galletas María, Chiquilin, Principe)</i> | <ul style="list-style-type: none"> ○ 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 ○ every day | <ul style="list-style-type: none"> ○ 15 g or less ○ between 15 g and 30 g ○ between 30 g and 45 g ○ between 45 g and 60 g ○ 60 g or more | <i>1 plain biscuit = 7 g</i> <i>1 chocolate biscuit (type Prince)= 20 g</i> | |
| Pastries <i>(croissants, fruit tarts and pies, waffles, pancakes, custard cream pies, etc, e.g. magdalenas, napolitanas, croissants)</i> | <ul style="list-style-type: none"> ○ 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 ○ every day | <ul style="list-style-type: none"> ○ 35 g or less ○ between 35 and 70 g ○ between 70 and 105 g ○ between 105 and 140 g ○ between 140 and 175 g ○ between 175 and 210 g ○ between 210 and 245 g ○ 245 g or more | <i>1 Belgian waffle= 50 g</i> <i>1 chocolate croissant= 95g</i> <i>1 piece of apple tart= 150g</i> <i>1 piece of custard cream pie= 200g</i> | |

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| Food groups | How often does your child consume the following products? | and what is the average amount per day? | Example portion sizes | Choose the one most frequently consumed |
|--|--|--|---|---|
| Sugar-based desserts (jelly beans, gummy, lollipops, hard candies, lokum) | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day | <input type="radio"/> 5 g or less <input type="radio"/> between 5 and 10 g <input type="radio"/> between 10 and 15 g <input type="radio"/> between 15 and 20 g <input type="radio"/> between 20 and 25 g <input type="radio"/> between 25 and 30 g <input type="radio"/> between 30 and 35 g <input type="radio"/> 35 g or more | <i>1 jelly bean=1g</i> <i>1 lollipop=6g</i> <i>1 hard candy=6g</i> <i>1 small lokum=15g</i> | |
| Breakfast cereals | | | | |
| Unsweetened breakfast cereals (<i>Corn Flakes, Weetabix, Muesli Krispies</i>) | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day | <input type="radio"/> 15 g or less <input type="radio"/> between 15 and 45 g <input type="radio"/> 45 g or more | <i>1 bowl cereals = 30 g</i> <i>1 individual box= 30 g</i> <i>1 tablespoon= 10g</i> <i>For examples of different portion sizes, please see Appendix</i> | <input type="radio"/> with added sugar <input type="radio"/> without added sugar |
| Sweetened breakfast cereals (<i>Frosties, Pops, Cruesli, ChocoKrispies</i>) | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day | <input type="radio"/> 15 g or less <input type="radio"/> between 15 and 45 g <input type="radio"/> 45 g or more | <i>1 bowl cereals = 30 g</i> <i>1 individual box= 30 g</i> <i>1 tablespoon= 10g</i> <i>1 cereal bar=24g</i> <i>For examples of different portion sizes, please see Appendix</i> | |
| Bread (including sandwiches and toast) | | | | |
| White bread and other bakery products (<i>Bread, rusk, crusted roll, french stick, Rice wafer, sandwich bread, toast</i>) | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day | <input type="radio"/> 30 g or less <input type="radio"/> between 30 and 60 g <input type="radio"/> between 60 and 90 g <input type="radio"/> between 90 and 120 g <input type="radio"/> between 120 g and 150 g <input type="radio"/> 150 g or more | <i>1 big slice of bread= 30 g</i> <i>1 small slice of bread= 20-25 g</i> <i>1 rusk = 10 g</i> <i>1 crusted roll= 40 g</i> <i>For examples of different portion sizes, please see Appendix</i> | |

