THE EFFECTIVENESS OF A PARENT-BASED EDUCATION PROGRAM IN PROMOTING HEALTHY LIFESTYLES AND CONTROLLING BODY WEIGHT FOR PRIMARY SCHOOL STUDENTS

by

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Statement of Originality

I, LO Sze Wan, hereby declare that I am the sole author of the thesis, and that the material presented in this thesis is my original work except for those items indicated in the acknowledgement. I further declare that I have followed the University's policies and regulations on Academic Honesty, Copyright and Plagiarism in writing the thesis, and no material in this thesis has been submitted for a degree in this or other universities.

Abstract

Background: Childhood obesity is a serious health problem that may affect children until their adulthood. Prevalence of childhood obesity found in Hong Kong has increased significantly. Childhood obesity is believed to be to associate with unhealthy behaviour; therefore, different programs have been conducted previously to promote healthy lifestyle behaviour. So far, the effectiveness of these programs is still controversial. As a parent is an agent having great impact on children, the purpose of the present study was to design a parent-based childhood obesity program, and the effectiveness of this program was assessed.

Methods:

Design: A randomized, controlled trial, including pre- and post-intervention assessment to examine the effects of a comprehensive intervention program comparing the control condition of a parent's self-efficacy in managing problem behaviour of children.

Subjects: 128 pairs of primary school students and parents in Hong Kong were recruited to participate in a "Healthy for Life" program.

Duration: The 20-week program included 10 weeks of intervention and a maintenance period of 10 weeks.

Intervention: Participants were randomly divided into an intervention group (n=62) and a control group (n=54). In the intervention group, parents were given education on health knowledge, information on childhood obesity and parenting skills strategies for managing obesity-related problem behaviour of children. In addition, they received a health information sheet nine times during the intervention period. Parents were recommended to

use such knowledge and skills to control the body weight of children through modifying children's unhealthy lifestyle behaviour in the intervention period. In the control group, parents received several health information sheets during the intervention period only.

Outcome measures: Parents were asked to complete the "Lifestyle Behaviour Checklist" to assess the problem level and their confidence level in managing the child's behaviour. Body Mass Index (BMI), waist circumference and weight status of children were measured at baseline, at week 10, week 15 and week 20 after the baseline.

Result: There were no significant differences on parent's self-efficacy (the problem level and the confidence level) in managing the obesity-related problem behaviour of children between the two groups. However, parents reported the significant improvement on their confidence level in managing children's obesity-related behaviour (physical activity). One hundred and seven (107) children completed all anthropometric measurements. There was no difference of changing children's BMI, waist circumference and weight status of children between the intervention group and the control group. Regarding anthropometric measure changes within groups, the intervention group had a better effect in changing the BMI between baseline and post-intervention, between baseline and 10-week follow up, as well as between post-intervention and 5-week follow up stages.

Conclusion: The program had an effect on alleviating parent's confidence in managing children's behaviour related to physical activity. No significant effect on reduction of BMI in the intervention group was found, and it could be maintained in the period of 10-week follow up. However, no significant effect was found on changing waist circumferences between groups. Unfortunately, a short study period and few teaching sessions may be the

cause of insignificant outcomes. Future studies may design a longitudinal study (more than 1 year) and consider providing intensive teaching sessions to enhance the power of a study.

Keywords: children, parents, obesity

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1. Introduction

The prevalence of overweight and obesity conditions was found in Hong Kong in a survey (Centre for Health Protection, 2018) in primary school, which showed 17.6% of students were overweight and obese. In adults, being overweight and obese are related to various health problems, such as cardiovascular disease, insulin resistance, musculoskeletal disorder, cancers, and disability (World Health Organization 2020). When children become overweight and obese, they are more likely to experience anxiety or depression, attributed to weight bias (Pizzi & Vroman, 2013). An effective program to control childhood obesity is necessary. According to the health needs of children, a "Healthy for Life" program was conducted. It is a parent-based education program to promote healthy lifestyle and control body weight for primary school students. The objectives of this study are to: 1) design and implement a parent-based education program to control childhood obesity in Hong Kong; 2) explore the influence of the parent-based education program in alleviating parent's self-efficacy in managing obesity-related problem behaviour of children in the study period; 3) explore the influence of a parent-based education program in reducing BMI percentile, waist circumference and weight status of children in the study period. This study hypothesized: 1) BMI, waist circumference and weight status of children as well as the number of overweight/obese of children in the intervention group would be reduced, compared with those in the control group; 2) parents did not perceive managing obesity-related problem behaviour as a problem and increased their confidence in managing obesity-related problem behaviour, compared with those in the control group. After this study, it was found that parents have

gained confidence to modify obesity-related problem behaviour through enhancing their health knowledge of these conditions. Body weight of children can be reduced.

1.1. General Introduction of Childhood Obesity

Childhood obesity is a critical health problem in the world. The number of overweight children is over 41 million under the age of 5. There were over 340 million children and adolescents aged 5-19 who were overweight or obese in 2016 (World Health Organization, 2018). Abarca-Gómez and colleagues (2017) measured the BMI of children aged 5-19 and found that the prevalence of obesity increased from 0.7% to 5.6% in girls and 0.9% to 7.8% in boys from 1975 to 2016. Overweight and obese children have a high chance of becoming obese until adulthood and develop non-communicable diseases such as diabetes and cardiovascular diseases. Becoming overweight and obese is preventable. To avoid this health crisis, it is necessary to prevent or control childhood obesity.

1.2. The Definition

Overweight and obesity are defined as having excessive fat accumulation in the body, which presents a health risk (World Health Organization, 2015; Centers for Disease Control and Prevention, 2015). Weight in proportion to height determines “overweight” and “obesity” of individuals (World Health Organization, 2015). Body Mass Index (BMI) is the index used to determine overweight and obesity of individuals. If the BMI of individuals is equal to or greater than 25, an overweight condition is identified. When the BMI of individuals is equal to or more than 30, obesity is deemed to be present (National Institutes of Health, 2012; World Health Organization, 2015). Obesity is associated with

negative health consequences (Gaesser & Blair, 2019). Therefore, an overview of this health crisis should be undertaken.

Childhood obesity means more fat accumulation in the body and affects the development of a child. However, characterizing obesity in childhood is quite different from that in adulthood because of the rapid change of body composition and height in childhood (Karnik & Kanekar, 2012; Sahoo, et al., 2015). Currently, three measurements are commonly used to capture childhood obesity – skin fold thickness, Body Mass Index (BMI) and the growth reference data for children 5-19 years of age.

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Skin fold thickness adopted the indicator of children's skin fold. The standardized techniques to the nearest 0.1mm in measuring triceps, subscapular, suprailiac and quadriceps skinfold thicknesses of children by using skinfold caliper for three times. The mean was used as the value for each site. The sum of the four skinfolds are presented as fat mass (Vafeiadi et al., 2015). Body fat was calculated by using the equations computed by Slaughter and colleagues (Marques-Vidal, et al., 2008). When a child's skinfold thickness is more than 25% (for boys) and 30% (for girls), he or she is classified as obese (table 1) (Williams et al., 1992). BMI percentile is another estimate of childhood obesity. BMI percentiles were calculated using 2000 CDC growth standards (Smego et al., 2017). Children are classified as obese when the BMI is above the 85th percentile (Center for Disease Control and Prevention, 2015; Dinsdale, Ridler & Ells, 2011). The final estimate used the growth reference data for 5-19 years as recommended by WHO. It merged the data of height-for-age, weight-for-age, and BMI-for-age of 5-19 years. BMI z-score was

computed using the growth reference data for 5-19 years of age. Children whose results exceeded 1 to 2 standard deviation (SD) above the mean growth reference data of the corresponding age and gender were classified as overweight or obese (World Health Organization, 2015).

Table 1.

Skinfold thickness of children aged 5-18

Classification	Skinfold Thickness (% body fat)	
	Male	Female
Normal	≥ 25%	≥ 30%
Obesity	≤25%	≤ 30%

*according to age, gender, and race-specific approach

A gradually increasing prevalence of childhood obesity was found in Hong Kong, which has shown little improvement (Centre of Health Protection, 2018). Although people understand the importance of healthy behaviour, they may not follow it (De Ridder & De Wit, 2006). Previous childhood obesity studies have been found worldwide. However, only a handful of childhood obesity programs were conducted in Hong Kong (LO, et al., 2016). Even fewer studies focused on educating parents regarding knowledge about childhood obesity. Despite the involvement of parents in those programs, no provision was made for parental education on parenting, misconceptions, and lack of health knowledge. The parent plays a main role in caring for children (Suhaimi, Hussin & Hashim, 2017). The parent may affect a behavioural change in children, especially for overweight and obese children. Besides, a high dropout rate is a limitation of previous childhood obesity programs

(Coppins et al., 2012; Sacher et al., 2010; Small et al., 2012 & Taylor et al., 2007). Nowadays, the smart phone is commonly used to enable a mobile communication app, which was applied in this study to increase communication between the investigator and parents, to deliver information and to minimize the dropout rate in the current study.

Due to few interventional studies being conducted in Hong Kong, it was important to conduct a childhood obesity study to improve conditions of overweight and obesity in children. As mentioned before, the prevalence of childhood obesity was still high in Hong Kong, and parents were found to have misconceptions about obesity and underestimated the weight status of their children (Hearst et al., 2011, Lundahl, Kidwell & Nelson, 2014). For parents who need to plan their children's eating and activity patterns, they need to have adequate knowledge about healthy weight status so that they can control their children's behaviour (Hearst et al., 2011). As parent's self-efficacy can deter parents in managing obesity-related behaviour, and the confidence of parents with overweight and obese children was low (Morawska & West, 2013, West et al., 2010), it was determined that parent's self-efficacy must be enhanced through parental education.

Childhood obesity is a global health problem that demands more attention because childhood and adolescence are essential developmental periods for the individuals to establish their future health (Sabo et al., 2012). The basic factors contributed to overweight and obesity are - increased intake of energy-dense foods; foods poor in nutrients and rich in fats, sugar, and salt; and insufficient physical activity. As a result, a challenging imbalance of the whole organism was found (Zalewska & Maciorkowska, 2017).

Overweight and obese children spend much time engaging in sedentary activities, such as TV viewing and playing computer games, which were proved to be contributing factors to childhood obesity (Hu et al., 2019; Saha et al., 2018). Previous study found that overweight and obese children spent much more time watching TV than normal weight children. Overall, during TV viewing, snacking was a common behaviour for all children to perform, which increases the risk of becoming overweight and obese (Hu et al., 2019). Video games also related to the prevalence of obesity. As video games and TV viewing are normal activities for children in daily living, the more children engaged in such activities, the less time they had to participate in physical activity (Saha et al., 2018). Evidence showed that obese children participated in TV viewing for several hours per day, whereas they spent less than three hours on physical activity. Some of them become physically inactive (Khan, 2018).

Parents and families influence a child's weight status directly, apart from children's characteristics (Davidson and Birch, 2001). Within families where individuals live together, the parents are the gatekeepers who determine which activity children participate in and which food can be available at home to their family members, which affects children's nutrition and physical status (Gerards & Kremers, 2015). Thus, parents play an imperative role in affecting a child's lifestyle behaviour and weight status. A parenting problem hinders children in developing a healthy lifestyle. A previous study found that parents' negative emotion, emotional liability and poor emotion regulation may contribute to children becoming overweight and obese (Pace, Aiello & Zappulla, 2019). Obese children had difficulties in managing and regulating their own negative emotion, which affected their

capability for self-regulation in controlling their eating behaviour. Both an authoritarian and permissive parenting style can influence children to put them at risk of becoming overweight or obese. An authoritarian practice caused children to lack the ability to manage and regulate their eating behaviour. A permissive parenting style also related to poor self-control and lower interpersonal skills, as parents exercise less control over their children (Pace, Aiello & Zappulla, 2019). Parental support and encouragement are very important for children to engage in physical activity (Mutz & Albrecht, 2017). However, parents do not have the relevant skills to change children's behaviour or to make family lifestyle changes, and they lack confidence in their ability to manage their child's behaviour (West et al., 2010). In addition, parents have misconceptions about childhood obesity. Evidence showed that some parents encourage children to skip breakfast to achieve weight loss (Tin et al., 2011). Parents who underestimated the weight status of their children allowed them to overeat and put them at risk of becoming overweight and obese. In addition, children were allowed to participate in less physical activity (Park, 2017). As knowledge and education may increase parental confidence in changing their child's behaviour (Ek et al., 2019; Rea, Smith & Taveras, 2016), it is essential to involve parents in enhancing their knowledge of how to develop a healthy lifestyle for their children.

2-5 Literature Review

2. Parent's Self-efficacy

Parent's self-efficacy is centrally correlated to parenting behaviour (Kendall & Bloomfield, 2005) and is related to individual self-efficacy. Bandura addressed self-efficacy in 1982 (Bandura 1982). Self-efficacy is defined as the ability of an individual to

perform actions effectively. It is vital to the understanding of an individual's transaction with one's environment and a core structure, and it can mediate between knowledge and behaviour. Self-efficacy expectations are related to self-perceived skills (Bandura 1982), and an individual's self-efficacy can be determined by personal history or by one's success or failure. Individuals with a strong sense of self-efficacy will persist in executing a task until they succeed, whereas, someone with a low sense of self-efficacy will give up on a task early (Kendall & Bloomfield, 2005).

Parents are the primary caregivers for children. As such, they need to be able to care for their children, and their self-efficacy defines how they believe they can handle specific issues effectively. Parents influence their children and nurture their development and adjustment (Bandura, 1997). Their self-efficacy is associated with parent and child well-being. A review focused on how the parent's self-efficacy is a factor affecting healthy functioning in parents and children and showed how it impacts the parent-child relationship, parental mental health, and child development (Albanese, Russo & Geller, 2019).

The parent's self-efficacy indicated the parent's confidence in making good decisions for children in the family environment. A parent's self-efficacy is a central construct for parents to carry out the role of parents for childhood obesity treatment and prevention (Heerman et al., 2017). Heerman and colleagues (2017) assessed the associations between parenting self-efficacy, parent depressive symptoms, and preschool child healthy behaviour. A parent's strong self-efficacy is associated with longer child sleep and fewer meals in front of the TV, which benefits a child's health. A systematic review assessed how a parent's self-

efficacy is related to childhood obesity. The review included literatures of parenting competence and self-efficacy-related scales, parenting locus of control and parenting beliefs-related scales, parent satisfaction-related scales and parenting and nursing-related scales. Although lack of data was found between parent's self-efficacy and prevention of childhood obesity, the link between parenting self-efficacy and child's behavioural difficulties was highlighted (Grossklaus & Marvicsin, 2014). Child behaviour affects a parent's self-efficacy and parenting (Glatz, Cotter & Buchanan, 2017). Parents who have higher levels of self-efficacy may find it easier to face difficult and challenging child behaviour compared to parents with lower levels of parental self-efficacy. Parental self-efficacy is very important for parents who wish to perform positive parenting skills when children exhibit difficult behaviours (Glatz, Cotter & Buchanan, 2017). Parents' self-efficacy would be changed when faced with challenging child behaviour (Jones & Prinz, 2005). When parents perceived their children's behaviour as a problem, their confidence to manage such behaviour would decline, whereas, successful results in managing their children's behaviour might enhance their self-efficacy. A parent's self-efficacy interacts with parenting and child outcomes. It is also affected by environmental and family contexts (Jones & Prinz, 2005).

The relationship between a parent's self-efficacy and their child's behaviour

A parent's self-efficacy influences their children's diet, physical activity, sedentary, and screen time behaviours, which is why it is very important for childhood obesity prevention (Norman, et al., 2018). To explore the relationship between a parent's self-efficacy and childhood obesity, one may first focus on eating behaviour and activity, which

affects the amount of energy intake and expenditure. Parents with a higher level of self-efficacy may contribute to healthy child behaviour. A previous study investigated parental self-efficacy for promoting obesity protective dietary intakes in young children (Walsh et al., 2019). Parents' self-efficacy was assessed, and multinomial logistic regression examined self-efficacy tracking categories and parents' ages, education, and BMI. Linear regression examined the association between parents' self-efficacy tracking categories and child dietary intakes. Higher educational level of parents may have lower odds of low self-efficacy. It was also observed that positive association was found between parents' self-efficacy and children's dietary intakes (Walsh et al., 2019). This provides important insights into the impact of parental self-efficacy on young children's obesity protective dietary intakes (Walsh et al., 2019). Previous evidence showed that the mother's self-efficacy is associated with healthy dietary intake and physical activity (Rohde et al., 2018). This study examined the association between parental self-efficacy among Swedish mothers and the dietary and physical activity behaviour of their children. Linear regression examined the association between parents' self-efficacy and children's dietary intake and levels of physical activity. The finding revealed a positive association between mothers' self-efficacy and healthy eating and physical activity behaviour (Rohde et al., 2018).

The relationship between parents' self-efficacy and childhood obesity was investigated in a previous study (Suhaimi, Hussin & Hashim, 2017). The role of parents and the prevalence of childhood obesity were addressed. A quantitative approach was applied in using self-administered questionnaires involving 320 parents. The findings of this study found that childhood obesity crisis starts with parents. Parental food selection

preferences and parental self-efficacy have significant influence on the prevalence of childhood obesity. It is important to help parents playing their role to prevent childhood obesity, rather than providing effective strategies for healthy eating, physical activity and dietary patterns of their children (Suhaimi, Hussin & Hashim, 2017).

Studies stated the age of children having the greatest influence by parents was limited. Glatz, T., & Buchanan, C. M. (2015) compared parents' self-efficacy within different age groups. Parent's self-efficacy increases through infancy and the preschool years and declines in the adolescent period. However, it does not mean that parents' self-efficacy is not vital in another childhood development period. Erikson (1959) revealed that children aged 5-9 are influenced by parents, as in this stage, children learn on their own and build up their self-confidence. Although both parents and teachers affect their development most, parents play a main role in preparing and planning children's daily activities and eating habits. They become facilitators in changing their problem behaviour.

2.1. The Importance of the Role of Parents

Parents play an important role in childhood development. As stated, family-based interventions in control of childhood obesity acknowledge the family environment as a unit and the great influence of parents (Centis et al. 2012; Coppins et al., 2011; Elder et al., 2014; Foster et al., 2012; Foster et al., 2014; Gunnarsdottir et al.; 2011; Kalavainen, Korppi & Nuutinen, 2011; Lloyd, Lubans, Plotnikoff & Morgan, 2014; Marcus et al., 2009; Morgan et al., 2010; Rausch, Kovalskys & De Gregorio, 2013; Robertson et al., 2012; Sacher et al., 2010 & Small et al., 2012). Parents are gatekeepers and role models on health-

related behaviour and health-related choices such as planning daily activities, food selection and preparation, as well as influencing children's perception of physical activity and eating (Reilly et al., 2019). Many studies supported parental impact on childhood obesity. Faith and colleagues (2012) pointed out that children are dependent on parents to structure their daily living and home environment. Parents play a unique role for affecting a behaviour change in obese children. Bean and colleagues (2019) also supported parent-based intervention, stating that parent-based intervention is vital for young children, demonstrating the need to have more improvement on child weight status. A previous study assessed the effectiveness of a parent-based program and a family-based program in controlling childhood obesity (Boutelle et al., 2017). The parent-based program was effective for child weight loss, compared to the family-based program (Boutelle et al., 2017). It demonstrated that parent-based intervention could be used on weight loss treatment for children.

