

Title: ToyBox Study Malaysia: Improving healthy energy-balance and obesity-related behaviours among pre-schoolers in Malaysia

Running title: ToyBox Study Malaysia

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Abstract

The prevalence of childhood overweight and obesity is increasing in Malaysia and currently nearly 10% of children aged between 6 months and 12 years are overweight and almost 12% are obese. Early interventions to prevent excess weight gain are needed. *ToyBox Study Malaysia* is a feasibility project, funded by the Medical Research Council Newton-Ungku Omar Fund, to assess the practicalities of adapting the existing European *ToyBox Study* intervention programme to the Malaysian kindergarten setting. The main aims of all *ToyBox* programmes are related to improving four key energy-balance related behaviours, namely drinking water, eating healthy snacks and meals, reducing sedentary behaviour and increasing physical activity. Using stratified sampling, the *ToyBox Study Malaysia* intervention will be delivered and compared to usual practice by assessing behaviour, physical activity and health related outcomes as measured by questionnaires, accelerometry and anthropometry. It is hoped that the evidence-based *ToyBox Study Malaysia* will help to achieve healthier energy-balance related behaviours in the children and their families and provide lifelong benefits to health. This article provides information on the dietary patterns, physical activity levels and prevalence of overweight and obesity in Malaysian children, and the approach of the *ToyBox Study Malaysia*.

Keywords: obesity, children, pre-schoolers, healthy eating, energy balance, behaviour

Introduction

Childhood obesity is one of the most critical public health challenges around the world (NCD Risk Factor Collaboration 2017). Prevention of childhood obesity is an international issue because it has a direct impact on child health and wellbeing (WHO 2016) and increases risk of obesity in adulthood, which can cause obesity-related diseases, and psychological and socio-economic problems (Craigie *et al.* 2011).

Globally, in 2014 the number of overweight and obese children under the age of 5 years was estimated to be over 41 million (UNICEF *et al.* 2015). Lobstein *et al.* (2015) noted that, in most countries, where it has been recorded, the prevalence of childhood overweight and obesity has increased over the last three decades. In 2013 the prevalence of overweight and obesity in developed countries was reported to be as high as 23.8% of boys and 22.6% of girls (Ng *et al.* 2014). Globally, the NCD Risk Factor Collaboration (2017) reported that the age-standardised prevalence of obesity had increased from 0.7% of girls in 1975 to 5.6% in 2016, and in boys from 0.9% in 1975 to 7.8% in 2016.

In Malaysia, levels of childhood obesity have risen considerably over the last two decades (IPH 2011). In a Malaysian cross-sectional study, prevalence of overweight and obesity amongst children aged 6 to 12 years increased from 20.7% in 2002 to 26.4% in 2008 (Ismail *et al.* 2009). A more recent Malaysian nutrition survey, which assessed the nutritional status of a nationally representative sample ($n=3542$) of children aged 6 months to 12 years, reported that 9.8% of children were overweight and 11.8% were obese (Poh *et al.* 2013). Amongst pre-school children aged 4 to 6 years, the prevalence of overweight and obesity was 16% in urban cities and 17% in rural areas (Poh *et al.* 2013). Strategies to treat and prevent obesity are urgently required in Malaysia and it is now considered a public health priority (National

Coordinating Committee on Food and Nutrition 2016; MOH 2016a). A recent workshop entitled 'Addressing the Global Health Challenge in Malaysia' organised by The Academy of Medical Sciences and involving experts working in the obesity field from both international and national agencies, also emphasised the need for innovative solutions related to children's healthy lifestyles to prevent obesity (The Academy of Medical Sciences 2017).