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| Food groups | How often does your child consume the following products? | and what is the average amount per day? | Example portion sizes | Choose the one most frequently consumed |
|--|--|--|--|---|
| Brown or wholemeal bread and other bakery products (Bread, rusk, crusted roll, french stick, Rice wafer, sandwich bread, toast) | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day | <input type="radio"/> 30 g or less <input type="radio"/> between 30 and 60 g <input type="radio"/> between 60 and 90 g <input type="radio"/> between 90 and 120 g <input type="radio"/> 120 g or more | <i>1 big slice of bread = 30 g</i> <i>1 small slice of bread = 20-25 g</i> <i>1 rusk = 10 g</i> <i>1 crusted roll = 40 g</i> <i>For examples of different portion sizes, please see Appendix</i> | |
| Savoury snacks | | | | |
| Salty snacks (Lays, Doritos, Ruffles, Pringles, Cheetos) | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day | <input type="radio"/> 25 g or less <input type="radio"/> between 25 and 75 g <input type="radio"/> 75 g or more | <i>1 small bag chips = 30 g</i> <i>1 Tuc biscuit = 3 g</i> <i>(1 package Tuc biscuits = 100 g)</i> <i>For examples of different types of salty snacks and portion sizes, please see Appendix</i> | |
| Meat, poultry and fish products | | | | |
| Meat and poultry (chops, steak, bovine, pork, poultry, burger, etc) | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day | <input type="radio"/> 25 g or less <input type="radio"/> between 25 and 50 g <input type="radio"/> between 50 and 75 g <input type="radio"/> between 75 and 90 g <input type="radio"/> between 90 and 115 g <input type="radio"/> 115 g or more | <i>1 chicken filet = 150 g</i> <i>1 chicken nugget = 25 g</i> <i>1 pork chop or 1 roast sausage (20 cm) or 1 large cutlet = 130 g</i> <i>1 steak = 175 g</i> <i>For examples of different types of meat and poultry and portion sizes, please see Appendix</i> | <input type="radio"/> Broiled, boiled, grilled <input type="radio"/> Fried |
| Fish and fish products (Fresh or frozen fish, fish fingers, shellfish) | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day | <input type="radio"/> 25 g or less <input type="radio"/> between 25 and 50 g <input type="radio"/> between 50 and 75 g <input type="radio"/> between 75 and 90 g <input type="radio"/> between 90 and 115 g <input type="radio"/> 115 g or more | <i>1 young herring = 80 g</i> <i>4 tablespoons shrimps = 80 g</i> <i>1 fresh cod filet = 200 g</i> <i>1 fishstick = 30 g</i> <i>For examples of different types of fish and portion sizes, please see Appendix</i> | <input type="radio"/> Broiled, boiled, grilled <input type="radio"/> Fried |

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| Food groups | How often does your child consume the following products? | and what is the average amount per day? | Example portion sizes | Choose the one most frequently consumed |
|--|--|---|--|---|
| Meat products <i>(ham, salami, pate, etc)</i> <i>(ONLY with cold meals and with bread)</i> | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day | <input type="radio"/> 15 g or less <input type="radio"/> between 15 and 30 g <input type="radio"/> between 30 and 45 g <input type="radio"/> between 45 and 60 g <input type="radio"/> 60 g or more | <i>15g spread on 1 slice of bread</i> <i>1 slice= 20g</i> | |
| Potatoes, rice and pasta | | | | |
| Pasta <i>(spaghetti, penne, lasagne, macaroni, etc)</i> | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day | <input type="radio"/> 75 g cooked or less <input type="radio"/> between 75 and 225g cooked <input type="radio"/> 225 g cooked or more | <i>50 g non-boiled pasta gives 125 g= 1 cup cooked pasta</i> <i>1 tablespoon boiled pasta = 25 g</i> <i>For examples of different portion sizes, please see Appendix</i> | <input type="radio"/> White pasta <input type="radio"/> whole pasta Which of the following types of sauce and how many tablespoons does the child consume per 1 cup of pasta? <input type="radio"/> with tomato sauce <input type="radio"/> with meat sauce <input type="radio"/> with cream sauce <input type="radio"/> with grated cheese <input type="radio"/> none of teaspoons |
| Rice | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day | <input type="radio"/> 75 g cooked or less <input type="radio"/> between 75 and 225g cooked <input type="radio"/> 225 g cooked or more | <i>40 g non-boiled rice gives 100g =1cup boiled rice</i> <i>1 tablespoon boiled rice =25g</i> <i>For examples of different portion sizes, please see Appendix</i> | <input type="radio"/> White rice <input type="radio"/> Brown rice |