Parents influence children both in childhood and in adolescence. Larsen et al., (2015) described parental influences on a child's dietary behaviour, parents' dietary behaviour and their food parenting practices. Parental influence on children's dietary behaviour declines as children age. Although a decline was found in parental influence on older children, parents still have an impact on children's different daily lifestyles or activities. Parents are also an important person who can prevent negative behaviour of adolescents. In a previous study that assessed parental monitoring on adolescent initiation of sexual activity, it was found that adolescents were less likely to initiate sexual activity, such as dating, when there was parental monitoring at earlier ages (Ethier et al., 2016). Kuntsch & Kuntsche (2016)

conducted a systematic review to provide an overview of the effectiveness of parent-based programs in alleviation of substance use among adolescents. It revealed that there was a desirable effect of parental involvement in preventing, curbing, or reducing substance use such as alcohol, tobacco, and cannabis. It reflected that the parent is an important person to affect development of their child until adolescence, and it supports the current study in using parent-based intervention to make change in a child's obesity-related problem behaviour.

3. Childhood Obesity

3.1. Negative Impact of Childhood Obesity

Childhood obesity can have a negative impact on the physical and psychological health and development of children. In particular, it may cause problems in children's physical fitness, sexual maturation, self-esteem, academic performance or even the family financial situation.

Physical fitness

According to evidence related to health and well-being, physical fitness is defined as health and daily-life activities, including practicing sports for youths. Physical fitness refers to an individual's ability to perform daily tasks without fatigue. It includes the following aspects: cardiorespiratory fitness, muscular endurance, muscular strength, flexibility, coordination and speed (Deforche, De Bourdeaudhuij & Tanghe, 2006). It is important for disease prevention and health promotion (Augestad & Jiang, 2015). Children's' physical fitness is affected by conditions of overweight and obesity (Jin &

Jones-Smith, J., 2015). Many studies indicated a strong inverse relationship between obesity and physical fitness in children and adolescents (Brunet, Chaput, & Tremblay, 2007; Dumith et al., 2010; Ortega et al., 2008). Evidence showed that the physical fitness of obese children is poorer than those with normal weight (Bovet, Auguste & Burdette, 2007, Brunet, Chaput, & Tremblay, 2007, Dumith et al., 2010, Ortega et al., 2008). A review on how physical fitness influences health outcomes among children and adolescents in Sweden showed that a higher cardiorespiratory fitness level was found in children with lower total adiposity. Also, a higher level of cardiorespiratory fitness is associated with lower abdominal adiposity among children and adolescents, and an abdominal adiposity is a predictor for cardiovascular disease and diabetes mellitus (Ortega et al., 2008). By assessing physical fitness and body composition in the 1981 Canada Fitness Survey (CFS), BMI and waist circumference and the physical fitness tests revealed that BMI and waist circumference were negatively associated with physical fitness performance in activities such as the standing long jump, 1-min speed sit-ups and the speed shuttle run. Results suggested that the physical fitness of obese children was poorer than the reference value of children at the same age in the 1981 CFS (Brunet, Chaput, & Tremblay, 2007). Cross-sectional studies conducted in other countries also provided consistent evidence on the relationship between children's physical fitness and obesity. Students with normal weight showed better performance in physical tests than those who were overweight or obese in grades 1 to 4 in all secondary schools in the Republic of Seychelles (Bovet, Auguste & Burdette, 2007). Another study using a Brazilian sample also found that normal-weight students had better physical fitness performance compared to overweight and obese students.

Physical activity is a key determinant for children's health and body shape and produces a benefit to enhance physical fitness (Gómez-Cabello et al., 2018). However, many factors affect children engaging in physical activity, including their feelings about physical activity, their level of self-esteem, and physical constraints. Specifically, 'pleasant', 'health', 'desire to feel and look better' and 'good opportunity to be with friends or meet new friends' are the motivators for obese children to engage in physical activity (Deforche et al., 2004). Conversely, obese children are less motivated to participate in various physical activities because they had more physical complaints during sports and they did not like doing it (Deforche, De Bourdeaudhuij & Tanghe, 2006). As a result, they are at greater risk of becoming adiposity and have poor physical fitness.

Sexual maturation

Sexual maturation refers to sexual organs becoming developed. Puberty is a process through which endocrine changes come about in late childhood that cause sexual maturation and reproductive capability. When children experience the onset of puberty, female appearance of the breast bust changes and menses begins, and boys' genitals change (Li et al., 2017). Race, nutrition, genetic and environmental factors affect puberty timing. In addition, childhood obesity is an important factor affecting puberty timing. The range of normal age of children having the onset of puberty is from 8-13 years for girls and from 9-14 years for boys (Day et al., 2015). Puberty is an important period that may involve weight gain. When children have onset of puberty, leptin mediates the pubertal clock mechanism within the brain. It drives weight gain and other physiologic and hormonal changes (Lehrer,

2015). Rapid growth in height and weight is also found among the adolescents during puberty (Benedet, 2014). Obesity compromises the maturation of body organs and tissues, redistribution of adipose tissues and the increase of bone mass and fat-free mass, and secondary sexual characteristics are also developed earlier in obese children during the pubertal period. There were some studies addressing the negative impacts of early sexual maturation. Mengel and colleagues (2017) stated that there were lower increments in bone mineral characteristics in overweight and obese boys because of the adverse increment in body fat mass. Lee and colleagues (2016) also found significant reduction of secretion of luteinizing hormone and suppressed secretion gonadotropin hormone in overweight and obese girls. Their studies also indicated high BMI affecting luteinizing hormone secretion response to the gonadotropin stimulation hormone in boys with early puberty (Lee et al., 2013). Another review showed more obese girls with early puberty compared to girls in the normal weight group (Li et al., 2017). Lee et al. (2016) analyzed community-based pubertal data and found that there was earlier puberty in overweight boys compared to normal weight boys, and there was late puberty in obese boys compared to overweight boys. The findings of literature investigating the association between sexual maturation and childhood obesity show that the timing of puberty development was normal. The breast development occurred relatively earlier among obese girls (Denzer et al., 2007). Another cross-sectional study using a sample aged 8-14 years old showed that earlier sexual maturation is associated with higher body weight for both sexes (Benedet et al., 2014). Another study of Chinese teens found similar results: that childhood obesity is positively related to sexual maturation in both boys and girls; more boys become obese compared to girls; however, the rate of obesity was higher among boys, while the rate of early

maturation was higher among girls (Chen et al., 2017).

Psychological development

Being overweight and obese can cause a negative impact in an individual's self- and body esteem, as well as affect one's psychological development, especially for children. Obese children are more likely to experience stigmatization and bullying, which can cause a negative impact on mental health and result in low self-concept or even depression (Williams, et al., 2013). A study investigated the peer relationship among peers and obese children. It found that obese children were less likely to be named as a best friend by their peers and had a lower rate of peer acceptance. Their teachers and peers said that obese children were more highly withdrawn. Peers also found them less attractive and less physically active. Obese children also acted in a more aggressive-disruptive manner (Zeller, Reiter-Purtill, & Ramey, 2008). Another study found that children with high BMI were more likely to report low body esteem, and girls with high BMI experienced more bullying by peers, which was directly associated with lower body esteem in girls (Williams, et al., 2013). A meta-analysis reviewed 759 studies and found that there was an association between the relationship between childhood obesity and anxiety, though the direction was not clear. In other words, obese children with greater BMI are more likely to have higher body dissatisfaction (Russell-Mayhew, McVey, Bardick & Ireland, 2012).

Quality of life

Good health contributes to the happiness and well-being of an individual. Quality of life affects children's health, including physical and psychological aspects. Health-related

quality of life affects physical and occupational function, psychological state, social interaction, and somatic sensation. Obesity is one of the determinants affecting health related quality of life (Houben-van Herten et al., 2015). Overweight and obesity affect children's mental status. Depression is a common symptom of overweight and obese children (Morrison et al., 2015). Another review investigated the variables affecting quality of life in overweight and obese children and adolescents. It reported that self-image and bullying are variables that affect children's quality of life. These factors could be prevented earlier. These variables are mainly related to lower peer acceptance in schools (Buttitta et al., 2014).

Academic performance

The disadvantages in academic performance among obese children were found in existing literature, but less understood. A previous quasi-experimental study investigated the effectiveness of a school-based program. The program included curricula, dietary and physical activity components. Obese children in the experimental group showed reduced BMI percentile as well as improved performance in reading and Mathematics (Hollar et al., 2010). The possible mechanism underlying this relationship included weight-related interpersonal difficulties and poor physical fitness. A study using a parental phone survey found that academic performance was significantly associated with weight-related teasing among overweight children (Krukowski et al., 2009). By exploring the relationship between physical fitness and academic performance, Chomitz et al., (2009) found a positive relationship between physical fitness and Mathematics and English test results (Chomitz et al., 2009), though the relationship between physical fitness and academic

performance needs further examination. Weight-related nutritional status, attendance rate, weight-related teasing and intelligence quotient may also further influence one's academic performance results (Datar & Sturm, 2006, Florence, Asbridge & Veugelers, 2008, Hollar et al., 2010). Torrijos-Niño and colleagues (2014) also revealed that academic achievement was positively related to physical fitness. Obese boys had lower academic achievement than overweight or normal weight boys. Cardio-respiratory and speed levels were associated with high academic achievement. The mechanisms of aerobic exercise might influence cognitive functions. Aerobic exercise can increase oxygen saturation, promote angiogenesis, and increase cerebral blood flow to the brain. It can also increase cerebral levels of neurotransmitters that facilitate information processing and influence neurogenesis by changing the regulation of neurotrophins. The positive relationship between aerobic capacity and academic achievement may motivate students to strive for achievement in both academics and physically fitness. Students may have better health, which may help contribute to their academic achievement. Finally, physical activity can improve self-esteem and mental health. It can reduce stress, anxiety and depression problems that affect school performance, and it can boost their self-esteem (Torrijos-Niño et al., 2014). Obese children have probably had poorer physical fitness than normal weight children (Ceschia et al., 2016). It may affect cognitive function of individuals, which affects academic performance.

Negative health consequences

Childhood obesity carries negative health consequences that affects children until adulthood. It is associated with every system in the body, including the endocrine,

gastrointestinal, pulmonary, cardiovascular, and musculoskeletal systems. Some comorbidities will happen in youth with obesity, such as type II diabetes mellitus, dyslipidemia, obstructive sleep apnea and steatohepatitis. Obese girls had early onset of sexual maturation with rapid linear growth and advanced skeletal maturation. They may be at higher risk of developing hyperandrogenism and polycystic ovary syndrome. Obese children had higher risk of obstructive sleep apnea with increasing BMI. They may also have alveolar hypoventilation leading to severe oxygen desaturation. What is more, childhood obesity is associated with asthma and risk of nonalcoholic fatty liver disease. Although patients with nonalcoholic fatty liver disease are asymptomatic, laboratory abnormalities were detected, including elevations in levels of live transaminases, alkaline phosphatase, and gamma-glutamyl transpeptidase. In addition, various musculoskeletal problems such as impairment in mobility, increased prevalence of fractures, joint pain and malalignment in lower limbs were increased in obese children. Obese children had significant increased risk of type II diabetes mellitus, hypertension, dyslipidemia, and carotid-artery atherosclerosis compared to those adults never suffering with obesity (Kumar & Kelly, 2017).

Financial burden

Compared to adulthood obesity, childhood obesity contributes to more of a financial burden. From an economic point of view, childhood obesity may result in greater direct and indirect healthcare costs compared to those of adulthood obesity. A review of the medical cost of obese children during their lifespan found that obese children (at the age of 10) generated greater medical costs for weight control throughout adulthood compared

to normal-weight children (Finkelstein, Graham & Malhotra, 2014). Moreover, obese children have a higher risk of developing an early onset of chronic illnesses, such as diabetic mellitus and cardiovascular diseases, which escalates the financial burden for child healthcare providers. Therefore, long-term investment in prevention of childhood obesity is needed (Trasande & Elbel, 2012).

3.2. Causes of Childhood Obesity

Obesity is the consequence of excess energy being deposited in the body. To avoid obesity, the energy intake should be less than the energy expenditure. To calculate energy intake, a Kcal/g unit is used to calculate energy density for each food time. There is no standardized method to calculate dietary energy density. Energy density was calculated by dividing the energy content (Kcal) by the weight of foods or beverages being consumed. The overall dietary energy density calculation is made by using the total food-only energy intake (Kcal) of each individual and dividing it by the total gram weight of foods consumed. To control obesity, obese individuals avoid consuming a higher proportion of calories from those foods with the medium and higher energy density categories, such as corn bread, whole eggs, ice-cream, full-fat potato chips, pork bacon and natural cheeses, etc. (Vernarelli et al., 2018). Apart from energy intake, energy expenditure is a component of controlling obesity. Energy expenditure can reduce the energy deposited in the body and prevent obesity. Body movement or physical activity determines the activity-induced energy expenditure (Westerterp, 2017). Obese individuals may probably have lower body movement and more energy intake (Westerterp, 2017).

Parental obesity is an important contributor to childhood obesity, but it depends on the genetic composition of individuals. Ten per cent of individuals become obese because of obesity-predisposing genetic factors (Herbert et al., 2006). It is essential to maintain an energy balance in daily activity (such as eating, physical activity, exercise and resting) to prevent or control childhood obesity. Weight change and daily activity are interrelated, and when examined in previous studies, it was found that a higher frequency of meal intake, breakfast consumption and the Mediterranean diet intake were adversely associated with BMI, apart from the eating and physical activity pattern (Kontogianni et al., 2010).

Daily lifestyle behaviour also governs children's weight management. A study on lifestyle and perinatal life showed that engaging in physical activity was a protective factor against childhood obesity. Family history of obesity, television watching, and sugar-sweetened beverage consumption were positively related to childhood obesity (Ochoa et al., 2007). This study investigated any association between lifestyle patterns combining diet and physical activity and childhood obesity. It found that snacking and sedentary activity/behaviour were significantly and positively associated with childhood obesity in children aged 3-6. For children aged 7-11, eating varied food and participating in more physical activity engagement were inversely associated with obesity. (Lioret et al., 2008).

3.3. Positive Impact of Weight Loss

Weight loss provides health benefits that include both physiological and psychological aspects for obese children. Improvements in blood pressure, blood cholesterol, and blood sugars are reported after 5-10% of body weight is lost (Centers for Disease Control and

Prevention, 2018). Children may benefit with blood pressure improvement when lower BMI is achieved (Hagman et al., 2019). In addition, many studies assessing weight loss of children only found other outcomes, such as cardiometabolic risk marks, quality of life and societal participation were also improved after weight loss (Zolotarjova & Vreugdenhil, 2018).

Physiological function

Weight loss can enhance the physiological function of individuals and can also improve physical fitness. Detailed descriptions follow.

Cardiac function

Weight loss may enhance cardiac function, and it can reduce mortality and morbidity of obese children. Cardiac function benefits the whole body and is associated with strengthening various systems. Improved cardiac function in children was observed after children engaged in exercise, and BMI was reduced (De Araujo, 2012). Although weight loss benefits the health of obese children, an appropriate method for weight loss is suggested (Zolotarjova & Vreugdenhil, 2018). Lifestyle interventions and parental support may be suitable for weight loss in children (Rotman, et al., 2019). A preceding study reviewed obesity paradox. It found there may be improved cardiovascular risk of overweight and obese individuals after weight loss (Lavie, Milani & Ventura, 2009). Childhood obesity would bring about change in myocardial geometry and function. An interventional study found that weight loss may improve obesity-related structural and functional cardiac alterations (Erbs et al., 2018), since obesity may cause left ventricular

hypertrophy in children and contribute to the pathogenesis of obesity-related left ventricular remodeling. Obese children were required to lose weight to normalize cardiac ventricular mass, which has benefits for the health of cardiovascular system (Brady, 2016). A guideline also stated physical benefits of weight loss in the United States. When obese children undertake exercise training, weight loss and body composition were improved. Their anthropometric parameters, such as glucose, blood pressure, dyslipidemia and subclinical measures of atherosclerosis normalized (FOR, E. P. O. I. G., & CHILDREN, R. R. I., 2011).

Muscular and skeletal function

Weight reduction may reduce loading of the muscular and skeletal system, which may improve weakness or disorders of the muscular and skeletal system and restore its function. Reduction in weight can relieve symptoms of knee osteoarthritis (Atukorala et al., 2016). Obese children may complain of back, foot and knee pain and have a high level of inflammation as result of osteoarthritis (Stovitz et al., 2008). Stovitz and colleagues (2008) showed the benefit of weight loss on improvement of muscular and skeletal disorders. The other study showed that obese children benefit from weight loss to aid gait pattern, skeleton and postural balance. Weight loss offers various benefits, such as positive changes in gait kinematics and kinetics, increased stride length, gross motor, and co-ordination exercises (Steinberg et al., 2018).

Respiratory function

Weight loss can improve respiratory function. It can improve inflammation of

individuals with asthma and respiratory distress (Freitas et al., 2015). Weight loss can help children to improve their lung function. There was a study to evaluate asthma outcomes of obese asthmatic children on weight loss (Jensen et al., 2013). The outcome showed that dietary intervention can reduce weight in obese asthmatic children. It may also improve expiratory reserve volume and asthmatic control questionnaire score (Jensen et al., 2013). Improvement of children's lung function was also observed after children engaged in exercise, and BMI was reduced (De Araujo, 2012). Another study also proved that weight loss can improve asthma features and lung function of obese children with asthma (Willeboordse et al., 2016). Weight reduction intervention was provided for obese children with asthma. After that, anthropometry, lung function, lifestyle parameter and inflammatory markers were measured. The study results showed that asthma control and asthma-related quality of life of obese children with asthma was improved after weight loss. In addition, their forced vital capacity was also improved.

Weight in relation to height of obese children correlated with apnea hypopnea index and change in mean oxygen saturation (SpO2) (Lilitwat, Chotinaiwattarakul & Udomittipong, 2017). Apnea hypopnea index and gas exchange was observed to have significant improvement when obese children lost weight. Weight decrease can improve the severity of obstructive sleep apnea in obese children with obstructive sleep apnea (Lilitwat, Chotinaiwattarakul & Udomittipong, 2017). Evidence revealed that weight loss can improve respiratory function of overweight and obese children.