Malaysia is a multicultural country that has been described as a food paradise (Raji *et al.* 2017). The diet is varied but meals are typically based on rice accompanied with a form of protein and vegetables. In the past, the Malaysian diet has been described as relatively low in energy density (Reeves & Henry 2000). However, it has been noted that intakes of energy, fats and sugars have increased with economic affluence (Ismail 2002) and over the last few decades, with greater levels of urbanisation and more eating outside of the home, dietary patterns have changed (Fournier *et al.* 2016). Despite an abundance of fruit grown locally, consumption of fruit and vegetables amongst adults has been reported to be very low compared with other countries (Yen *et al.* 2015). One recent study of Malaysian children aged 1-6 years reported that on average they consumed 0.91 and 1.07 servings of fruit and vegetables, respectively, per day, and that less than a fifth achieved the daily recommended servings of fruit and vegetables (Chong *et al.* 2017). Interventions to encourage the consumption of fruit and vegetables in Malaysia are warranted (Yen & Tan 2012). Sugars-sweetened beverages (SSB) are also popular, and readily available, often more so than drinking water. For example, in a study of Malaysian adolescents (Loh *et al.* 2017) mean SSB consumption was found to be on average 177.5 ml/day. This compares to 63 ml/day for Korean adolescents (Ha *et al.* 2016) and 127 ml/day for Australian children and adolescents (Clifton *et al.* 2011). In the past, sweetened condensed milks were commonly added to coffees and teas, and Malaysian adults were reported to consume around 30 g/day of

condensed milk, which contains 16 g of sugar (Amarra *et al.* 2016); today most people have replaced sweetened condensed milk with nutritionally similar but cheaper sweetened creamers. Children in Malaysia also frequently consume malted drinks with added sugar, particularly at breakfast time (Nurul-Fadhilah *et al.* 2013). Among children aged 6 to 12 years, it has been reported that 73.5% consumed malted drinks at least once a week (Mohammed *et al.* 2015).

Childhood obesity is a consequence of poor diet but also low physical activity levels and a sedentary lifestyle. A recent study assessed the physical activity levels of Malaysian children aged 7 to 12 years (Lee *et al.* 2014). Children ($n=1736$) representing all ethnic groups were recruited throughout Malaysia and their physical activity levels were assessed by questionnaire, and in a subsample by pedometers ($n=514$). Physical Activity Questionnaire scores and pedometer step counts were negatively associated with BMI, and screen time was positively associated with waist circumference. It was concluded that strategies aimed at promoting active living in Malaysian children should focus on not only increasing physical activity but also reducing sedentary behaviours. Correspondingly, the 2016 Malaysia Active Healthy Kids Report Card (Sharif *et al.* 2016) assessed data on physical activity in Malaysian children aged 5 to 17 years, and concluded that they were engaging in low levels of physical activity and had high levels of screen time. A study by Lee *et al.* (2016) that investigated physical activity patterns in Malaysian pre-schoolers ($n=835$) found that 40% of the children achieved the active play recommendation of at least two hours of physical activity per day for pre-schoolers; however, 27% exceeded the National Coordinating Committee on Food and Nutrition (2013) recommendation of less than two hours daily of screen time. This highlights the need for greater opportunities to promote physical activity and reduce sedentary activities amongst children in Malaysia.

Given that childhood obesity is increasing in many countries worldwide, there is a clear need for effective interventions that target infancy or early childhood and shift children towards a healthy weight trajectory (de Onis *et al.* 2010). School and kindergartens are a convenient environment for interventions (Waters *et al.* 2011), but research into strategies that aid parents in modifying their children's diet and activity levels is also necessary (Gibson *et al.* 2012; McSweeney *et al.* 2016). It is also useful to make teachers aware of how sedentary some children are during the kindergarten/school day, as they too can help deliver strategies to decrease sedentariness in the classroom and playground (De Decker *et al.* 2013). A Cochrane systematic review on diet, physical activity, and behavioral interventions for the treatment of overweight or obesity in preschool children up to the age of 6 years (Colquitt *et al.* 2016) concluded that interventions with multiple components appear to be the most effective treatment, though it was noted that current evidence is limited and may be subject to bias. The preschool years are a vital time for establishing healthy eating behaviours (Monasta *et al.* 2010) and the WHO has highlighted it as a critical period for obesity prevention (WHO 2012).