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| Food groups | How often does your child consume the following products? | and what is the average amount per day? | Example portion sizes | Choose the one most frequently consumed |
|--|--|--|---|---|
| Deep- fried potato products (<i>French fries, croquettes, etc</i>) | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day | <input type="radio"/> 50 g or less <input type="radio"/> between 50 and 150 g <input type="radio"/> 150 g or more | 2 sliced potatoes or 3-4 croquettes or 20 frites =100g | |
| Potatoes (<i>boiled, steamed, baked, mashed, etc</i>) | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day | <input type="radio"/> 50 g cooked or less <input type="radio"/> between 50 and 100g cooked <input type="radio"/> between 100 and 150g cooked <input type="radio"/> between 150 and 200g cooked <input type="radio"/> 200 g cooked or more | 1 cooked potato (size of an egg)= 50g 1 tablespoon mashed potatoes = 50 g <i>For examples of different portion sizes, please see Appendix</i> | |
| Sugar, jam and other spreads | | | | |
| Chocolate spread/ other sweet spread (<i>Chocolate or praline spread, chocolate sprinkles, honey, jam/marmalade, maple syrup, etc, e.g. Nocilla, Nutella</i>) | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day | <input type="radio"/> 10 g or less <input type="radio"/> between 10 and 20 g <input type="radio"/> between 20 and 30 g <input type="radio"/> between 30 and 40 g <input type="radio"/> between 40 and 50 g <input type="radio"/> 50 g or more | 1 teaspoon= 5g 15 g for 1 large slice 10 g for 1 small slice | |
| Legumes dishes | | | | |
| Legumes (<i>White/red beans, chickpeas, lentils</i>) | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day | <input type="radio"/> 30 g or less <input type="radio"/> between 30 and 60 g <input type="radio"/> between 60 and 120 g <input type="radio"/> between 120 and 150 g <input type="radio"/> between 150 and 180 g <input type="radio"/> 180 g or more | 1 tablespoon of cooked legumes = 30 g | |

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1a. How often does your child eat something in between meals (apart from breakfast, lunch, dinner)

- ☐ 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
- ☐ every day

1b. Which of the following items does your child usually eat in between meals:

| | |
|-------------------------------------|---|
| <input type="radio"/> ₁ | Crisps and other similar salty snacks |
| <input type="radio"/> ₂ | Breakfast cereals |
| <input type="radio"/> ₃ | Cakes and sweet biscuits |
| <input type="radio"/> ₄ | Fruit (fresh, dried or tinned) |
| <input type="radio"/> ₅ | Vegetables (raw or cooked) |
| <input type="radio"/> ₆ | Bread, toast and similar items e.g. crumpets, muffins |
| <input type="radio"/> ₇ | Crispbread, crackers, breadsticks, rice cakes etc |
| <input type="radio"/> ₈ | Sweets or chocolate |
| <input type="radio"/> ₉ | Yoghurt, fromage frais etc |
| <input type="radio"/> ₁₀ | Other dairy products like cheese |
| <input type="radio"/> ₁₁ | Other (PLEASE SPECIFY) |
| <input type="radio"/> ₁₂ | Does not eat between meals |

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2a. How often does your child drink something in between meals (apart from breakfast, lunch, dinner)

- ☐ 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
- ☐ every day

2b. Which of the following items does your child drink in between meals:

| | |
|-------------------------------------|---|
| <input type="radio"/> ₁ | Water (not in other drinks e.g. not in soup) |
| <input type="radio"/> ₂ | Sugared beverages (soda drinks like cola, lemonade, ice tea, ...) |
| <input type="radio"/> ₃ | Light beverages (<i>light soda drinks, light cola, ...</i>) |
| <input type="radio"/> ₄ | Tea (herbal tea, black tea, green tea, chamomile, etc) |
| <input type="radio"/> ₅ | Smoothies (e.g. COUNTRY- SPECIFIC EXAMPLES) |
| <input type="radio"/> ₆ | Sugared or chocolate milk (e.g. COUNTRY- SPECIFIC EXAMPLES) |
| <input type="radio"/> ₇ | Plain milk |
| <input type="radio"/> ₈ | Fruit juice, home-made, freshly squeezed |
| <input type="radio"/> ₉ | Fruit juice, pre-packed/ bottled |
| <input type="radio"/> ₁₀ | Other (PLEASE SPECIFY) |
| <input type="radio"/> ₁₁ | Does not drink between meals |

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3. Lunch at school

Does your child eat lunch at school?

☐ yes ☐ no ☐ alternating

4. Supplements

| | |
|--|--|
| Does your child take any vitamins, minerals or other food supplements? | <input type="radio"/> never or less than once per month <input type="radio"/> 1-3 days per month <input type="radio"/> 1 day per week <input type="radio"/> 2-4 days per week <input type="radio"/> 5-6 days per week <input type="radio"/> every day |
|--|--|

If yes, please describe the supplements she or he takes

| Brand | Name (in full) including strength | Number of pills, capsules, teaspoons | How often does your child consume the supplement? |
|-------|-----------------------------------|--------------------------------------|---|
| | | | |
| | | | |
| | | | |

5. Who completed this food frequency Questionnaire?

- ☐ Father / Stepfather/ Male partner
☐ Mother / Stepmother/ Female partner
☐ other, specify,

Date .../.../....

Thank you very much for your willing cooperation!

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