Metabolic system

Weight loss may alleviate metabolic disorders. Lifestyle interventions may reduce nearly 60% risk of developing diabetic mellitus (Lavie, Milani & Ventura, 2009). Apart from diabetic mellitus, many metabolic symptoms could also be improved. A study investigated the improvement of de novo lipogenesis, liver fat, visceral fat, subcutaneous fat, and insulin kinetics by isocaloric fructose restriction. Children had small, but statistically significant, weight loss. Their liver fat decreased from 7.2% to 3.8% and visceral fat decreased from 123 cm3 to 110 cm3. The de novo lipogenesis area under the curve decreased from 68% to 26%. Insulin kinetics also improved. While children had small reductions in weight, their metabolic health could improve (Schwarz et al., 2017). Childhood obesity is also associated with hyperinsulinemia and other CRFs. Hyperinsulinemia is related to the risk of cardiovascular and other disorders (Hellmuth et al., 2016). A lifestyle intervention program was provided to obese children, and insulin resistance (HOMA index), fasting glucose, HbA1c, 2 h glucose in an oral glucose tolerance test, AA, and Carn were assessed. When children were found to have weight loss, insulin levels and insulin resistance were improved (Hellmuth et al., 2016). Weight loss can reduce the risk of glucose impairment of obese children.

Physical fitness

Physical fitness may be enhanced after weight reduction. Physical fitness was affected if children were overweight or obese. Physical fitness is defined as individuals having the ability to carry out daily tasks without fatigue and having the energy to enjoy leisure. Body composition, cardiorespiratory endurance, muscular fitness, and musculoskeletal flexibility are considered to be components of physical fitness (Wilder et al., 2006). Weight

loss may enhance partial physical fitness of overweight and obese children. A study also proved that cardiovascular fitness of participants was enhanced through a six-minute walk test after weight loss (Bartels et al., 2013). Another study also reported a similar result that weight loss can be beneficial for physical fitness through a six-minute walk test. In addition, body composition such as glucose, blood pressure and triglycerides can be improved, and a study outcome reported such a finding (FOR, E. P. O. I. G., & CHILDREN, R. R. I., 2011, Wing et al., 2011). Muscle strength and musculoskeletal flexibility may improve by having aerobic training. Enhancement of physical fitness is beneficial to increase children's engagement in physical activity and to reduce physical difficulties in sports participation.

Psychological variables

Obesity may have a negative impact on psychological variables and affect childhood development. Psychological variables include life satisfaction, optimism, self-esteem, and perception of social support. These elements may affect the psychological states of individuals (Mavros et al., 2011). Obese children are always under stigmatization (Zeller, Reiter-Purtill & Ramey, 2008). Weight bias persists and results in teasing and discrimination (Washington, 2011). Overweight children experienced more weight stigma and body dissatisfaction than children with a normal weight. They avoided exercise when they experienced more weight stigma (Vartanian & Shaprow, 2008). They were perceived to display more aggressive and disruptive behaviour (Zeller, Reiter-Purtill & Ramey, 2008). Obese children experience difficulties in social interaction and/or peer recognition. Weight loss may improve their life satisfaction, body image and their newly learned abilities, such as being able to be physically active and self-manage their weight (Palmeira et al., 2010).

Evidence showed psychological improvement for children (Fonvig et al., 2017). Fonvig and colleagues (2017) conducted a childhood obesity treatment program for children to improve their psychological well-being and to weight loss. Significant weight loss for children was found in the study, and in addition, a great reduction in weight was associated with greater improvement of quality of life, mood, and body image satisfaction. Weight loss and maintenance may also be supported by long-term behavioural self-regulation. A behavioural self-regulation program assessed the effectiveness of weight loss and tested mediators of weight loss (Teixeira, et al., 2010). The majority of psychological variables significantly improved after weight loss. In contrast, specific psychological eating variables, such as lowering emotional eating and adopting a flexible dietary restraint pattern, could sustain long-term weight loss for individuals (Teixeira, et al., 2010). Peer influence is important in childhood development. It affects interpersonal relationships of children and adolescents. Children learn social skills and establish close relationships with their peers. Poor peer relations predict poor psychological development and adjustment and may increase the risk of psychological disorders (Zeller, Reiter-Purtill & Ramey, 2008). Weight loss may benefit them in improving social function. There was a study to examine game playing for psychological improvement and weight loss. Weight loss in obese children may benefit them with more peer support. Peer support for children may promote group cohesion and cooperation. As a result, these game players may have increased self-esteem after weight loss. It may improve their psychological health and enhance peer acceptance (Staiano, Abraham & Calvert, 2013).

In childhood status, parental support is the most important factor to affect children's

behaviour in their attempt to lose weight (Erikson, 1959). Parents and families discriminate against youth who are obese. Although the comments were supportive or helpful, this may be perceived as negative and is experienced as victimization (Beck, 2016). If parents identify their children as overweight, it may increase children's feeling of stigmatization, and weight gain was found (Ling, Stommel & Choi, 2018). A study found that parents' encouragement and criticism of their children's weight was associated with poorer physical self-perceptions and greater dieting and dysfunctional eating as a result of weight gain. On the other hand, parents' encouragement of healthy lifestyles without emphasizing weight control was associated with better psychological well-being (Gillison et al., 2016). Parental support for healthy lifestyle behaviour and positive parental involvement for weight concerns may reduce negative psychological consequences for overweight and obese children (Gillison et al., 2016). A parent-based program has been conducted previously. Hammersley and colleagues (2019) conducted an internet-based and parent-based program in facilitating behaviour change in children who are overweight or at risk of becoming overweight. The intervention included multiple behaviours, such as nutrition, physical activity, screen time, and sleep. Although non-significant weight loss was found, parents showed improvement in dietary-related practices and self-efficacy.

Quality of life

Weight loss can promote quality of life. It can assess emotional or psychological health. Health-related quality of life (HRQOL) is defined as social, mental, and physical well-being. It evaluates the level of activity, participation, and body function and structure. Environmental and personal factors also affect these three components and levels of

involvement. The correlation between factors and these three elements also affect HRQOL (Tsiros et al., 2009). Overweight and obese children presented physical functional difficulties, such as exercise intolerance and social functional impairment. Obesity is a condition of stigmatization and is less socially acceptable in childhood. These children faced discrimination and teasing from their peers (Khodaverdi et al., 2011). These factors also affect their HRQOL. A previous study reviewed different literature regarding HRQOL of overweight and obese children. A reverse association was found in HRQOL and BMI. Apart from HRQOL, their physical and social functioning were also found to be impaired. Apart from physical wellness upon weight loss, the children's HRQOL also improved (Tsiros et al., 2009, Zeller, Reiter-Purtill & Ramey, 2008). A previous study assessed the outcomes after weight loss intervention with obese adolescents. Their physical fitness, such as metabolic syndromes, hypertension, and lipid abnormality, had improved. Their quality of life also showed significant improvement (Holterman et al., 2010). Another study revealed qualify of life was alleviated after weight loss. General health, vitality and change in health were obviously better after weight loss. Therefore, weight loss contributes to health-related quality of life rather than increases physical fitness (Ross et al., 2009).

4. Ecological Model of Predictors of Childhood Overweight

To explore more about predictors of childhood overweight, the "Ecological Model of Predictors of Childhood Overweight" is a model used to elaborate surrounding components that affect a child's weight status. Characteristics of the child, child risk factors, and contextual factors interact to influence the weight status of children and contribute to overweight and obesity (Davison & Birch, 2001).

As proposed by Davison & Birch (2001), the Ecological Model of Predictors of Childhood Overweight (figure 1) describes various factors and their priorities in affecting the weight status of children. There are several layers around the center of this model. Each layer shows various factors affecting children's weight status. The most important factors are allocated in the inner layer of the model, and the less important factors are allocated in the outer layer.

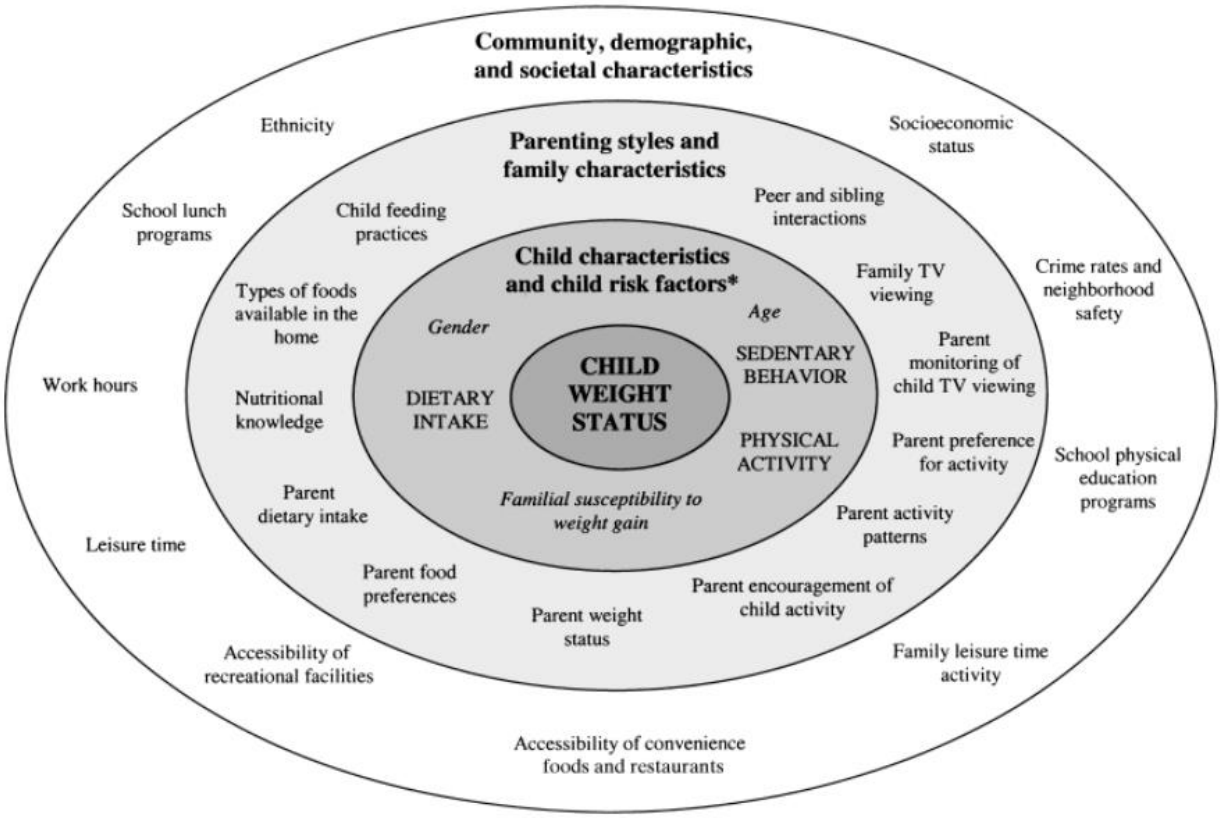


Figure 1 shows the Ecological Model of Predictors of Childhood Overweight (Davison & Birch, 2001)

Factor in the Centre

In the model, child weight status is placed in the center of the oval. Child weight

status may change and be affected by various factors, such as child characteristics and child risk factors, parenting styles and family and community, and demographic as well as societal characteristics. These factors are allocated by the level of impact on child weight status.

Factors in the 2nd Inner Layer

Child characteristics and child risk factors are located in the 2nd inner layer of the model. Child characteristics include age and gender. Due to the difference in body composition, the trend of weight gain and hormone influence, gender is a component contributing to childhood obesity (Wisniewski & Chernausek, 2009). More boys became overweight and obese in China, whereas, more overweight and obese girls were found in Western countries (Song et al., 2016). At the same time, older age is associated with a child's weight change because body fat varies with age (Ogden et al., 2014). Physical activity, sedentary behaviour, dietary intake and family susceptibility are risk factors that contribute to childhood obesity (Spear et al., 2007).

Physical activity

Physical activity can increase energy expenditure and contribute to long-term weight control as well as prevent obesity (Jakicic & Otto, 2005). WHO recommended that children should engage in moderate and vigorous intensity physical activity (table 2) for at least 60 minutes (World Health Organization, 2017). To enhance the health of individuals, moderate to vigorous intensity physical activity should be promoted. Gutin and Owen (2011) reviewed studies of the relationships between physical activity and cardiometabolic

biomarkers of youths. Results showed that when youths engaged in high amounts of moderate-vigorous physical activity, their cardiometabolic biomarker profiles improved. A longitudinal study found that participants engaged in the highest vigorous intensity activities were at low odds of becoming overweight and obese, compared to those in the lowest vigorous intensity activity (Hamer & Stamatakis, 2018). Another study measured sedentary time and physical activity independently to predict weight gain. The results showed that body weight was inversely associated with those engaging in moderate-vigorous intensity physical activity at baseline (Ekelund et al., 2017). It is a healthy habit for health or weight loss. Adopting the recommendation from WHO, fewer than 50% of children and 10% of adolescents meet the minimum requirement of physical activity daily (Leek et al., 2011). However, compared with normal-weight children, obese children were found to have even less physical activity (Page et al., 2005).

Table 2.

Moderate and vigorous intensity physical activity (World Health Organization, 2019)

Moderate-intensity physical activity (approximately 3-6 METs)	Vigorous-intensity physical activity (approximately >6 METs)
Brisk walking	Running
Dancing	Walking/climbing briskly up a hill
Gardening	Fast cycling
Housework and domestic chores	Aerobics
Traditional hunting and gathering	Fast swimming
Active involvement in games and sports with	Competitive sports and games such as

children/pets	traditional games, football, volleyball, hockey, and basketball
General building tasks such as roofing, thatching, and painting	Heavy shoveling or digging ditches
Carrying/moving moderate loads less than 20kg	Carrying/moving heavy loads more than 20kg

Sedentary Behaviour

Sedentary behaviour refers to any waking behaviour with an energy expenditure less than 1.5 METs while a person is in a sitting or lying posture without mobility impairment (Tremblay et al., 2017). METs are metabolic equivalents. MET is a common term to express the intensity of physical activity. One MET is defined as energy expenditure of sitting quietly, and it is equal to caloric consumption of 1 kcal/kg/hour (World Health Organization, 2019). TV viewing, video game playing, computer use/screen time, driving automobiles, and reading are also included in sedentary behaviour. These behaviours may reduce energy expenditure of children and contribute to childhood obesity.

High use of technologies, such as internet and public transportation, make daily activities more convenient. It shortens time for transportation and allows accessibility to worldwide information. Meanwhile, it also encourages more sedentary activities. These activities would reduce children's energy expenditure and habitual physical activity engagement as a result of increasing the chance of obesity. As mentioned before, TV viewing and computer games are considered sedentary behaviour and are favorite

sedentary activities of children. In particular, TV viewing is significantly associated with childhood obesity because children consume more snacks and remain physically inactive (Brown, Nicholson, Broom & Bittman, 2011, Procter, 2007). By asking children to record their daily activity and dietary habits, a cross-sectional study showed that the proportion of overweight children is higher among those who spent more than 3 hours on screen per day. TV viewing was positively associated with more consumption of energy-dense snacks and sweetened beverages (Li, et al., 2015).

Dietary Intake

Dietary intake is a contributing cause of obesity and is determined by energy consumption. A healthy diet is promoted, as it is essential to health. It protects individuals against chronic illnesses, such as heart disease and diabetes. The principles of a healthy diet include eating a variety of foods, and consuming less salt, sugars, and fewer saturated and industrially-produced trans-fats (World Health Organization, 2019). Individuals commonly adopt an unhealthy dietary pattern of consuming a higher proportion of animal fats and a lower level of fiber (Popkin, 2006), which contributes to childhood obesity (Nishtar, Gluckman & Armstrong, 2016). Obese children were found to consume more foods with fat spreads, coated poultry, potatoes cooked in oil, coated fish, processed meats, other meats, desserts and sweets, milk, and sugar-sweetened beverages; whereas, weight loss was found in children who consumed more whole grains and high-fiber breakfast cereal (Dong et al., 2015).

Food portion determines the energy balance of children. Food portion refers to the

amount of food consumed, and it affects the energy intake of individuals, including children. Food contains a certain amount of calories, determined by food composition. Larger food portion size increases the risk of obesity. A review reported that larger food portions (i.e., snacks and various meals) lead to an increase in energy intake of individuals in the United States (Ello-Martin, Ledikwe & Rolls, 2005). If parents feed children a large food portion size, children develop a usual dietary habit in food consumption that contributes to childhood obesity. A study reported that large portions of food significantly increase an individual's energy intake, and this intake effect was found for both snacks and a variety of meals. Parents were advised to prepare an appropriate portion of foods for their children and find ways to help recognize hunger and fullness to control eating (Ello-Martin, Ledikwe & Rolls, 2005).

Snacking contributes to obesity according to the energy density of foods. Snacking is an eating pattern of eating little with frequency (Miller, Benelam, Stanner & Buttriss, 2013). It is a behaviour providing health benefits, such as blood glucose stability and appetite control. On the other hand, snacking also was defined as a contributing factor of obesity. It is associated with intake frequency and food choice. These factors also related to energy intake (Miller, Benelam, Stanner & Buttriss, 2013). Snacks count as 27% of total calorie intake in a whole day, and children often consumed energy dense foods in snacking on such foods as chocolate, chips, or fruit drinks (Robin, 2007). These snacks contain high energy and proportions of energy and fat, compared to non-snacking eating. Although the average amount of food that snacks contained was not much, children who frequently consumed snacks showed a higher risk of obesity (Roblin, 2007). For one reason, a snack-dominated

meal pattern was associated with higher sucrose intake and lower intake of micronutrients (Ovaskainen et al., 2006). For whatever reason, in the recent decades, children were found to consume more snacks (e.g. candies, sweet beverages, and energy dense foods, such as French fries and pizza) (Newby, 2007). This was especially true for those who watched TV more frequently, as more snacks were consumed during TV viewing (Brown, Nicholson, Broom & Bittman, 2011, Procter, 2007).

Factors in the 3rd Inner Layer

Parenting styles and family characteristics are in the 3rd inner layer of the model because these factors affect the child's weight status indirectly. As mentioned before, family members influence child weight status through their behaviour, such as their dietary intake, food preference, their own weight status, activity pattern and preference, etc. Peer and sibling interactions affect children's weight status in behavioural change, too. For example, TV viewing is positively associated with children's weight status, and parents' attitudes toward TV viewing will influence children's TV time (Fuller-Tyszkiewicz, Skouteris, Hardy & Halse, 2012; Pearson, et al., 2011). Parental impact occurs through parental behaviour, monitoring and caring (Anderson & Butcher, 2006; Clark et al., 2007; Huffman, Kanikireddy & Patel, 2010; Lindsay et al., 2006). If TV viewing and snacking is common in leisure time, these family characteristics may contribute to childhood obesity. Therefore, the parent is a key person influencing children's' daily activities and habits. These factors determine children's weight change. Meanwhile, the home environment, determining food provision and nutrient knowledge, has indirect influence on children's weight status.

Child Feeding Practice

Child feeding practice is determined by parents' preference and eating behaviour. A previous study assessed the association between parental feeding practices, problem food behaviours and dietary intake of overweight children. It was found that parents play a main role in children's eating behaviour. If parents guided and monitored children in eating, they might eat fewer unhealthy foods. If parents were fussy eaters, they would less likely monitor children's food intake and would allow them to have more freedom in eating. In contrast, children consumed fewer fruit and vegetables if there were no fussy eaters (Haszard et al., 2015). On the other hand, a finding reported that emotional feeding practices of parents might be associated with emotional eating of children. They may easily contribute to overweight and obesity (Braden et al., 2014). Child feeding practice was directly associated with parent feeding practice.