The ToyBox-Study Intervention

The original *ToyBox Study* intervention was developed with the aim of preventing obesity in pre-schoolers. It adopted a multifactorial evidence-based approach, underpinned by behavioural models to promote fun, recognition and consumption of healthy food, and play (Manios *et al.* 2012). The *ToyBox Study* focused on the promotion of water consumption, healthy snacking, physical activity and the reduction/breaking up of sedentary activities (Manios *et al.* 2014). The design of the original *ToyBox Study* intervention followed the

PRECEDE-PROCEED logical model (Green & Kreuter 2005) and incorporated intervention mapping to provide a stepwise strategy, and this has resulted in more than 30 peer-reviewed publications (full details about the design of the *Toybox Study* Intervention can be read here: Manios *et al.* 2012). The *ToyBox Study* is aimed at kindergarten-aged children, but also included their parents. The modules and the timing of the delivery of the modules are outlined in Figure 1. The *ToyBox Study* intervention has already been implemented in six European countries, namely Belgium, Bulgaria, Greece, Germany, Poland and Spain; so far 266 kindergartens and 8709 children and their families have participated. To date, the *ToyBox Study* intervention has never been trialled outside Europe; however, the design of the intervention does allow scope for minor amendments to take into account the policies, political structures, economic and cultural attitudes in different countries. Currently in Malaysia there are no other obesity prevention interventions aimed at the kindergarten age group; hence it was deemed appropriate to initiate a feasibility study for the application of this approach, namely *ToyBox Study Malaysia*.

ToyBox Study Malaysia

The *ToyBox Study Malaysia* is a collaboration between the University of Roehampton (UK), the University of Durham (UK), Universiti Kebangsaan (Malaysia) and Universiti Malaysia Sarawak (Malaysia) with support from Harokopio University (Greece). In line with the original *ToyBox Study* intervention, *ToyBox Study Malaysia* targets four key energy-balance related behaviours: 1) drinking water; 2) eating healthy snacks and meals; 3) reducing sedentary behaviour; and 4) increasing physical activity. The specific aims of *ToyBox Study Malaysia* are to: adapt the *ToyBox Study* programme for use in Malaysia, including translation into Bahasa

Malaysia and adapting the modules to local cultures; evaluate the feasibility of the intervention by assessing the acceptability of the *ToyBox Study* programme to parents and kindergarten teachers; and evaluate the adapted *ToyBox Study* programme through a pilot randomised controlled trial (RCT). This RCT will compare the effects of the *Toybox Study* programme to usual practice in kindergartens on physical activity and health-related behaviours and outcomes, measured by accelerometry, dietary intake, and anthropometry.

ToyBox Study Malaysia will specifically target kindergartens funded by Jabatan Kemajuan Masyarakat (KEMAS), the Community Development Department under the Ministry of Rural and Regional Development. A Theory of Change workshop with KEMAS officers, kindergarten teachers and parents will facilitate the development of a model for the implementation of the *ToyBox Study* in Malaysia. The intervention will run for 24 weeks across an entire kindergarten school year. To evaluate whether the intervention has altered children's health-related behaviours, measurements will be conducted at baseline, and post-intervention. Measurements recorded in this study will include children's height, weight, waist circumference, food intake (assessed with a food frequency questionnaire), and physical activity behaviour (using accelerometry), as well as feedback from teachers and parents.

To support the intervention, teachers will be encouraged to teach and promote the four key energy-balance related behaviours. Teachers and their assistants will be trained to conduct the *ToyBox Study* programme, with a 2-day Training of Teachers (TOT) session prior to the start of the programme, and two half-day TOT sessions at regular intervals to obtain feedback on the programme up to that point and to provide a refresher on the upcoming components. The intervention may require making changes to the classroom environment, for example establishing a drinking water station or clearing an area to make space for physical activities.