Parent Dietary Characteristics

Dietary behaviour of parents also associates with, and influences, children in eating since parents, especially mothers, are responsible for preparing food (Padez, et al., 2005). Children follow parents' habits to develop their own habits, and parents play a critical role in developing children's dietary behaviour. A study assessed the relationship between parents and children in dietary intake. If parents consumed dietary components significantly for health, this behaviour determined the risk of obesity and was associated with children's intake. It was suggested that assisting parents to improve their quality of diets may improve children's diets as well. It did not only apply to snacking (Watts et al.,

2014). Parents have responsibilities to develop healthy dietary habits and inhibit unhealthy activity for their children to reduce the prevalence of obesity.

Food selection and preparation are the responsibilities of parents, so parents determine the nutritional intake of children. Coleman, (2019) addressed the traditional feeding practices of parents. Due to a widening price gap between natural and nutritional foods, parents seemed to purchase less costly and nutritionally deficient food. Jilani and their colleagues (2018) stated that parents also consumed more processed foods as they trusted in advertisements. Some parents who were not avoiding additives consumed more sweet, fatty, and processed foods. When children follow the eating habits of their parents, they may contribute to their own overweight/obesity condition.

Working parents may have challenges to prepare home meals (Powell, 2019). It is probable that they may skip breakfast and have a habit of eating out. If parents do not have time to prepare breakfast, skipping breakfast may become a dietary habit for themselves and their children as well. Skipping breakfast contributes to obesity. Breakfast skipping refers to the habit that individuals do not consume breakfast in the morning, usually between 06:00 to 09:00am (Smit et al., 2010). On the other hand, many parents perceived skipping breakfast as an effective way of weight control, due to their misconceptions about breakfast (Tin et al., 2011). There is a probability that adolescents' breakfast consumption is associated with one or both parents' dietary behaviour; for example, parents make or eat breakfast at home, or they do not eat breakfast, and adolescents will follow (Merten, Williams & Shriver, 2009). When parents were too busy to cook or skipped breakfast

themselves, children were more likely to skip breakfast. In addition, children were likely to skip breakfast when parents failed to recognize the importance of breakfast or hurried to go to work in the morning (Vanelli, Iovane & Bernardini, 2005). Therefore, it is critical to provide enough education to parents about nutrient balance and healthy breakfast habits. If parents do not prepare breakfast for their children, children may eat breakfast outside or skip breakfast. Meanwhile, children are also likely to develop such habit with parents' encouragement or approval.

The habit of eating out also contributes to obesity. Food consumed when eating out usually contains energy with fat and less fiber (Bin Zaal, Musaiger & D'Souza, 2009, Lachat, et al., 2012, Newby, 2007). If children have developed such a habit, they are at higher risk for obesity because they commonly consume more "fast food" with poorer nutritional quality, which contains higher energy and fats (Newby, 2007). Working parents or those with a busy schedule are more likely to use eating out as an option (Story, Kaphingst, Robinson-O'Brien & Glanz, 2008). It was found that families were at restaurants purchasing fast-food takeaway at least weekly by assessing parents' perception of the eating environment for school-aged children (Fulkerson, Story, Neumark-Sztainer & Rydell, 2008). Regarding the risk factors of childhood obesity in China, a cross-sectional study examined dietary habits, lifestyle habits and feeding practice, and children's height and weight, along with parental characteristics, and the study showed eating out was a main dietary habit of Chinese families, one of the risk factors of childhood obesity. The results also suggested that the frequency of eating out was high, and this was associated with a higher level of childhood obesity (Jiang, et al., 2006).

Parents' Perception of Physical Activity

Parents' perception of physical activity also affects children's physical activity engagement. A previous study showed that parents' beliefs and perceptions of physical activity influences a child's physical activity competence. The mother's role modelling behaviour directly affects the amount of time children spend on physical activity, and their beliefs influence the child's competence. The father's beliefs influenced the child's physical activity and perception on competence (Bois et al., 2005). Another review study also reported the significant correlations between parental support and the physical activity level of the child (Gustafson & Rhodes, 2006). Parental support and modelling are the main components affecting the physical activity encouragement of children. However, if parents were less physically active, their encouragement was not effective to enhance the physical activity level of children. (Tate et al., 2015). Parents are not only carers of children, but also role models for them. Parents acting as role models had a direct effect on the time children engaged in physical activity, and parents' beliefs about the child's competence also had an indirect effect on children's physical activity by influencing children's perceived competence (Shen et al., 2018). A study in Portugal found that parents' sedentary behaviour and parental education are risk factors for childhood obesity, and mothers have a great impact on the lifestyle activities of their children, such as the time allowed for watching TV (Padez, et al., 2005). Parents' sedentary activity, such as TV viewing, could also be a model for children that affects their development of lifelong habits. If parents are physically inactive, their children are likely to follow their behavioural pattern. The home environment also plays a role. Preschool children were found to watch TV for a longer

period of time if there was TV in their bedroom. It was suggested that TV should be kept out of children's bedrooms to inhibit them watching TV (Lindsay, Sussner, Kim & Gortmaker, 2006). The study also revealed the positive association of lifestyle behaviour between parents and children in China. Parents were found to have a positive association with children on diet, screen time, and physical activity. Apart from diet, children engaged in leisure-time sport. positively associating with parents. Children are more likely to participate in sports if parents also do so (Dong et al., 2016).

Factors in the Outer Layer

Community, demographic and societal characteristics are in the outer layer of the model. Ethnicity affects parents' perceptions of overweight and obesity. A school lunch program, school physical education, parents' working hours, leisure time, recreational facilities, family leisure time activities, convenience of foods and restaurants, crime rate and neighbors, ethnicity and socioeconomic status are also taken into account in this category. These elements cannot directly affect children's weight status but count as an indirect influence.

Although the factors are distributed according to the impact of child weight status, all of them are inter-related. For example, parents' decisions regarding joining the school lunch program may depend on the distance between home and school, their working hours, and other unforeseeable factors. When making the decision, their level of nutrition knowledge may also play a role. In addition, the child's age, gender, and family susceptibility of overweight also have considerable effect in children's' weight status. The

various community and societal characteristics are stated as follows and contribute to childhood obesity indirectly.

School lunch program

A school lunch program is an important way of school-day dietary intake for school children. The food supply in the school lunch program determined the quality of nutrition intake of children (Peckham et al., 2019). A study investigated food selection and consumption in a school lunch program in the U.S. In the national school lunch program, free lunch recipients most likely chose the free lunch that was higher in fat and protein, but lower in carbohydrates and sodium; whereas, students paying for a full-price lunch chose lunches from home and school. That lunch was relatively higher in protein and sodium than the lower income participants' free lunch. This is a significant factor affecting body weight of children (Peckham et al., 2019). Comparing school lunch programs worldwide, Japan's program has a significant effect on decreasing the prevalence of childhood obesity (Miyawaki, Lee & Kobayashi, 2018). There, children have no choice on menu items for the school lunch. It is a part of their school education on dietary and nutrition for them to understand food portion and meal balance. Meals are managed in a uniform way according to regulated nutrition standards. Results showed a decreasing prevalence of overweight and obesity in boys, but not in girls. Girls in Japan have an increasing problem of thinness rather than being overweight and obese because of misconceptions of self-image and body image of girls. They were most likely to think that thinness results in increased positive self- and body image. In short, the school lunch program proved to have a protective effect to prevent overweight and obesity of children in Japan (Miyawaki, Lee & Kobayashi, 2018).

The evidence showed that the combination of education and adequate meal supply can enhance health knowledge for school children and their parents.

School physical education program

Physical Education was less concerning, and this may be reflected in the school curriculum. Regarding students' holistic development, the school plays a critical role. Apart from academic development, Physical Education is the only subject in the curriculum that delivers knowledge of various sports and provides opportunities for students to engage in physical activities. However, many schools have focused on academic achievement of students and ignore their physical development. Consequently, the number of lessons of Physical Education has been reduced, and it has become an elective subject in some primary schools. However, in the United States, a study found that shrinkage of physical education courses or making it optional in primary schools could potentially contribute to physical inactivity among the students in the United States (Snethen, Broome, & Cashin, 2006).

Parents' working hours

Parents' working schedules influence children's' activity patterns and their physical activity engagement. Meanwhile, parents are the role models for children. If they engage less in physical activity, children may follow this lifestyle and develop it as a habit. In particular, parents' work schedules affect the activity pattern of children. With one or both parents working in non-standard hours, children may spend more time at home and less time engaging in physical activity and, consequently, contribute to a high risk of obesity. A

previous study reported childhood obesity was significantly associated with both parents' work in nonstandard hours, but not one parent's non-standard working hours (Champion et al, 2012). The same relationship was also found between childhood obesity and one or the other parent working a nonstandard schedule (Champion et al, 2012).

Physical environment and recreational facilities

A key factor influencing children's activity engagement is the community and neighborhood environment. By exploring the role of the environment in promoting obesity of children in the U.S. (Sallis & Glanz, 2006), it was found that the environment development pattern (such as lack of a sidewalk, long distance to school, and walking inconvenience) is one of the contributing factors for obesity. In such a case, children would choose alternative methods such as taking public transportation instead of walking, which may directly reduce their physical activity engagement. Recreational facilities, such as parks and playgrounds, within neighborhoods are most important for children. When these facilities were available in close proximity, it was more likely they were attracted to spend more time to play. Supporting evidence showed that children had a higher rate of adiposity when living in a neighborhood with undesirable environmental development, such as poor housing, unsafe surroundings and lack of sidewalks or parks (Singh, Siahpush & Kogan, 2010). Similarly, a longitudinal study found that the longer the distance between children's home and park or recreation programs, the greater the association with higher BMI. Therefore, better accessibility to parks and recreational resources were recommended to reduce children's BMI (Wolch et al., 2011).

Family leisure time activity

Family activity planning was determined by parents. If parents are physically active, children will follow (Sigmundová et al., 2016). High use of technology also contributes to obesity because it shortens time for transportation and distance through communication, accesses worldwide information more conveniently and enriches daily activities and entertainment, which reduces physical activity engagement of children (Baranowski, 2019; Brown, Nicholson, Broom & Bittman, 2011; Procter, 2007; Rey-López, Vicente-Rodríguez, Biosca & Moreno, 2008). The socioeconomic background of the family also affects activity patterns of children. Children with a lower socioeconomic class or with migration background participated less in organized sports because they could not afford the membership fee. In addition, those childhood obesity programs that combined nutrition and physical activity and yielded the best results were hard to access (Hilpert et al., 2017).

Convenience of foods and restaurants

Foods' and restaurants' accessibility are directly associated with children's consumption of energy dense foods. Supermarkets provide more healthy foods, but convenience stores provide more energy dense foods, which affects children's eating behaviour (He et al., 2012). The shorter the distance between convenience stores or fast-food outlets in the surrounding neighborhood and children's homes, the stronger is the association with poor nutritional intake (He et al., 2012). Zeng, et al., (2019) reported that school children increased their body weight while they were living in "food deserts" – a food desert is defined as an area that lacks access to healthy foods (Dubowitz et al., 2015). The proximity to fast-food restaurants can contribute to weight gain. The shorter the

distance between fast-food restaurants and school, the higher the positive association with obesity rates of children in U.S. (Zeng et al., 2019). On the other hand, supermarket proximity and availability influence individuals' healthy food purchasing behaviour or healthy diet consumption. Improvement of supermarket access could help to reduce childhood obesity because a supermarket is a primary source of healthy food provision. However, He and colleagues (2012) stated the nearest supermarket was not associated with healthy eating. This finding may explain the food purchasing behaviour of children. When children live closer to convenience stores or fast food stores, they were more likely to buy fast foods when parents were not around, compared with those living far from convenience stores or fast food stores (He et al., 2012). This behaviour and proximity of convenience stores and fast-foods shops contribute to the increase of the childhood obesity rate. Although the closest supermarkets are not directly associated with healthy food purchasing behaviour or healthy diet consumption, it benefits certain groups of people. Zeng et al., (2019) revealed that improved supermarket access could help to reduce the childhood obesity rate of children in low-income families, but it would not benefit all children (Zeng et al., 2019). This study did not provide more details about this finding. There seemed to be different perceptions of food accessibility within various population groups. Children in the low-income group were concerned about the cost of food purchases, whereas, others were concerned about accessibility to food shops only. Also, children perceived supermarkets as a place for adults to make larger-scale grocery purchases rather than a place to buy snacks (He, et al., 2012). Children in the low-income group may be instructed by their parents to buy foods in supermarkets to reduce food costs. Obesogenic environmental change is important, but educational interventions for both children and

parents are necessary. Parents should influence children's perceptions of food selection, nutrition, and portion control (He et al., 2012; Zeng et al., 2019).

Crime rate and neighborhood

The crime rate and neighborhood could affect one's intention for engaging in outdoor activity. As a result, children may engage in more sedentary activity at home and increase their risk of obesity. Safety issues are a concern for parents when allowing children to take part in physical activity. Neighborhood safety issues directly inhibit children's participation in physical activity. Even though many people understand the important roles of community and neighborhood that affect childhood obesity, fewer studies reported on the relationship between community, neighborhood, and childhood obesity. A study was conducted that compared the degree that parents limited their children's outdoor physical activity in a poor inner city and suburban community (Weir, Etelson & Brand, 2006) and it found that children in inner city neighborhoods engaged less in physical activity compared to children living in suburban areas. Parents' anxiety contributed to lower physical activity engagement of children in inner city areas because of a higher criminal rate. Parents were worried about both play environment safety and personal safety of children engaged in outdoor activities (Weir, Etelson & Brand, 2006). Another study showed there was no association between perception of neighborhood safety and children's physical activity engagement, as parental perception of personal safety influences physical activity engagement among boys and girls in various aspects (Carer, Timperio & Crawford, 2008). Other studies showed that parents' concerns regarding safety was positively associated with children's level of physical activity in Australia and the U.S. (Carver, Timperio & Crawford,

2008; Weir, Etelson & Brand, 2006). A study was conducted to provide evidence-based assessment across physical activity behaviours, sleep, and related community and government initiatives for children and youth (Huang et al., 2019). Physical activity behaviour, sedentary behaviours and organized sport participation got lower grades even though more than half of youth and parents felt that their neighborhood was safe (Huang et al., 2019).

Race/Ethnicity and socioeconomic status

Race and ethnic groups are found to influence childhood obesity. Also, the economic and societal status of parents may affect the body weight of children, their perceptions and food choices, and their eating behaviour. African American and Latino children were found to have higher BMI scores than white children. Their background significantly affected their lifestyle behaviour. The majority of these children came from immigrant families characterized by low maternal education, higher rates of maternal depression, early introduction of solid foods, restrictive feeding practices, physical inactivity, and beverage and fast food consumption. The unhealthy weight development of children aligned with their behaviour and social phenomenon. Latino immigrant families were facing a rapid increase in income combined with an uncontrolled feeding practice of children. Processed foods are inexpensive, which attracted them to buy more of these highly caloric foods. At the same time, these children were found to consume soda, and this behaviour increases calorie intake and the prevalence of childhood obesity in these groups of children (Guerrero et al., 2016). In addition, this study described growth trajectories in the body mass index (BMI) among the major racial and ethnic groups of US children. It found that African-

American and Latino children displayed higher predicted mean BMI scores. Asian children had lower average BMI raw scores compared with whites, African-American, and Latino children. Lower birth weight and a higher proportion of breastfeeding were found in Asian children (Guerrero et al., 2016).

Parental educational level is indirectly associated with childhood obesity. The educational level of parents determined their decision making to seek appropriate advice when their children experienced unhealthy outcomes. Food choice and characteristics of physical activity of children were also affected (Padez, et al., 2005). Parental misclassification of children's overweight or obesity status was revealed as being caused by parental educational level. A study was conducted to explore the hypothesis that non-obese, well-educated parents could report an accurate weight status of children, and obese parents and children would report a false negative for overweight or obesity. It was found that parents with a low education level caused a lack of health information and social desirability bias and were factors contributing to negative false results for overweight or obese conditions (Cullinan & Cawley, 2017). In addition, the parental educational level is associated with eating behaviour and screen time (Cameron et al., 2012). Less educated parents provided more energy dense foods and beverages (Smetanina et al., 2015). It was found that parents with low income hold a fairly even lower educational level. They provided snacks for children using nutritive reasons such as promoting growth and satisfying hunger and non-nutritive reasons such as rewarding behaviour, keeping children quiet and celebrating achievements (Blaine et al., 2015). Furthermore, longer screen time was also reported in lower socioeconomic families compared to higher socioeconomic

families. Lower socioeconomic families allowed children to have greater access to media such as TV, DVD players, video games in their bedrooms, but lower access to portable play equipment such as bikes and jump ropes (Tandon, et al., 2012). Parents were concerned about the neighborhood's safety, having no time to supervise children in their neighborhoods, and difficulty in accessing alternative activities and allowed children to access media indoors as an alternative to outdoor activities (Tandon, et al., 2012). The maternal educational level was also associated with childhood obesity (Padez, et al., 2005). Mothers are usually responsible for food purchasing and preparation, as well as arranging children's lifestyle behaviour (Padez, et al., 2005). Mothers' perceived inappropriate health concepts caused inadequate health outcomes for these arrangements. Therefore, childhood obesity was found where parents held a lower education level.

The factors in the 1st and 2nd layer of the model are more important in affecting the weight status of children. The factors in the 3rd layer are uncontrollable, so that the proposed study program focused on controlling factors in the 1st and 2nd layer of the model.

4.1. Interventions in Childhood Obesity

Interventions for childhood obesity are similar to adulthood obesity. However, children usually have a lower level of self-control (Levitan et al., 2015; Pandita et al., 2016) and their physical and psychological health is still under development. Therefore, parents or family members who are taking care of them play an important role in their weight control. Many intervention programs not only involve children, but also their teachers, parents or family members (Spear et al., 2007). To date, it has been inconclusive about

which treatment is the most effective in children's weight. Most treatments have included various strategies such as diet control, education, behavioural therapy, etc. These strategies are recommended to modify their behaviour as well as their lifestyle. For those with a severe weight problem, strategies such as medication and surgeries were also suggested.

4.1.1. Interventions in Weight Management

Physical activity, dietary and behavioural modification are commonly used in weight management. There is no standardized definition of weight management. The majority of studies described weight management as a strategy for weight loss. Education is the main strategy of weight management. Perry and colleagues (2018) conducted a family-focused child weight management programme support to families with a 5- to 9-year-old obese child. The programme involved healthy lifestyle sessions followed by telephone sessions. The healthy lifestyle sessions included information on healthy eating, restricting sedentariness and being physically active, as well as monitoring lifestyle behaviours. The targets were to improve lifestyle behaviour and to have weight loss. Chai and colleagues (2019) reviewed previous studies to explore the effectiveness of family-based weight management of overweight and obese children. The effective interventions of weight loss were to use parent-targeted strategies, including nutrition and physical activity education sessions, positive parenting skills, role modelling and child behaviour management. Children were encouraged to exhibit positive healthy eating/exercise behaviours.

Physical activity or exercise

Physical activity/exercise is an effective intervention to increase energy consumption

and contribute to weight loss (Hill & Wyatt, 2005). According to a World Health Organization recommendation (2017), children aged 5-17 are encouraged to participate in moderate- to vigorous-level physical activity for at least 60 minutes 3 times per week. Children can control their body weight and receive obvious health benefits from engaging in regular physical activity (World Health Organization, 2017). To achieve the goal of weight control, moderate- to vigorous-level aerobic physical activity is an essential intervention. However, inconsistencies were found across different studies regarding the level of aerobic physical activity. A systematic review study on the effects of physical activity on the fitness and health of children has been reported. Although no BMI was significantly changed, physical activity was associated with health benefits. Children who participated in more physical activity, their anthropometric measures such as blood pressure, cholesterol level and blood glucose, were improved (Janssen & LeBlanc, 2010). By reviewing existing studies with well-designed controlled trials, Watts, Jones, Davis & Green (2005) found that children with exercise training had bodyweight or BMI reduction, and their body composition, such as body fat and body mass as well as body functions, also benefited from the training programs (Watts, Jones, Davis & Green, 2005). A prospective randomized study also found children in the exercise group showed reduced body weight and fat percentage improvement with increased total ghrelin and UAG levels (Kim et al., 2008). In summary, continuous exercising and level of physical activity are main factors affecting weight loss.

Dietary interventions in weight management

Dietary intervention is a main component in weight management. It could affect

the energy balance of the individuals and greatly impact children's' development. Many dietary interventions were implemented, but the effect was controversial.

Nutritional counseling was commonly used, but the content was different. The randomized controlled trial study was done to evaluate the effectiveness of a portion control system on change of BMI z-score in children (Ho et al., 2016). Participants in the intervention group received an extra 10 to 15 minutes counseling on using a calibrated dinner plate and breakfast cereal bowl for the child, and adults used it for dietary portion control in the family. Although no differences were found between groups, BMI z-score was reduced between baseline and 6 months of each group (Ho et al., 2016). Other dietary counselling was provided in the previous study. In this study, three groups were randomized. Group 1 received usual care, group 2 received a motivational interview and behaviour therapy, and group 3 received motivational interviewing and dietary counselling. As a result, children's BMI percentile was lowest in group 3, and it showed significance. Dietary intervention can bring a positive effect on childhood obesity (Resnicow et al., 2015).

Diet modification is another type of dietary intervention. It focuses on caloric reduction through decreased intake of high-energy dense food, low nutrient foods with an increased intake of low-energy dense food and high-nutrient food to control obesity (Altman & Wilfley, 2015). Hayes et al. (2016) implemented a family-based treatment which is combined with diet and behaviour modification, etc. The traffic light diet is a common tool used to identify various foods to encourage children to consume a healthier, nutrient-rich diet to lose weight. The child's body mass change and food fussiness were

finally improved (Hayes et al., 2016). Weight gain is caused by energy imbalance. It does not only associate with being less physically active, but also relates to oral intake. Eating out is a habit that promotes obesity. Reduced eating out consumption can improve dietary intake and reduce body fat and BMI (Altman et al., 2015). A study was done on evaluating the association between change of diet and a child's BMI and body fat. Reduced eating out consumption significantly associated with greater reduction in BMI and body fat. This study found that overall diet quality was changed when eating out consumption was reduced (Altman et al., 2015).

Behavioural modification in weight management

Lifestyle is an activity pattern affecting the dietary and activity pattern of children every day. Unhealthy lifestyle behaviour is one of the components contributing to childhood obesity. To benefit the health of children, it is essential to change lifestyle behaviour at a young age. By reviewing the behavioural interventions preventing childhood obesity, a systematic review showed a small effect on behavioural change, such as increasing physical activity and healthy dietary behaviour, reducing sedentary activity and unhealthy dietary behaviour. However, there was no effect on BMI. The intervention period was a key factor in effectiveness (Kamath et al., 2008). A two-year family behavioural treatment was conducted involving home environment observation, food management (e.g. cooking style, types of food storage and selection), as well as intervention to increase physical activity and reduce unhealthy foods intake. After treatment, BMI had significant reduction, cholesterol, triglycerides, and blood pressure were also reduced in the intervention group, but not in the control group (Jiang, et al., 2005). To enhance the effect

of weight control, a previous study used mandometer to obtain feedback of weight loss in obese children and adolescents. After 12 months, mean BMI SDS and body fat of the mandometer group was significantly lower, compared to the standard care group. The concentration of higher density lipoprotein cholesterol also had greater improvement in the mandometer group (Ford et al., 2010).

Combined lifestyle interventions in weight management

There is no conclusion on which intervention was the most effective, and each intervention has its strengths and weaknesses after reviewing various interventions in weight management. To achieve effective weight management, combined lifestyle interventions are needed. Combined lifestyle interventions are for obesity prevention and control. The expert panel of the childhood obesity area suggested weight management interventions should be combined with counseling, physical activity, and diet to increase energy expenditure, after reviewing existing literature (National Heart, Lung and Blood Institute, n.d.). Many childhood obesity programs reported their effectiveness in research settings, rather than in primary care settings (National Heart, Lung and Blood Institute, n.d.). A systematic review of randomized controlled trials showed the high effectiveness of combined lifestyle interventions in treating childhood obesity. The review reported the mean effect size was 0.95 at post-intervention and 0.6 at follow up for no-treatment controls. The mean effective size was 0.48 after interventions and 0.91 at follow up for controls education or information provision (Coppock, et al., 2014). The effectiveness of multidisciplinary interventions, including nutrition, exercise, and psychological aspects, was reported in a previous study (Ranucci et al., 2017). The duration of the program was

six months for children and three months for adolescents. During the intervention period, intensive lifestyle interventions were delivered by a family-based approach. Apart from anthropometric measures, cardiometabolic risk index, and nutrition habits of the participants and their families, a set of functional motor fitness tests was also assessed before and after interventions. After interventions, a significant reduction was reported of all the measurements in children and weight circumference, fat body mass percentage in adolescents. The nutritional habits measure showed a medium and a large effect size with children and adolescents, respectively. Both also had improvement in physical fitness (Ranucci et al., 2017).

Intensity of weight loss intervention

Apart from interventions, intensity of weight loss intervention is also one of the components influencing the effectiveness of intervention. Intensive intervention is necessary to arouse alertness of intervention for participants to enhance treatment effects. This was observed in six weeks in the summer residential weight-loss camp for overweight children. The program included physical activity sessions, dietary restriction, and group-based educational sessions. The control group provided unmonitored activity only. After interventions, participants had lost 6 kg and reduced BMI by 2.4 units. Fat mass was reduced from 42.7 to 37.1 kg, but fat-free mass was the same as before among those who stayed for about 29 days, compared with the control group. For those staying longer, better improvement was found in the final outcomes (Gately et al., 2005). One hundred and sixteen parents and obese children were randomly assigned to a multi-component community-based childhood obesity intervention (MEND) and control group in another

study. Those in the intervention group attended 18 3-hour group educational sessions over 9 weeks and physical activity sessions twice weekly with a 12-week free family swimming pass. It was observed that weight circumference z-score and BMI z-score were reduced at 6 months and 12 months, compared to the control group (Sacher et al., 2010).

Parents are the main carers for children. There should be a focus on parental education on the above weight loss interventions to empower the effectiveness of the current study.

4.2. Effective Strategies of Different Approaches for Childhood Obesity

Clients' needs are essential to determine strategies for childhood obesity. Different approaches may be provided based on the treatment or prevention needs of the clients. Numerous studies have focused on the effectiveness of interventions treating childhood obesity. The long-term and short-term effect of interventions for childhood obesity were investigated in the United States. Dietary-behavioural-physical activities were combined to increase energy expenditure. A positive outcome was found (Nemet et al., 2005). A previous review showed that combined interventions (dietary, physical activity, behavioural change, and parental involvement) were the most effective in weight control (Snethen, Broome & Cashin, 2006).

To slow down the prevalence of childhood obesity, a preventive approach should be promoted to enhance health knowledge among children and caregivers. This approach should increase the awareness of children and caregivers, as well as reduce medical expense of obesity-related complications or comorbidities (Lehnert, et al., 2013). The

effectiveness of combined intervention to prevent childhood obesity was assessed. It included interventions of diet, physical activity and/or lifestyle and social support. A minor, but positive, impact on BMI was found in some short-term studies (Summerbell et al., 2005). To achieve the long-term effect on weight control, skill education is a more effective intervention. Children in the physical activity group showed better performance in motor skills, but no difference in BMI (Reilly et al., 2006).

To slow down the prevalence of childhood obesity, it is recommended to make the treatment approach the priority in control of childhood obesity. Even though the combined intervention was found effective, the facilitators of such intervention are the key factor to the success of the intervention. Children rely on parents in planning daily activities and are influenced by caregivers in making behavioural changes. The role of caregivers is very important, and it is suggested the role of parents or families should be taken into consideration when assessing the effectiveness of interventions.

Childhood obesity programs were conducted for obese children. These programs included a combination of various interventions. To enhance the power of effectiveness, persons such as teachers and parents were invited to participate. A combined setting with community and family involvement is most likely to show the desired effect in weight control of children.

Family-based program

A family is a group of people with close relationships. Parents play the main role in

caring for children as well as family members. Siblings also exert peer influence on children's behaviour through daily activities and interaction. As parents take up caring for children, they are responsible for preparing foods and meals and for planning daily activities. They affect the holistic development of children, especially their daily habits. Therefore, family involvement was advocated for the childhood obesity program (Golan, Kaufman, & Shahar 2006; Waters et al., 2011). Due to the great impact of parents and families, many childhood obesity programs invited them to participate in such programs, with a view to enhancing their knowledge as well as affecting their children's behavioural change or weight loss (Coppins et al., 2011; Elder et al., 2014; Foster et al., 2012; Gunnarsdottir et al., 2011; Kalarchian et al., 2009; Lloyd, Lubans, Plotnikoff & Morgan, 2014; Morrison et al., 2013 & Sacher et al., 2010).

Enhancing parents' knowledge in childhood obesity holds benefits for weight control for children because parents are the key persons who nurture children in their perceptions, attitudes and behaviour. There was a family-based program focusing on an education package for two years in the United Kingdom. Sixty-five children participated in the program, and they were randomly assigned into the intervention/control (I/C) group and the control/intervention (C/I) group in year 1 or year 2. After that, they took turns. Children were requested to attend physical activity sessions and workshops focusing on healthy eating, physical activity, sedentary behaviour reduction, behavioural change, and psychological wellbeing. Parents and siblings were welcome to attend the physical activity sessions, and they were requested to participate in various workshops in the intervention period. Using a questionnaire, BMI SDS, waist circumference, body fat and lifestyle

outcomes were evaluated to identify the changes at baseline, at 6 months, 12 months, and 24 months. Before intervention, it was found that 60% of the children were above the 99.6th BMI percentile at baseline. After intervention, 19% of I/C children compared to 48% of the C/I children were above the 99.6th percentile at 24 months (p=0.04). No significant difference was found between groups in nutrient intakes. However, the consumption of potato crisps was significantly reduced in the C/I group at 24 months (mean =25g/week, 95% CI, -1.2- 51.2), compared to the I/C group (mean= 87g/week, 95% CI 41.2-132.8). Moderate activity was engaged in more in the C/I group at 24 months (I/C mean=182.9 min, 95% CI, -39.2- 404.90; C/I mean=606.9min, 95%CI, 202.7-1011, p=0.038) (Coppins et al., 2011).

To investigate the effectiveness of behavioural treatment for childhood obesity, a pilot study was conducted in Iceland. Sixteen obese children participated in the study. Pairs of parent and child were randomly assigned to two groups and received treatment at different times. The duration of treatment was over 4 months. Group A received family-based treatment over 4 months and follow-up for 1 year. Group B received standard care for 1 year before starting family-based treatment. During treatment, parent and child dyads attended 11 group education sessions and 11 individual sessions. In group sessions, parents received information about behaviour modification techniques and heathy diet. The traffic light/spotlight diet was used to assist parents and children in choosing dietary intake. Parent and child dyads attended individual sessions together. They were weighed and submitted a self-monitoring record. The record was used to analyze the change in body weight, fruit and vegetable consumption and physical activity. Goal setting and problem solving were

also discussed in these sessions. Anthropometric measures, fruit and vegetable consumption and physical activity were evaluated at baseline, 4 months, 12 months, and 16 months. Children were found to have significant reduction in BMI-SDS during treatment ($p<0.001$). The mean BMI-SDS of group B children was reduced from 3.24 to 3.22 at 12 months ($p=0.88$), compared to the standard treatment. Whereas, group A children maintained the BMI-SDS (2.92) after treatment in the 1-year follow-up (2.94). On the other hand, they increased their consumption of daily fruit and vegetables and their level of physical activity ($p<0.001$). The participating parents also reduced their weight on average (5.1kg; $p<0.001$) (Gunnarsdottir et al., 2011). Family-based program was not only beneficial for children, but also for their family members, and especially for parents.

Many studies were concerned with the maternal impact on children (Gibson et al., 2007, Maher, Fraser & Wright, 2010, Ong et al., 2007). The impact of fathers was ignored. To investigate the impact of fathers in childhood obesity, a study was conducted in Australia. Fifty-three overweight and obese fathers with their children participated in the "Healthy Dad, Healthy Kids" program. They were randomly assigned into the intervention group and the control group according to family unit. The duration of the program was 3 months. In the program, fathers were requested to attend 8 sessions. Five sessions were for fathers, and 3 sessions were for fathers and children together. The content included physical activity, nutrition, and dietary components. The outcome measurements of fathers' weight, BMI, waist circumference, blood pressure and resting heart rate, physical activity, and dietary intake of both were assessed at baseline, 3 months, and 6 months. Fathers' weight was found to have a significant change at the 3-month and at 6-month follow up ($p<0.001$;

d=0.43). The group difference was also found in percentage of weight loss ($p<0.001$). Waist circumference ($p<0.001$), blood pressure (systolic blood pressure, $p=0.01$; diastolic blood pressure $p=0.04$), resting heart rate ($p=0.01$) and mean steps per day ($p=0.002$) of fathers were also found to have reduction at 3-month and at 6-month follow-up. Mean steps per day ($p<0.01$), resting heart rate ($p=0.01$) and dietary intake ($kjkg^{-1}$, $p=0.01$) of children also had improvement (Morgan et al., 2010). Another similar study was also conducted, but it evaluated the impact of the program on fathers' and mothers' parenting practice. Eighty-seven fathers and their children participated in the program. They were randomly assigned into the intervention group and the control group. The duration of the program was 7 weeks, which included 7 sessions. Four sessions were provided for fathers and the rest of sessions were for both mothers and fathers. The content included physical activity, dietary intake, and nutrition. Anthropometric measures and parenting practices of fathers and mothers were collected at baseline and at 14 weeks follow-up. As a result, reports showed significant reduction in fathers' weight ($p<0.001$), waist circumference ($P<0.001$), diet ($P<0.01$) and physical activity ($p=0.04$). Physical activity ($p=0.01$) and BMI z-score ($p=0.05$) of children were also found to be reduced. Surprisingly, fathers' parenting practices had improvement (use of reinforcement, $p<0.01$; limit setting, $p=0.048$), but there was no difference in maternal parenting practices (Lloyd, Lubans, Plotnikoff & Morgan, 2014). These studies revealed that the impact of fathers existed, and they affected children's behavioural change as well as weight loss.

A 12-week family-based program was facilitated in the United Kingdom. The program targeted parents and children and emphasized parenting skills, healthy lifestyle,

and emotional issues. Twenty-seven overweight/obese children and their parents participated in the program. Education sessions, group meetings, and interaction activities were also included in the program. Anthropometric measures were collected, and psychosocial health and lifestyle were also assessed through questionnaires before and after, as well as at a 9-month and 2-year follow-up. BMI z-score of children reported significant change at a 9-month follow-up and was maintained at a 2-year follow-up. The mean change of BMI z-score was reduced -0.23(95% CI: -0.42 to -0.03, P = 0.027). Both BMI and waist circumference also showed significant reduction from baseline to the 2-year follow-up. Quality of life of both parents and children had improved (95% CI 11.9, 15.1 and 10.1). The result also reported significant reduction in sedentary behaviour, less consumption of unhealthy food and an improved eating style at home. Regarding cost of treatment, the program cost £517 and £402 per child. The cost was lower than other childhood obesity treatment (Robertson et al., 2012). To remain substantially healthy, lifestyle behavioural change and parental education are important, contributing to better quality of life for parents and children.

To reflect the impact of parents in childhood obesity, there was a study conducted in the United States that investigated the effect of the Be Beary Healthy program. This program concentrated on a parent-focused approach, providing education that strengthened their feeding skills for preschool children. This was a single-group study with a pre- and post-test. Forty-five mothers and their children participated in the program. Parents received age-appropriate nutrition education. To facilitate parents' practice in providing the right portion of foods, a plate was provided. Parents could use the plate to measure food

portion and provide foods for children. The nutrition and diets of children were assessed before and after intervention, as well as asking for parents' experiences in using the plate. The outcome reported that children had significant reduction in average intake. The average total fat (g) ($t=1.96$, $p=0.05$) and mean carbohydrates (g) ($t=3.96$, $p<0.01$) consumed by children were found to have declined. Children consumed less calories ($t = 3.49$, $p<.01$) according to the post-test, compared to the pre-test. No significant difference in patients' nutrition knowledge was found ($t = -1.12$, $p = .26$). Parents had considerable positive feedback in using the plate because children were willing to use it and eat from the plate (Small et al., 2012). The skill training was more useful than knowledge enhancement in this study. It showed the impact of parents. However, the study was single-group design, and it was suggested to have comparisons to show the effectiveness.

After reviewing previous studies regarding family-based childhood obesity programs, skill training is suggested, but it needs to relate to caring of children in dietary intervention and physical intervention such as cooking recipes, enhancing activity strategies and parenting skills in managing problem behaviour of children, etc. These interventions are practical and useful and can help parents to make use of these interventions for planning children's daily activity. Parents assume the main caregiver role, so that they must join a childhood obesity program for affecting children's behaviour.

Parental Impact on Children Aged 5-9

Parents have a great impact on childhood development of children aged 5-9. According to Erikson's theory of personality, these children belong to the development

stage of industry vs. inferiority (Erikson, 1959). They develop their ability and may learn complex skills or complete tasks on their own. In this stage, they also develop their self-confidence. Parents and teachers play an important role in this stage. As they could assist these children to develop autonomy, initiative, and industry, they should be facilitators of this study. According to the previous childhood obesity studies (Anderson & Butcher, 2006, Andrews Silk & Eneli, 2010, Clark et al., 2007, Gibson, et al., 2007, Lindsay et al., 2006), parents affect weight of children by genetic factors and may influence eating and activity patterns of children in daily life. Larsen et al., (2015) provided a model describing parental influences on a child's dietary behaviour, parents' dietary behaviour and their food parenting practices. Parental influence on children's dietary behaviour declines when children become older. Older children are influenced by genetic and shared environmental effects on food preferences and dietary behaviour. Although a decline was found in parental influence on older children, a parent still has an impact on children in different daily lifestyles or activities. A parent's support was strongly associated with organizing physical activity. If parents increase involvement on health-promoting intervention, it could improve the prevalence of various healthy behaviours of older children (Pengpid & Peltzer, 2016). Unfortunately, it did not emphasize the actual age range of children affected by parental impact.