Teachers will be encouraged to run interactive classroom activities every day. A complete set of materials including equipment such as puppets, stories, ideas and equipment for fun active games (presented in a comprehensive Teachers' Guide) will be provided to help achieve the study aims and ensure consistency between settings. A field trip to a suitable location, such as a food manufacturing plant or a farm, will be organised to provide the children with real life experiences related to the key behaviours. Parents and caregivers will be encouraged to get involved and advised via newsletters and tip cards to apply relevant environmental changes at home, act as role models and implement the healthy lifestyle behaviours together with their children (Manios *et al.* 2014).

The main adaptation required to implement the *ToyBox Study Malaysia* is translation of all the materials. In addition, there are also some images that needed to be made more culturally relevant. For example, a picture showing a character stood next to a tap drinking a glass of water is to be changed by removing the image of the tap, as in Malaysia boiled or bottled water is usually recommended, and a story describing activities to do in the snow will be substituted with a story that reflects the warmer climate in Malaysia. Also, a component in the healthy food and snacks module, the Magic Snack Plate, will be replaced with the newly introduced Malaysian Healthy Plate (Figure 2), also known as #SukuSukuSeparuh or #QuarterQuarterHalf plate (MOH 2016b).

Engagement with key stakeholders including teachers, parents, people who prepare the food in the kindergartens, the Ministry of Health, the Community Development Department (KEMAS), and the Malaysian Association for the Study of Obesity (MASO), will ensure the *ToyBox Study Malaysia* intervention is culturally acceptable and that the study meets their expectations successfully.

Ultimately, it is hoped that the evidence-based *ToyBox Study Malaysia* intervention will help achieve healthier energy-balance related behaviours in kindergarten children and provide lifelong benefits to health. The results and lessons learned may be of benefit to governmental bodies, other researchers as well as the general public. In the longer term it is believed that these changes have the potential to bring benefits to the economy through better health, greater productivity and reduced healthcare costs.

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Conflict of Interest

The authors declare no conflict of interest.

References

Amarra MS, Khor GL & Chan P (2016) Intake of added sugar in Malaysia: a review. *Asia Pacific Journal of Clinical Nutrition*, **25**: 227-240.

Chong KH, Lee ST, Mg SA *et al.* (2017) Fruit and vegetable intake patterns and their associations with sociodemographic characteristics, anthropometric status and nutrient intake profiles among Malaysian children aged 1-6 years. *Nutrients*, **9**, 723; doi:10.3390/nu9080723.

Clifton PM, Chan L, Moss CL *et al.* (2011) Beverage intake and obesity in Australian children. *Nutrition and Metabolism*, **8**: doi 10.1186/1743-7075-8-87.

Colquitt JL, Loveman E, O'Malley C (2016) Diet, physical activity, and behavioural interventions for the treatment of overweight or obesity in preschool children up to the age of 6 years. *Cochrane Database of Systematic Reviews*, Issue **3**. DOI: 10.1002/14651858.CD012105

Craigie AM, Lake AA, Kelly SA *et al.* (2011) Tracking of obesity-related behaviours from childhood to adulthood: a systematic review. *Maturitas*, **70**, 266-284.

De Decker E, De Craemer M, Santos-Lozano *et al.* (2013) Validity of the ActivPal and the Actigraph monitors in pre-schoolers. *Medicine and Science in Sports and Exercise*, **45**: 2002-2011.

de Onis M, Blössner M, Borghi E (2010) Global prevalence and trends of overweight and obesity among preschool children. *American Journal of Clinical Nutrition* **92**: 1257-64.

Fournier T, Tibere L, Laporte C, *et al.* (2016) Eating patterns and the prevalence of obesity. Lessons learned from the Malaysian Food Barometer. *Appetite*, **107**: 362-371.

Gibson EL, Kreichauf S, Wildgruber, A *et al.* (2012) A narrative review of psychological and educational strategies applied to young children's eating behaviours aimed at reducing obesity risk. *Obesity Reviews*, **13**: 85-95.