School-based program

School is a small community for children to develop their social skills and have friendship with peers. It is also a place for them to receive education in different aspects. It is a critical place for reforming social and physical environment and providing more

information and strategies to help children to develop healthy lifestyles (Centers for Disease Control, 2013). Teachers do not only play an important role on knowledge delivery and affecting children, but they also have a great impact on children's development, school engagement and achievement. Strong effects of both positive and negative relationships between teachers and children were found in both engagement and achievement (Roorda, et al., 2011).

Many studies explored the effectiveness of provision of childhood obesity programs in the school environment, but the outcomes were quite different. A health promotion project regarding childhood obesity was implemented in a school to assess the effectiveness of multicomponent intervention for five months in Italy. Samples were divided into the intervention group and the control group. Teachers and parents received the information/knowledge regarding nutrition and physical activity to prevent and treat childhood obesity in both groups. Children were requested to participate in several meetings with experts during curricular hours, receiving various interventions on physical activity and nutrition. In addition, parents also received weekly calls motivating them to improve the child's lifestyle and check the child's habits. Anthropometric measurement and behaviour data were collected before intervention and at an 8-month follow-up. No difference was observed between the two groups before intervention. A standard deviation score of BMI was found to increase 0.12 unit in the control group, but it reduced 0.06 unit in the intervention group ($p<0.002$). Children were found to spend 3 more hours in outdoor activity in the intervention group, compared to the control group. In addition, a significant reduction of TV viewing was also revealed in the intervention group, but it increased in the

control group. For extra-school sports courses, time spent was stable in the intervention group, but was reduced in the control group (Centis et al., 2012).

To find out the effectiveness of treatment, a study compared the long-term efficacy of group-based treatment and individual counselling for treating childhood obesity in Finland. Samples were randomly assigned to receive group treatment and routine counselling, respectively. Anthropometric measurement (height and weight) was measured before and after treatments, and at 1-year, 2-year, and 3-year follow-up. After receiving treatments, it showed there were no significant differences in the weight to height ratio between baseline and follow-up in both groups. In contrast, there was a high correlation of BMI and BMI-SDS reported (r=0.85 in baseline and 2-year follow up, r=0.76 in baseline and 3-year follow up) (Kalavainen, Korppi & Nuutinen, 2011).

A school-based program was conducted to evaluate the change of food intake among students at schools in Argentina. Samples were randomly assigned to the intervention group and the control group. The 6-month program offered workshops focused on enhancing knowledge in nutrition and exercise for children, as well as educating their parents or caregivers on the importance of physical activity and introducing healthy snack bars. BMI and a weekly food frequency questionnaire were requested to be filled in before and after intervention. After collecting data of baseline and post-intervention, there was no significant difference in BMI change in the intervention group and the control group. For food intake, boys failed to increase intake of the healthy foods that were mentioned in the program in the intervention group; whereas, girls did – especially in skim milk (p=0.03)

and orange juice (p=0.05). In addition, girls and boys reduced their intake of economical foods such as hamburgers and hot dogs (p>0.001, p=0.01) in the intervention group, and girls were also found to reduce their intake of these foods (p=0.008) in the control group (Rausch, Kovalskys & De Gregorio, 2013). The program showed the effectiveness of correcting food intake of children, but gender difference is also a main component to consider for the level of effectiveness.

There was a school-based program conducted in Sweden. Samples were recruited in ten schools and randomized to the intervention group and the control group. The intervention group received various interventions, including physical activity and other aspects on food intake for children, and awareness intervention was provided to school staff and parents. The data of anthropometric measures, physical activity and eating habits was collected before and after intervention, as well as in follow-up. There was significant difference of overweight and obesity of children in grades 2-4 in the intervention group between baseline and follow-up (p<0.05). Boys were found to have significant difference in grades 3-4 among both groups, but there was no difference in girls (p<0.05). Physical activity level was higher for children in the intervention groups (p=0.06), especially after school time (p=0.004). In dietary intake, children more often consumed high-fat dairy products (p=0.001), sweetened cereals (p=0.02) and sweet products (p=0.002) in the intervention group. No matter whether there was a high or low parental education background, they had exhibited more healthy behaviour in choosing dairy products in the intervention group (OR=3.58, 1.65), compared to the control groups. In addition, parents with low educational background had exhibited behaviour that showed more choice of fast

food products in the intervention group (OR=2.5), compared to the control group (OR=1) (Marcus et al., 2009). Although these programs were implemented in schools, parents were invited to participate in such programs.

With reference to previous studies, it is not effective to provide dietary intervention in control of childhood obesity (Rausch, Kovalskys & De Gregorio, 2013). Combined interventions are needed to reduce energy reservation in the body. Counselling is not effective for treating childhood obesity (Kalavainen, Korppi & Nuutinen, 2011), so that combined interventions that include physical activity and dietary intervention are promoted. Health knowledge and educational level of parents also affected the effectiveness in control of childhood obesity (Marcus et al., 2009). There was a need to enhance the health knowledge of parents, although the educational level of parents cannot be changed.

Community-based program

Apart from school, the community is a secondary place for engaging activity for children. Children spend much time in a park, recreational center, community center or elsewhere. Many barriers affected children engaging in physical activity in the community, such as safety in the neighborhood, accessibility of community facilities or crime rates (DeMattia & Denney, 2008). The community impacts the activity level of children, so that many studies also implemented childhood obesity programs or intervention in the community.

A community-based program was implemented in New Zealand for two years. It was a pilot program for prevention of childhood obesity. Seven hundred and thirty children

were recruited in 2003-2005, and they were randomly assigned to the intervention or control area based on primary school location. All interventions were provided by community activity coordinators, and they attached with each intervention school. During program implementation, children were encouraged to become more physically active every day and provide more non-curricular activity, and teachers were developed to provide a resource facilitating activity in a short break during lessons in the first year. The focus was shifted to nutrition and dietary intake in the second year. Students received the information about adverse health effects of sugary drinks and developed healthy eating resources. More physical activity was encouraged through rewarding them by playing card games. The program promoted various physical activities and introduced play equipment in the second year. Anthropometric measurement was made at baseline, 1-year follow-up and 2-year follow-up. Dietary intake was assessed by a short food questionnaire, and physical activity was measured by using unidirectional tactical accelerometers at various time points. After the 2-year intervention, the mean BMI z-score was significantly lower in the intervention group, compared to the control group – (95% CI: 0.01, 0.18) at 1-year follow up and (95% CI: 0.21, 0.32) at 2-year follow up. Waist circumference and systolic blood pressure was found to become lower at 2-year follow up and at 1-year follow up, respectively. In dietary intake, fewer carbonated beverages (p=0.04) and fruit juice or drinks (p=0.03) were consumed in the intervention group. In the activity aspect, no difference was found in television viewing and physical activity in both groups. However, mean accelerometry counts were higher in the intervention group (p=0.001) (Taylor et al., 2007). The program was only implemented in school and did not involve parents or families. Parents and families' involvement would affect children's behavioural change in daily

living rather than be limited to the school setting only.

To evaluate the effectiveness of a weight management program for children in the community, a 6-month program was conducted in the United States. One hundred and fifty-five pairs of child and parent were recruited. They received family-based behavioural treatment in groups (6-12 pairs of child and parent). Then, 12 face-to-face sessions were provided biweekly for 3 months and monthly for 2 months. Twelve home sessions and 12 telephone calls were provided in week 2, or in a week 4 group meeting. The targets of home sessions were parents. The focus was on weigh-in, an assessment on progress of behavioural goals and introduction of new content. Telephone calls focused on checking the previous week's goals. The content of these sessions included dietary intake, daily activity, self-monitoring, and stimulus control. Anthropometric measures and pediatric qualify of life were assessed at baseline, 3 months, and 6 months. All interventions were delivered by YMCA facilitators. After intervention, there was significant reduction in overweight in children at the 6-month follow up ($p>.001$). Parents were found to have reduction in weight at 6 months ($p=.04$), but no relationship was found between the parent's weight change and child's weight change. Health-related quality of life of children was reported to have significant improvement at 6-month follow-up. Those participants who attended more face-to-face sessions had more reduction in percentage overweight (Foster et al., 2012).

An extended study was done to investigate the long-term effect of the program. It was conducted in the United States, as well. One hundred and fifty-five children/adolescents

and their caregivers enrolled in this study. The venue and interventions were the same as for the preceding study. Outcomes were assessed at baseline, 3 months, and 6 months, including anthropometric measures and health-related quality of life of children. The outcomes reported BMI ($p=0.03$) and BMI z-score ($p<0.001$) of children/adolescents having significant reduction. Their caregivers also were found to have reduction in weight ($p=0.01$). Their health-related quality of life also had improved ($p<0.001$) (Foster et al., 2014). Conversely, two studies also used single arm research design. Although it provided intervention for all participants, it did not include a comparison to show the effectiveness of the program or treatment. In addition, the study involved parents in weight management. It showed the important role of parents in treating childhood obesity.

A community-based program was also conducted and delivered in the community and primary care setting in the United Kingdom. It focused on childhood obesity interventions that were implemented at home. The program was called "MEND" and included the content of the Mind, Exercise, Nutrition and Do it. One hundred and sixteen obese children participated in the program, and they were assigned into the intervention group and the control group. They received 6-month intervention with the 9-week MEND program and a 12-week free family swim pass. Eighteen sessions were delivered over 9 weeks, and these sessions included nutrition education, physical activity, behaviour change sessions and a closing session. After 9-weeks' education, they issued a free-family swimming pass to access a community swimming pool for a further 12 weeks. Outcome measures were collected at baseline, 6-months follow-up and 12-months follow-up. A questionnaire was administered, addressing anthropometric measures, a level of physical

activity and self-esteem. After multicomponent interventions, waist circumference and BMI had significant reduction ($p<0.0001$) in the intervention group, compared to the control group at 6 months. A difference between groups in blood pressure, heart rate, physical activity, and sedentary activity as well as self-esteem was revealed (Sacher et al., 2010). Although it is a community-based program, family involvement is an imperative component in a childhood obesity program.

Intensive sessions in delivering health knowledge were effective for weight reduction of children (Foster et al., 2014; Sacher et al., 2010). Teaching sessions may need to match parents' time, but it was difficult to fit all parents' needs (Ho, Yiu & Lam, 2016). Health information provision and group communication using mobile phones will replace intensive teaching sessions. In addition, free usage of sport facilities seemed to enhance the power of the program's effect. Physical activity should be developed and become a habit instead of providing a free pass to use sport facilities (Sacher et al., 2010). To reduce the cost of using sport facilities, physical activity at home will be introduced and encouraged to engage parents and children, which could promote physical activity everywhere.

Childhood Obesity Program in Family and Community

Some investigators understood that family and community are also important in control of childhood obesity. Children were influenced by families, and their activity level was affected by both families and community support such as facilities. By the way, such programs belong to the family domain rather than to the community.

A 2-year family- and community-based study was done in the United Kingdom. Five hundred and forty-one families participated in the program called “MOVE/me Muevo”, and they were randomly assigned into the intervention group and the control group. A half-day training was provided by recreation center staff and the content focused on physical activity and healthy eating policies. Four weekly workshops and home visits were provided in the recreation center. During workshops, family intervention was targeted to address the physical and social aspects of the home environment and delivered by workshop, home visit and phone consultation. Making changes in physical activity, healthy food and beverage were emphasized in the recreation center. The outcome measurements, such as anthropometric measures, physical activity, and sedentary time, were collected. BMI outcomes and waist circumference showed a decrease for girls in the intervention group, compared to the control group. In dietary intake, sugary beverage intake was lower in the intervention group ($p<0.01$), but no differences were found in fruit juice intake, physical activity, and sedentary time (Elder et al., 2014). Although it was a community-based program, parental involvement was the component that was to enhance behavioural change and weight control in childhood obesity. It better understands family prior influence on children in activity and dietary factors, rather than community.

Although parents/families were involved in the above studies, parenting skill and styles were not introduced. Parenting style affects the weight status of children. Parental warmth and emotional support could help overweight children reduce/stabilize weight status during a family-based behavioural weight control program (Rhee et al., 2016). Parenting skill also affects how parents tackle problem behaviour that contributes to

childhood obesity. Parents reduced maladaptive feeding comments and decreased problematic behaviours of children during mealtime by using positive parenting skill. (Shinn, Timmer & Sandoz, 2017).

School and community-based programs had partial effectiveness on weight loss or behavioural change. However, parental involvement is limited; whereas, a family-based program allowed parents to have direct involvement in control of childhood obesity by modifying their behaviour in daily living. In addition, the family is an environment for growing children. Parents take on the main role in the family to coordinate dietary intake and physical activity. The family is the better place for organizing a childhood obesity program.

With reference to the ecological model of predictors of childhood overweight, it clearly identified factors and characteristics contributing to childhood obesity. Parents and family are the main factors contributing to the obesity of children, apart from risk factors and the characteristics of children. Parents and family may also help to control childhood obesity.

4.3. Summary of Childhood Obesity Programs

Childhood obesity programs have been implemented in families, schools, and community in the past. Families and parents were invited to participate in various programs, such as community-based programs and school-based programs. Parents and families are important persons in various childhood obesity programs. The aims were to cooperate with

parents and families to provide interventions or to continuously affect children in the family setting, not only in communities or schools (Centis et al. 2012; Coppins et al., 2011; Elder et al., 2014; Foster et al., 2012; Foster et al., 2014; Gunnarsdottir et al.; 2011; Kalavainen, Korppi & Nuutinen, 2011; Lloyd, Lubans, Plotnikoff & Morgan, 2014; Marcus et al., 2009; Morgan et al., 2010; Rausch, Kovalskys & De Gregorio, 2013; Robertson et al., 2012; Sacher et al., 2010 & Small et al., 2012). As mentioned before, parents are the persons planning children's daily activities and encouraging them to follow interventions. The family is a group that can provide more support on facilitating intervention on childhood obesity. When parents and families are involved in a childhood obesity program, children are less likely to resist behavioural change and are can more easily adopt a healthy eating and activity pattern (West, Sanders, Cleghorn & Davies, 2010). The majority of parents understood the benefit of physical activity and healthy nutrition on combatting childhood obesity (Akhtar-Danesh et al., 2011). Parents could do better on affecting behavioural change of children with overweight and obesity when they facilitate intervention in the family, with support as well (Stewart et al., 2008). Therefore, these two parties play a core role in a childhood obesity program, and it is more convenient to implement intervention in a family setting.

The other programs also had their strengths in facilitating intervention in controlling childhood obesity. The weaknesses of these programs cause ineffectiveness. Although, many programs understood the effectiveness of parental and familial participation in control of childhood obesity. These programs invited parents or families to participate in their study and told them to follow interventions (Coppins et al., 2011; Elder

et al.,2014; Gunnarsdottir et al., 2011; Foster et al., 2012; Foster et al., 2014; Marcus et al., 2009; Kalavainen, Korppi & Nuutinen, 2011; Rausch, Kovalskys & De Gregorio, 2013; Sacher et al., 2010 & Taylor et al, 2007). However, the effectiveness of parental involvement was limited. Even though parents and families are parties that affect behaviour of children 24 hours every day, adequate health knowledge and perception in health and childhood obesity are necessary and important for parents to provide suitable dietary intake and physical activity for children. A review study explored parents' perceptions of childhood obesity in Australia. Parents underestimated the health consequences of childhood obesity, and further childhood obesity education for parents was needed (Mikhailovich & Morrison, 2007). Health knowledge enhancement for parents is necessary, and parents must realize the physiological and psychological impact of obesity on childhood development.

Many additional resources were used in the other programs. Community-based programs and school-based programs invited various experts to participate in the programs, such as health care professionals to provide education and follow up. Some programs use extra manpower and train up them to implement childhood obesity programs (Foster et al., 2012; Foster et al., 2014). Additional community facilities were utilized to facilitate children having more physical activity (Sacher et al., 2010). Although extra resources were used, the outcomes were not significantly changed (Centis et al., 2012; Marcus et al., 2009; Sacher et al., 2010; Rausch, Kovalskys & De Gregorio, 2013 & Taylor et al, 2007).

Parenting affects children's development. Numerous evidences showed that

parenting practice influences children's development. Appropriate parenting skill is not only a component to improve the mental health and well-being of children, but it also improves family relationships. Positive parenting skill can reduce behavioural and emotional problems in children and adolescents (Sanders, 2008). Many previous programs provided childhood obesity intervention for parents to follow, but ignored the importance of parenting skill (Coppins et al., 2011; Elder et al.,2014; Gunnarsdottir et al., 2011; Foster et al., 2012; Foster et al., 2014; Marcus et al., 2009; Kalavainen, Korppi & Nuutinen, 2011; Rausch, Kovalskys & De Gregorio, 2013; Sacher et al., 2010 & Taylor et al., 2007). Changing general parenting may benefit children and have a large public health effect, and it is more effective for younger children with childhood obesity (Gerards et al., 2011). Therefore, parenting skill enhancement is expected to apply to childhood obesity programs.

Positive reinforcement is a strategy to maintain positive behaviour of children, but it was easily neglected in previous programs. Positive reinforcement included providing confirmation for good behaviour, praising and approval (Connor & Rueter, 2006). When positive encouragement is given, children exhibit more appropriate and reinforced behaviour and avoid negative and inappropriate behaviour (Sigler & Aamidor, 2005). Nevertheless, less positive reinforcement was used in previous childhood obesity programs (Centis et al., 2012, Marcus et al., 2009, Kalavainen, Korppi & Nuutinen, 2011, Rausch, Kovalskys & De Gregorio, 2013). The use of positive reinforcement in childhood obesity programs is expected to maintain healthy behaviour of children.

5. Health Belief Model and Social Learning Therapy

The health belief model and social learning therapy applied to a parent-based education program enhances its effectiveness. The health belief model proposed health-related actions would happen when there was motivation to make health issues relevant, such as when individuals perceived a threat and health recommendations would be helpful to reduce the perceived threat (Rosenstock, Strecher, & Becker, 1988). Social learning theory is a therapy to describe behaviours that are determined by expectancies (environmental cues, outcome expectation and efficacy expectation) and incentives/reinforcement (Rosenstock, Strecher, & Becker, 1988).

5.1. The Relationship Between Childhood Obesity Program and Health Belief Model

The health belief model is a conceptual framework for explaining, predicting, and influencing health-related behaviour (Salari & Filus, 2017). If a childhood obesity program involves a parenting element, parents would want to participate. Parents are likely to participate in a parenting program if they perceived their children were developing problem behaviours, or they perceived that this program would be effective in reducing the risk of their child's problem behaviour (Salari & Filus, 2017). In addition, parents are concerned about their children's subsequent weight loss because they believe that overweight and obesity interferes with children's activities and causes serious illness (Andrews, Silk & Eneli, 2010). A previous study explored barriers to recruiting parents of overweight children for an obesity prevention intervention. Apart from some factors pertaining to professionals, parents become one of the barriers. Parents rejected participating in childhood obesity prevention interventions due to being unaware of the negative health consequences of childhood obesity (Gerards et al., 2012). Parents were observed to have a

lack of motivation to change behaviour and did not recognize the advantages of behavioural change. They seemed not to understand that they were responsible for their child's weight, and some of them did not see the need to participate in an intervention (Gerards et al., 2012). Parents did not have the motivation to participate in childhood obesity prevention interventions when they did not perceive threats to their children. A health belief model is an appropriate model to apply in childhood obesity intervention programs to alert parents to the negative health consequences of childhood obesity.

5.2. The Relationship Between a Childhood Obesity Program and Social Learning Theory

Role modelling was applied in the childhood obesity prevention program and encouraged parents, as a role model, to affect behavioural change in their children. Being a role model is separate from social learning theory. It is a strategy to affect behavioural change of individuals. According to this theory, individuals need to observe others, learn from their behaviour and from the reactions of others to the role model behaviour (Horsburgh & Ippolito, 2018). Previous study was conducted to assess role modelling as an early childhood obesity prevention strategy (Natale et al., 2014). Positive and negative nutrition and physical activity practices were performed by children, parents, and teachers. It found that parents significantly influenced children in nutrition and physical activity patterns, no matter if these patterns are either positive or negative. Conversely, teachers did not significantly influence children's nutrition and physical activity pattern (Natale et al., 2014). The imperative role of parents was confirmed. Role modelling is appropriate to apply to parents to affect behavioural change of children for childhood obesity prevention.

5.3. The Relationship Between Ecological Model of Predictors of Childhood Obesity, Health Belief Model and Parent's Self-Efficacy

Parents play the major role in affecting a child's weight status, followed by childhood characteristics (Davidson and Birch, 2001). When parents participate in some programs with a parenting component, the topic of parent's self-efficacy has been excluded or conceptualized as perceived parent's self-efficacy to carry out the health-related behaviour (Salari & Filus, 2017). Parents' self-efficacy is a strong predictor of many health-related behaviours. When the target behaviour is more difficult to perform, the parents' self-efficacy would be reduced (Rosenstock, Strecher, & Becker, 1988). Since parents' self-efficacy is associated with children's dietary, physical and sedentary behaviours, parents are responsible to support their children by encouraging and limiting child behaviour and managing their problem behaviour throughout the course of childhood (Norman et al., 2018). Parents of obese children reported a lower level of parental self-efficacy in managing their children's obesity-related problem behaviour, compared to parents of normal weight children (West & Sanders, 2009). It indicated that parents of obese children face difficulties to organize and execute the course of action to achieve the desired outcomes for their children (Bohman, Rasmussen & Ghaderi, 2016). In order to enhance the effectiveness of a childhood obesity prevention program, parent's self-efficacy should be reinforced. Health knowledge enhancement and appropriate parenting skill application are strategies to enhance parents' self-efficacy to manage children with obesity-related problem behaviour. However, there are barriers to childhood obesity prevention to be considered. Parents of overweight and obese children labelled their children as being of

healthy weight. In addition, they had uncertainty and lack of knowledge in healthy eating, portion sizes and physical activity, as well as prevalence of childhood obesity and the negative health consequences (Vittrup, B., & McClure, 2018). Children of authoritarian and permissive parents had increased risk of being overweight (Pace, Aiello & Zappulla, 2019). When either authoritarian parents are too restrictive or permissive parents are too indulgent, children cannot regulate their behaviour on their own (Pace, Aiello & Zappulla, 2019). It is necessary to apply a health belief model in childhood obesity prevention interventions for parents to realize the negative health outcomes of childhood obesity and provide various strategies to develop healthy behaviour in their children. The combination of the ecological model of predictors of childhood obesity, the health belief model and parents' self-efficacy enhance the effectiveness of childhood obesity prevention interventions.

6. Research Gaps and Rationales

6.1. Childhood Obesity Studies in Hong Kong

Many studies were conducted regarding childhood obesity, but there was a lack of studies to design a program for children and parents in Hong Kong. Exploratory studies, phenomenon studies, review studies and cross-sectional studies were found. Fewer interventional studies were seen. Ko and Chow (2010) conducted a study to explore the epidemiology and medical consequences of childhood obesity. To find an association with illnesses and obesity, Leung et al. (2011) also created a screening program to determine risk factors and patterns of hypertension in Chinese adolescents. Students were asked to measure blood pressure and to collect lifestyle information in secondary schools in Hong

Kong. Hypertension was not prevalent in Chinese adolescents in Hong Kong. High waist circumference predicted a risk of hypertension onset. To prevent hypertension, increased physical activity is a protective factor that was mentioned in that study. Physical fitness related to children' health. The study by Mak et al., (2010) investigated the association between health-related physical fitness and weight status of adolescents. Overall physical fitness in normal weight children was better than in overweight and obese children. Push-up and sit-up tests were reported difficult for overweight and obese children to perform. Non-weight bearing tests may reflect their physical fitness in different weight statuses. There was a qualitative study found to help understand the physical activity culture of Chinese Children and their parents in Hong Kong. It explored any factors hindering children having physical activity. Parents and children had different perceptions of physical activity. Although parents praised physical activity contributing to well-being and balancing the lives of children, they were miserly in setting aside time to accompany them to have physical activity. They expressed they did not have time, had a habitual sedentary lifestyle, and did not wish to engage in physical activity with children. Children held different views on physical activity according to their age. Children (aged 9-12) said that physical activity was their interest. However, adolescents revealed that physical activity was not a priority due to the importance of academic performance. There were the barriers hindering Chinese children engaging in physical activity (Ha, Macdonald & Pang, 2010). Parental concerns regarding physical activity participation were also explored. Pang & Ha (2008) revealed that parental long working hours, safety issues and academic achievement were major concerns of parents in allowing children to engage in physical activity in Hong Kong. Lee et al., (2011) also investigated the specific childhood behaviour or

characteristics that contribute to childhood obesity. Unhealthy eating behaviour was found to have significant correlation with overweight and obesity of children. So et al. (2011) also assessed an association between breakfast frequency, BMI, and body fatness of children in Hong Kong. An inverse association was reported in children between breakfast frequency and childhood obesity. The more breakfast skipping, the heavier BMI was reported in those primary and secondary school students. The study by Kong et al., (2011) was done to propose a low-glycemic index diet for childhood obesity. It focused on reviewing evidences for and against a low-glycemic index diet in childhood obesity. Eating pattern was a predictor of childhood obesity according to outcomes of the above studies. Another study showed dietary pattern was not an important contributing factor to childhood obesity. Chan et al. (2014) created a study to find an association between dietary pattern and childhood obesity in assessing children's dietary pattern and measuring their cardiovascular fitness. Outcomes showed physical activity inversely associated with childhood obesity instead of dietary patterns.

There were fewer interventional studies found in Hong Kong. Studies with various aims were reported in creating studies. Few studies investigated the effectiveness of interventions to reduce childhood obesity. After reviewing the effect of a low-glycemic index diet on childhood obesity, a controlled trial study was done to evaluate the effectiveness of a low glycemic index diet on obesity in adolescents. The two groups were defined and allocated as obese adolescents for either a low-glycemic index diet or a conventional Chinese diet. Adolescents consuming a low-glycemic index diet were reported as having significant reduction in BMI, body weight and waist circumference after

6 months, compared to participants consuming a conventional Chinese diet. The result seemed to be effective to control childhood obesity. A low-glycemic index diet is not a generalized diet, and there needs to be specific education for individuals (Kong et al., 2013). The effectiveness of a motivational interview for weight control of obese children was conducted (Wong, & Cheng, 2013). Motivational interviewing counselling was provided to children, and telephone consultation was provided to their parents in the intervention group. The control group did not have any intervention. Outcomes showed motivational interviewing as having significant improvement in weight-related behaviour and obesity-related anthropometric measures after the 14-week intervention. It may be an alternative method to improve childhood obesity. More childhood obesity programs were suggested to explore more solutions to reduce the prevalence of childhood obesity in Hong Kong.

6.2. Hong Kong Situation

Specific Circumstances of Childhood Obesity in the Hong Kong Context

Hong Kong is a metropolitan city that mixes Chinese and western cultures. It has a complex historical and political background. Before 1997, Hong Kong was a colony of the United Kingdom, so that Hong Kong was permeated with western culture. After 1997, Hong Kong became one of the special administrative regions of China. Many citizens immigrated to Hong Kong in China after widening immigration policy. They enjoy freedom, better quality of life and a stable economic environment. Although Hong Kong is a tiny city, many people immigrated to this place. Due to a high living standard and insufficient supply of housing, many people must live in a tiny apartment and be able to afford a high living cost (LO et al., 2017). To maintain their living standard, both parents must work

outside the home, and their children are taken care of by grandparents, domestic helpers, and nurseries (Chan, Deave & Greenhalgh, 2010). Apart from this situation, a higher divorce rate also occurred in Hong Kong. Cultural difference is a problem, resulting in divorce and child abuse (Yip et al., 2014). This causes changes in family structure, which may be a cause of childhood obesity. Studies have shown that living in a single parent household is associated with overweight and childhood obesity (Sahoo et al., 2015). Moens et al. (2009) revealed that an overweight mother, living in a single-parent family and being in a family raised in a low household income is also associated with childhood overweight or obesity. A cross-sectional study explores the influence of multiple familial factors on children's weight status. Many family factors are associated with childhood obesity; family structure is also one of the related factors that can predict the child's weight status (Moens et al., 2009). Another study explored the role of family factors in childhood obesity. It also reported that maternal BMI and a single-parent family significantly affect child BMI z-scores (Gibson et al., 2016). Many new immigrants married Hong Kong people. When they live with their partner, they may not be able to adapt to a different living style and socioeconomic status. As a result, divorce would ensue. Single parents need to take up responsibilities in taking care of children and earning their living. Relatives, such as grandparents, or domestic helpers become the main carers of children. These conditions also affect the activity level and dietary intake of children. Despite provision of service and parenting programs (Family Health Service, Department of Health, 2016), such service and programs are held on weekdays. Time constraint is a barrier for them to participate. Although healthy school policy is implemented in primary and secondary schools, the effectiveness for prevention of childhood obesity was affirmed in the previous study (Lee,

Ho & Keung, 2010). Parents, teachers, and children may collaborate to help children develop healthy behaviour to achieve positive health. The negative social situation may bog down steps to decrease the prevalence of childhood obesity in Hong Kong. The above circumstances may probably contribute to childhood obesity in Hong Kong. It is necessary to find out root causes so that effective interventions for weight control of children can be conducted.

Sedentary activity

Children spend substantial time on sedentary activity instead of physical activity. It was revealed that adolescents spend two hours or more on television watching and homework, whereas, there was reduced sports participation for boys and not significantly decreased sport participation for girls in Hong Kong (Mak & Day, 2010). Seventy-six per cent of overweight children also were observed not to have exercise. Although parents organized physical activity for them, they considered the academic workload of their children before planning activities. Some parents arranged activities for them during holidays and weekends. However, these activities were yum cha (eating and drinking), watching movies, or shopping (Ha, Macdonald & Pang, 2010), which caused children to engage more in sedentary activity instead of physical activity.

Chinese culture

Chinese culture is a factor affecting the activity level of children. Academic achievement is an indicator to determine success in one's whole life. A proverb says, "Books have a gold house and a beautiful wife" (書中自有黃金屋, 書中自有顏如玉). It

reflects the importance of studying and the concept entrenched in the mindset of Chinese parents. All Chinese parents hope their children will have high academic achievement, so that they place great pressure on them. Parents focus on academic achievement and neglect the importance of physical and psychological development. Academic achievement is a key component of childrearing, and it could bring honor to the whole family (Wu, 2013). It is not only cultural characteristics of Chinese people (Huang & Gove, 2015), but also an exam-oriented education system that determines the further studies of those students and parents' focus on academic achievement (Ho, Yiu & Lam, 2016). Consequently, parents focus on academic work and study progress. Some parents valued the benefit of physical activity, but they did not actually encourage children to engage in physical activity.

Academic achievement is the primary way for children to be honored in their family. In addition, their belief in the value of academic achievement is the key to Chinese culture in childrearing (Wu, 2013). Parents are responsible for arranging activities for children. Under the influence of Confucius education philosophy, parents directly engage in educational activities and monitor the learning progress of children (Wu, 2013). Nevertheless, parents' value physical activity, but they seldom encourage children to engage in physical activity. It becomes a factor influencing physical activity participation of Hong Kong children (Lau & Yip 2006).

Safety issues

To prevent children from being in danger, parents prefer children having indoor activity rather than outdoor activity. Parents encouraged children to engage in physical

activity by provision of instrumental, motivational, and conditional support. However, they discouraged physical activity of children due to safety concerns, lack of time and academic achievement (Suen, Cerin, & Wu, 2015). Safety concerns are one of the barriers decreasing physical activity engagement of children. Although, fathers and mothers were found to have different safety concerns, they also considered safety issues before allowing their children's engagement in physical activities (Pang & Ha, 2008).

Informal childcare

Parents are quite busy in Hong Kong. To maintain their standard and quality of living, they must work for long hours and take care of family at the same time. Informal childcare is a common practice in Hong Kong. Grandparents and domestic helpers are the main carers of children. Informal childcare is associated with various related problems of children. Caregivers may be lacking in knowledge of childhood development. Moreover, domestic helpers were employed for multiple responsibilities, such as taking up the household duties as well as childcare. They may not have enough time to devote to children (Leung, Leung & Schooling, 2015). Childhood obesity is also associated with informal childcare. As mentioned before, domestic helpers and grandparents are the main caregivers. Domestic helpers come from Southeast Asia, where they experienced poverty and lack of knowledge in childcare (Lin, et al., 2011). Grandparents also play a role that contributes to childhood obesity. They have inappropriate perceptions of obesity, such as fat children are healthy and foods with more fat are nutritious. Children consume more unhealthy foods and become overweight or obese under care of grandparents (Li, Adab & Cheng, 2015).

Energy-dense food consumption

Eating habits probably contribute to overweight or obesity of children in Hong Kong. Children like to consume energy-dense food. Less than half of adolescents had breakfast every day, and they consumed less than recommended daily intake of fruits and vegetables (Yeung, 2010). In addition, parents and children had wrong concepts of losing weight. They perceived that breakfast skipping is a method for weight loss (Tin et al., 2011). When they do not eat breakfast, they may consume more snacks, especially energy-dense foods, such as chips, cake, and ice-cream, in the intervals between meals.

Many parents earn their living by working outside the home in Hong Kong. They did not have enough time for cooking, and they consumed meals outside the home more than three times per week in fast food restaurants and Chinese-style restaurants with their families. In addition, children also had meals at school and brought lunchboxes to school, and they would share snacks with classmates in recesses during the school day. Many energy-dense foods were consumed (Hui & Nelson, 2006). Apart from environmental factors or living patterns, parents also play an important role in energy-dense food consumption. If parents also had habits that allowed them to consume energy-dense foods, children also followed and developed the same bad habits (Lau & Yip, 2006).

6.3. Research Gaps

Many research gaps were found after reviewing previous studies regarding childhood obesity in Hong Kong. First of all, it is a fact that a rising trend of childhood overweight and obesity has been observed among primary school students in Hong Kong.

The detection rate of overweight and obesity among primary school students ranged from 15% to 17.6% in the academic years of 1996/97 to 2016/17. Although the rising trend was slowed down, it is a considerable challenge to find an effective strategy to minimize this negative health consequence (Centre of Health Protection, 2018). Many risk factors contribute to childhood obesity that we may be aware of and avoid. However, these are not essential causes for us to prevent or treat childhood obesity. Apart from genetic causes, diet and activity are effective to control energy expenditure and reduce obesity. Many people understand, but few of them can modify, daily lifestyle effectively. Therefore, many childhood obesity programs were conducted in previous studies. As mentioned before, many programs were conducted and many of them invited parental participation, such as provision of support, following dietary and activity advice, etc. (Centis et al. 2011; Coppins et al., 2011; Elder et al., 2014; Foster et al., 2012; Foster et al., 2014; Gunnarsdottir et al., 2011; Kalavainen, Korppi & Nuutinen, 2011; Lloyd, Lubans, Plotnikoff & Morgan, 2014; Marcus et al., 2009; Morgan et al., 2010; Rausch, Kovalskys & De Gregorio, 2013; Robertson et al., 2012; Sacher et al., 2010 & Small et al., 2012). These programs did not provide parental education, especially on their parenting, misconceptions and lack of health knowledge or managing obesity-related behaviour of children. Although parents play a key role in behavioural change of children and childhood development, previous studies did not reinforce parental-based education on childhood obesity. They focused on child and parent education together on how to implement interventions expected to enhance the power of studies (Centis et al. 2012; Coppins et al., 2011; Elder et al., 2014; Foster et al., 2012; Foster et al., 2014; Gunnarsdottir et al., 2011; Kalavainen, Korppi & Nuutinen, 2011; Lloyd, Lubans, Plotnikoff & Morgan, 2014; Marcus et al., 2009; Morgan et al., 2010;

Rausch, Kovalskys & De Gregorio, 2013; Robertson et al., 2012; Sacher et al., 2010 & Small et al., 2012). Behavioural change can promote long-term weight control of children. As parents are the main caregivers of children, it is better to provide health education on this aspect and parenting skills to manage obesity-related problem behaviour of children.

Technology is a main component of daily living nowadays. It is suggested to add technology into a health education program to minimize the weaknesses of previous studies, such as the higher dropout rate (Weihrauch-Blueher et al., 2016) and promote learning everywhere (De Simone, 2016). Many childhood obesity programs had more than 10% dropout rate (Coppins et al., 2012; Sacher et al., 2010; Small et al., 2012 & Taylor et al., 2007). The smartphone is quite popular, and it has capabilities for handling e-mail, text messaging, video viewing and wireless internet access. It was suggested to use it in health interventions for behavioural change and education (Luxgon et al., 2010; Cummiskey, 2011). A new health program was recommending the use of smartphones for improving information accessibility (Kratzke & Cox, 2012). It was an innovative way for teaching and learning (Herrington, et al., 2009), but few studies were done regarding behavioural change (Luxton et al., 2011). Health education using smartphones was also recommended to promote health concepts and healthy behaviour for youth (Cummiskey, 2011). To prevent weaknesses in mobile education, blended learning (face-to-face sessions and mobile learning) was implemented in the program. Communication between investigators and parents could be improved, and it could build up better interpersonal relationships and reduce the dropout rate in this study.

6.4. Rationales of the Study

There were few interventional studies regarding childhood obesity found in Hong Kong. A prevalence of childhood obesity is critical even though “Healthy School Policy” is encouraged to be made a part of the School Development Plan and Annual School Plan of primary schools and secondary schools in Hong Kong (Education Bureau, 2015). However, parents had misconceptions about obesity and underestimated the weight status of children (Hearst et al., 2011, Lundahl, Kidwell & Nelson, 2014). It causes parents to miss setting aside adequate time to provide interventions to treat weight problems of their children (Lundahl, Kidwell & Nelson, 2014). Parents who have a positive perception of healthy weight status of children can support children to develop healthy behaviour (Hearst et al., 2011). Parental education is vital to provide a positive health concept for children and help children to develop healthy habits in early childhood.