Green L & Kreuter MK (2005) Health program planning: an educational and ecological approach. 4th ed. New York: McGraw Hill.

Ha K, Chung S, Kim CI *et al.* (2016) Association of dietary sugars and sugar sweetened beverage intake with obesity in Korean Children and adolescents. *Nutrients*, **8**: 31.

Institute of Public Health (IPH). National Health and Morbidity Survey (NHMS) (2011) Non-communicable diseases, *Ministry of Health Malaysia*. Vol II.

Ismail MN, Norimah AK, Poh BK *et al.* (2009) Prevalence and trends of overweight and obesity in two cross-sectional studies of Malaysian children, 2002–2008. In Proceedings of the MASO Scientific Conference on Obesity, Kuala Lumpur, Malaysia, 12–13 August 2009.

Ismail MN (2002) The nutrition and health transition in Malaysia. *Public Health Nutrition*, **5**: 191-195.

Lee ST, Wong JE, Shanita SN *et al.* (2014) Daily physical activity and screen time, but not other sedentary activities are associated with measures of obesity during childhood. *International Journal of Environmental Research and Public Health*, **12**: 146-1641.

Lee ST, Wong JE, Ong WW *et al.* (2016) Physical activity pattern of Malaysian pre-schoolers: environment, barriers and motivators for active play. *Asia Pacific Journal of Public Health*, **28**: 21S-34S.

Lobstein T, Jackson-Leach R, Moodie ML *et al.*, (2015) Child and adolescent obesity: part of a bigger picture. *Lancet* **20**: 2510-2520.

Loh DA, Moy FM, Zaharan NL *et al.* (2017) Sugar sweetened beverage intake and its associations with cardiometabolic risks among adolescents. *Pediatric Obesity*, **12**: e1-e5. doi: 10.1111/ijpo.12108.

Manios Y, Androutsos O, Katsarou C *et al.* (2014) Designing and implementing a kindergarten-based, family-involved intervention to prevent obesity in early childhood: the ToyBox-study. *Obesity Reviews*, **3**: 5-13.

Manios Y, Grammatikaki E, Androustos O (2012) A systematic approach for the development of a kindergarten based intervention for the prevention of obesity in preschool age children: the Toybox-Study. *Obesity Reviews* **1**: 3-12.

McSweeney LA, Rapley T, Summerbell CD *et al.* (2016) Perceptions of nursery staff and parent views of healthy eating promotion in preschool settings: an exploratory qualitative study. *BMC Public Health*, **16**: 1

Ministry of Health Malaysia (2016a) Nutrition Research Priorities in Malaysia (2016-2020). Technical Working Group on Nutrition Research for National Coordinating Committee on Food and Nutrition.

http://nutrition.moh.gov.my/wpcontent/uploads/2016/12/FA_Buku_NRP.pdf. Accessed 11.4.18.

Ministry of Health Malaysia (2016b) Guidance on the Malaysian Healthy Plate: #QuarterQuarterHalf. Putrajaya, Malaysia: Disease Control Division, Ministry of Health Malaysia.

Mohamed HJJ, Loy SL, Taib MNM *et al.* (2015) Characteristics associated with the consumption of malted drinks among Malaysian primary school children: findings from the MyBreakfast study. *BMC Public Health*, **15**: 132.

National Coordinating Committee on Food and Nutrition (2013) Key message 5: be physically active everyday. In: NCCFN, ed. *Malaysian Dietary Guidelines for Children and Adolescents*. Putrajaya, Malaysia: Ministry of Health Malaysia; <http://www.moh.gov.my/images/gallery/GarisPanduan/MDG%20Children%20and%20Adolescents%20Summary.pdf>. Accessed 24.4.18.

National Coordinating Committee on Food and Nutrition (2016) National Plan of Action for Nutrition of Malaysia III 2016-2025. Ministry of Health Malaysia http://nutrition.moh.gov.my/wp-content/uploads/2016/12/NPANM_III.pdf. Accessed 24.4.18.

NCD Risk Factor Collaboration (2017) Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128·9 million children, adolescents, and adults. *Lancet*, **390**: 2627-2642.

Ng M, Fleming T, Robinson M *et al.* (2014) Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis of the Global Burden of Disease Study. *The Lancet*, **384**: 766–81.

Nurul-Fadhilah A, Teo PS, Hubrechts I *et al.* (2013) Infrequent breakfast consumption is associated with higher body adiposity and abdominal obesity in Malaysian school-aged adolescents. *PLoS One*, **8**: e59297.

Olds T, Maher C, Zumin S *et al.* Evidence that the prevalence of childhood overweight is plateauing: data from nine countries. *International Journal of Paediatric Obesity*, **6**: 342–360.

Poh BK, Ng BK, Siti Haslinda MD *et al.* (2013) Nutritional status and dietary intakes of children aged 6 months to 12 years: Findings of the Nutrition Survey of Malaysian Children (SEANUTS Malaysia). *British Journal of Nutrition*, **110**: S21–S35.

Raji MNA, Karim S, Chelshak FA *et al.* (2017) Past and present practices of the Malays food heritage and culture in Malaysia. *Journal of Ethnic Foods*, **4**: 221-231.

Rokholm B, Baker JL, Sorensen TI (2010) The levelling off of the obesity epidemic since the year 1999—a review of evidence and perspectives. *Obesity Reviews* **11**: 835–846.

Reeves S & Henry CJK (2000) Dietary change, energy balance and bodyweight regulation among migrating students. *International Journal of Food Sciences and Nutrition*, **51**: 429-438.

Sharif R, Chong KH, Zakaria NH *et al.* (2016) Results from Malaysia's 2016 record card on physical activity for children and adolescents. *Journal of Physical Activity and Health*, **13**: S201-S205.

The Academy of Medical Sciences. (2017) Addressing the Global Health Challenge of Obesity in Malaysia: Workshop Report. London, UK: The Academy of Medical Sciences.

UNICEF, WHO & the World Bank (2015) Levels and trends in child malnutrition: UNICEF-WHO-World Bank joint child malnutrition estimates. UNICEF, New York; WHO, Geneva; World Bank, Washington DC.

Waters E, de Silva-Sanigorski A, Hall BJ, *et al.* (2011) Interventions for preventing obesity in children. *Cochrane Database of Systematic Reviews*, Issue 12. Art. No.: CD001871. DOI: 10.1002/14651858.CD001871.pub3.

WHO (2012) Population based approaches to childhood obesity prevention. http://www.who.int/dietphysicalactivity/childhood/WHO_new_childhoodobesity_PREVENTION_27nov_HR_PRINT_OK.pdf. Accessed 29.3.18.

WHO (2016) Report of the commission on ending childhood obesity http://apps.who.int/iris/bitstream/10665/204176/1/9789241510066_eng.pdf?ua=1&ua=1
Accessed 12.12.17

Yen ST & Tan AKG (2012) Who are eating and not eating fruits and vegetables in Malaysia?

International Journal of Public Health, 7: 945-951.

Yen ST, Tan AK & Feisul MI (2015) Consumption of fruits and vegetables in Malaysia: profiling

the daily and nondaily consumers. *Asia Pacific Journal of Public Health, 27*, DOI:

10.1177/1010539512458523.

FIRST FOCUS				REPETITION			
4 weeks	4 weeks	4 weeks	4 weeks	2 weeks	2 weeks	2 weeks	2 weeks
Drinking	Physical Activity	Eating and Snacking	Sedentary Behaviour	Drinking	Physical Activity	Eating and Snacking	Sedentary Behaviour

Figure 1. Implementation timing of the modules for the *Toybox-Study*



Figure 2. The Malaysian Healthy Plate #SukuSukuSeparuh (published with kind permission of the Ministry of Health, Malaysia).