Apart from parental education, it is imperative to deliver effective interventions to control overweight/obesity. Combined interventions such as dietary and activity interventions were recommended to enhance the power of childhood obesity programs, in recent studies (Oude et al., 2009, Wang et al., 2013). Different dietary and activity interventions were involved in the program. Parental involvement is a vital component in a childhood obesity program. It is important that parents are essential subjects to receive correct health knowledge and information regarding childhood obesity. It helps them to realize the weight status of their children, monitor and assist their children to correct obesity-related behaviour, and provides benefit for the health of children in the long run.

Parents may have confidence to manage obesity-related problem behaviour after they are educated. However, self-efficacy of parents in managing obesity-related behaviour is lower in parents with overweight and obese children, compared to parents with normal weight children. In contrast, their confidence level was low correspondingly (Morawska & West, 2013, West et al., 2010). To increase the self-efficacy of parents in managing obesity-related behaviour of children, parental education is an essential part of developing positive health concepts for parents. They are suggested in order to affect the health concept and behaviour of children afterwards.

6.5. Summary

To reduce the prevalence of childhood obesity, a comprehensive childhood obesity interventions program is suggested. After reviewing numerous studies, it is certain that family, especially parental involvement, is vital (Ethier et al., 2016; Kuntsch & Kuntsche, 2016). Parents play a role of caregiver in families, and they have great impact on childhood development. Their participation is effective for behavioural change of children in dietary intake and physical activity. Parents adopt a sedentary lifestyle behaviour and seldom participate in physical activity in Hong Kong (Ha, Macdonald & Pang, 2010). Health misconceptions and underestimating weight status of children also are barriers in promoting positive lifestyle behaviour. Parental education is necessary to assist children combat obesity-related behaviour.

7. Aims, Objectives, Hypotheses, Research Questions of the Study

7.1. Aims

The study aimed to determine the effectiveness of a parent-based education program – "Healthy for Life" program – in controlling overweight and obesity of children by measuring parents' efficacy in managing problem-behaviour of overweight and obese children (primary outcome) and anthropometric parameters – BMI, waist circumference and weight status (secondary outcome).

With reference to previous studies, the studies provide interventions mainly on nutrition/eating and physical activity in control of childhood obesity (Centis et al, 2012; Coppins et al., 2012; Foster et al., 2012; Foster et al., 2014; Marcus et al., 2009; Rausch, Kovalskys & De Gregorio, 2013; Morgan et al., 2010; Lloyd, Lubans, Plotnikoff & Morgan, 2014; Robertson et al., 2012; Sacher et al., 2010; Taylor et al., 2007). Fewer programs invited parental involvement (Foster et al., 2012; Foster et al., 2014; Marcus et al., 2009; Rausch, Kovalskys & De Gregorio, 2013; Morgan et al., 2010; Lloyd, Lubans, Plotnikoff & Morgan, 2014; Robertson et al., 2012 Sacher et al., 2010). These studies also investigated the effect on weight change of children, but the results were controversial. It is important to assess the behavioural change of children in control of childhood obesity, but fewer studies assessed such change (Centis et al., 2012; Marcus et al., 2009; Rausch, Kovalskys & De Gregorio, 2013; Robertson et al., 2012). Many studies involved parental/familial involvement but did not assess parents' self-efficacy on making behavioural change in their children.

The “Healthy for Life” program is a program for controlling childhood obesity. It focuses on teaching and practice. Since many childhood obesity studies focus on parental participation or involvement, they were not concerned about parental self-efficacy in making change in the behaviour of children. In this program, the parent is seen as an agent to provide intervention in controlling of overweight and obesity in their children. Parents might have perceptions on readiness for making change of behaviour (Rhee et al., 2005). The program relates to their self-efficacy in managing problem behaviour of children. Parental education about childhood obesity was provided to help parents understand that obesity may cause negative health problems for their children. To increase parents’ confidence, education on appropriate parenting skill was delivered to help parents manage problem behaviour that contributes to childhood obesity, and to help them prevent weight from rebounding. Parenting skill is very important to build up a positive parent-child relationship, and appropriate parenting skill is associated with lower weight status of children (Pinquart, 2014). As a mobile communication application was applied in this program, parents could seek help anytime, which increased communication between the investigator and parents during the study period.

7.2. Research Questions

1. Could a parent-based education program improve parents’ self-efficacy in managing obesity-related problem behaviour of overweight and obese children?
2. Could a parent-based education program promote weight loss of overweight and obese children?
3. How effectiveness of the parent-based education program improves parents’

self-efficacy in managing obesity-related problem behaviour of overweight and obese children?

4. How effectiveness of the parent-based education program promotes weight loss of overweight and obese children?

7.3. Objectives and Hypotheses

The "Healthy for Life" program regarding childhood obesity was proposed in the study. The scope is to investigate the effectiveness of this program in alleviating the problem level and the confidence level of parents in managing obesity-related behaviour of children and in reducing BMI, waist circumference and weight status of children in Hong Kong. Research objectives and hypotheses are stated.

Research Objectives:

1. To design and implement a parent-based education programme for childhood obesity in Hong Kong.
2. To compare differences in BMI percentile, waist circumference and weight status of children in the intervention group and the control group.
3. To compare differences in parents' self-efficacy in managing obesity-related problem behaviour of children in the intervention group and the control group.
4. To explore the influence of a parent-based education program in reducing BMI percentile, waist circumference of children in the study period.
5. To explore the influence of parents' self-efficacy enhancement in reducing overweight and obesity of children.

Research Hypotheses:

1. Parents in the intervention group reported that they did not perceive obesity-related problem behaviour as a problem, more so than parents in the control group, as reflected by the problem scale in the Lifestyle Behaviour Checklist.
2. Parents in the intervention group reported increased confidence in managing obesity-related problem behaviour, more so than parents in the control group, as reflected by the confidence scale in the Lifestyle Behaviour Checklist.
3. After receiving intervention, BMI percentiles of children in the intervention group was reduced more than those in the control group.
4. After receiving intervention, waist circumference of children in the intervention group was reduced more than those in the control group.
5. After receiving intervention, the number of overweight/obese children in the intervention group was reduced, compared to those in the control group.
6. After receiving intervention, children's BMI percentile and waist circumference were decreased, compared to those in the control group.

8. Methodology and Design

The study adopted a randomized controlled trial, including pre- and post- intervention assessment, to examine the effects of a comprehensive intervention program comparing with the control condition of parent's self-efficacy in managing problem behaviour of children. The proposed program is a childhood obesity program to combat childhood obesity through educating parents to benefit children. Parents were taught to modify children's unhealthy behaviour, which included dietary intake and physical activity. Parents influenced behaviours of children that may affect their weight change indirectly. Teaching and practice were arranged in this program.

8.1. Participants

Primary school students aged 5-9 years old were recruited. According to the previous childhood obesity studies (Anderson & Butcher, 2006, Andrews Silk & Eneli, 2010, Clark et al., 2007, Gibson, et al., 2007, Lindsay et al., 2006), parents may influence the eating and activity patterns of children in daily life. Therefore, parents were invited to participate in childhood obesity studies.

8.1.1. Inclusion and Exclusion Criteria

Inclusion criteria for the study were: 1) children aged 5-9; 2) BMI percentile ≥ 85 (Centers for Disease Control and Prevention, 2016, World Health Organization 2018); 3) at least one parent or guardian was to participate in the program and parents agreed to use mobile communication apps for communication (WhatsApp/WeChat). Parent and child can read either Chinese or English. Children with chronic illnesses or/and under medication,

receiving treatment from dietitian or practitioner and participating in another health-related or weight management program were excluded.

8.1.2. Recruitment

School

Five hundred and thirty-nine primary schools in total were invited by mail, email, and cold call, to take part in the study. Private schools and schools for special education were not invited because it was thought that the diverse socioeconomic status and cognitive abilities may affect outcomes of the study. Students from four primary schools in Tuen Mun, Yuen Long, Sham Shui Po, and Ma On Shan were recruited.

Thirty-two primary schools had been invited to participate in the program in Tuen Mun, originally. In addition to email and mail invitations, the investigator called each school to explain the proposed program details, to increase schools' participation. One school showed interest in the program and took part in it. Due to the low response rate in school recruitment, all subsidized and direct-subsidized primary schools were invited in Hong Kong. Six schools replied and showed interest in this study. One school did not participate in the study due to failure to meet the inclusive criteria. Three schools agreed to participate in the "Healthy for Life" program after recruitment activity. The schools are located in Tuen Mun, Lai Chi Kok, Yuen Long and Ma On Shan. Principals agreed and received the informed consent for endorsement.

The program was conducted in 2016-2017. Though there were different starting points

across different schools, the treatment and follow-up measures were all completed by September 2017.

One participating school is a direct subsidized scheme primary school in Tuen Mun. The others are aided primary schools. Direct subsidized scheme primary schools have more flexibility in various areas, such as curriculum design, resources deployment and student admission, etc. Apart from government subsidies, these schools may collect school fees for additional support services and school facilities (Education Bureau, 2013). The other schools are aided primary schools. These schools may follow education policies of the Education Bureau and have no flexibility on innovation in various areas. Also, these schools received subsidies from government only and cannot collect school fees (Education Bureau, 2013). With different school backgrounds, the number of students in each grade has certain differences. Table B shows the number of students in each grade of four primary schools.

Table B.

Number of students in each grade of four primary schools

School/Grades	**1**	**2**	**3**	**4**
Tuen Mun	32	32	32	32
Lai Chi Kok	30	30	30	30
Yuen Long	25	25	25	25
Ma On Shan	25	25	25	25

Subject

Participating schools disseminated notices about the programs for parents, and they replied to the schools about their intentions. In total, 432 parents showed interest in the program in four schools. Once their agreement was received, their children had initial

screening for overweight/obesity – measuring anthropometric measures were administered by nursing students. One hundred and twenty-eight children (BMI percentile ≥85) were eligible to participate and were randomly allocated to the intervention group or the control group.

8.1.3. Sampling

The sample size of existing literature on provision of family-based lifestyle intervention programs ranged from 42 to 117 (Kim et al., 2016, West et al., 2010). Due to the various power of previous studies (from 0.1 to 0.92), the power of this study proposed 0.8, estimated effect size of 0.5 was proposed, and significant level of 0.025 (two groups with three repeated measures, and 80% power, in using the equation of Generalized Estimating Equation (GEE) for calculating sample size (Schumm, 2004):

$$m = (4\sigma\ 2\ /nd2\ )\ (1 + (n - 1)\rho)(z\alpha/2 + z\beta)\ 2$$

The sample size estimated was 104 subjects in total. Fifty-two subjects were estimated in the intervention group and the control group, respectively. Fifteen per cent dropout rate was considered, and in total, 122 subjects were planned to be recruited for the study.

To select samples, stratified random sampling was used to enhance the representativeness. This method can identify population characteristics and divide them into strata (Portney and Watkins, 2000). The target schools were selected, and proportional stratified sample was done according to the primary grade of students aged 5-9 (primary 1-4) (table A). After stratification, students were randomly allocated to either the

experimental group or the control group.

After the screening measures, 136 children were eligible to participate. However, only 128 parents agreed to participate in the program. Therefore, after obtaining the written consent from the parents, 128 pairs of parent and child were randomly allocated to either the intervention group or the control group, with 62 pairs in the intervention group and 54 in the control group, respectively. The successful recruitment rate was about 92%.

At the baseline assessment, the demographic information (e.g., age, gender, race, educational level, occupation, weight and height, family income and residential status, etc.) and Lifestyle Behaviour Checklist were collected from the parents, with the assistance of the investigator. In both groups, follow-up assessments were conducted immediately after the completion of intervention, in the 5-week and 10-week follow-up. Children had recorded their dietary as well as the type and pattern of their daily activity every day on the "Dietary Intake and Physical Activity Record" in the 10-week program. The data of weight and height as well as waist circumference for children were collected by nursing students before and after the program, in the 5-week and 10-week follow-up.

Table A.

Selection of Samples

Primary Grade	*Grade*	*Number of students*	*Proportion for sampling*	*Proposed Sample size*	*Estimated number of sampling*

A	1	128	6.25%	128	8
	2	128	6.25%		8
	3	128	6.25%		8
	4	128	6.25%		8
B	1	128	6.25%		8
	2	128	6.25%		8
	3	128	6.25%		8
	4	128	6.25%		8
C	1	128	6.25%		8
	2	128	6.25%		8
	3	128	6.25%		8
	4	128	6.25%		8
D	1	128	6.25%		8
	2	128	6.25%		8
	3	128	6.25%		8
	4	128	6.25%		8
	Total	2048	100%		128

8.2. Study Design

A randomized controlled trial with single-blinded design was employed in the study. Parents and children were randomized to two groups, but they were not informed of what groups they were in or what interventions they received. The investigator knew group

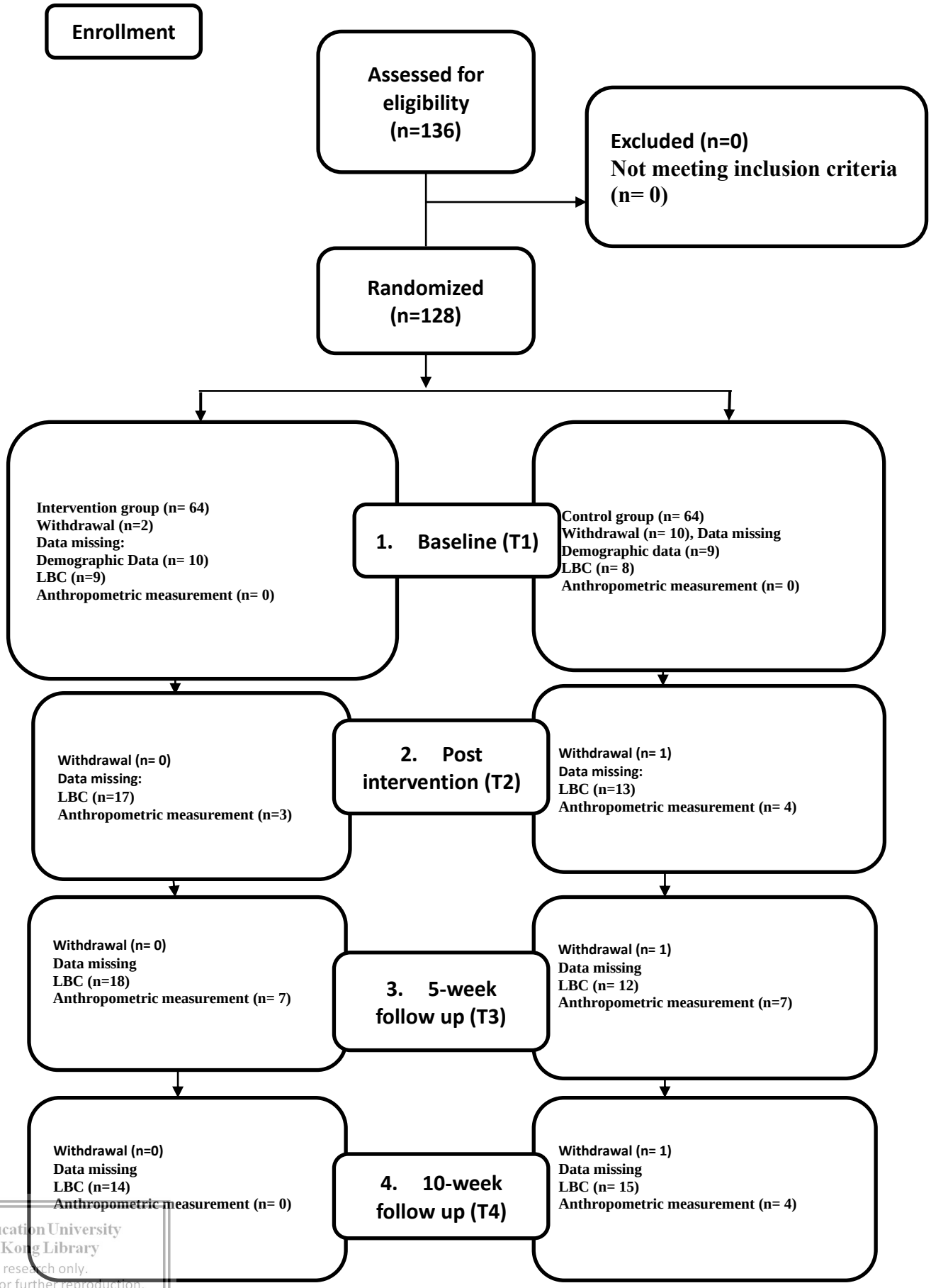
distribution, but the measurement team did not, as single-blinded design was applied in this study. Two conditions – the intervention group and the control group – with three periods for repeated measures: pre-test, post-test, 5-week and 10-week follow-up were applied to investigate the effectiveness of the proposed program.

To minimize sharing of information among the groups, environmental and grouping factors were considered. Parents of each group could not meet each other in receiving intervention. If parents with two children were participating in this program, they were allocated in the same group, rather than in a different group. For mobile communication, the intervention group and the control group had their own group for communication, and they could not communicate with parents who were allocated in another group.

After screening of overweight and obese children, they were randomly assigned to the intervention group and the control group by using https://www.randomizer.org. It is the website for investigators, providing a quick way to assign participants in the intervention group and the control group. Each child was assigned a number in each school before randomization. The total sets of numbers, number of sets and the number range were entered in this website. Set 1 was assigned to the intervention group and Set 2 was the control group. Then, the website would generate two groups, and the child would be assigned in each group based on their assigned number. The randomization process was generated by the investigator only, to ensure blindness of group allocation. The investigator was not blinded in the randomization process, but all participants did not know the group information. Child and parent are a unit of samples, and they were assigned to either the

intervention group or the control group. The flow chart of “Healthy for Life” program (Figure 2) is described the logistic of program implementation.

Figure 2 shows the Flow Chart of "Healthy for Life" Program



8.3. Intervention

The Ecological Model of Predictors of Childhood Overweight (Davison & Brich, 2001) described predictors of childhood overweight. Apart from child characteristics and risk factors, parents may affect their child's characteristics directly. Although the child's dietary intake, sedentary behaviour and physical activity were direct predictors contributing to childhood overweight and obesity, parents are responsible for food selection, preparation, and cooking. Sedentary behaviour of children was also influenced by parents. The behaviour pattern of children is greatly affected by parents. If parents performed more sedentary behaviour, their children would imitate that (Lindsay, Sussner, Kim & Gortmaker, 2006; Padez, et al., 2005). If parents are physically active, their children would follow. Pengpid & Peltzer, (2016) stated that parents' support was strongly associated with organizing physical activity. If parents increase involvement on health-promoting intervention, it could improve the prevalence of various health behaviours of older children. Interventions of the current study refer to this model and considered parenting styles and family characteristics to provide strategies.

The proposed program is a 10-week program with 5-week and 10-week follow-up. During the 10-week intervention period, 3 teaching sessions were provided on the 1st, 3^{rd,} and 7th week in school. The duration of each teaching session was 2 hours. The number of participants varied according to the size of the intervention group in each school. All sessions were group sessions, and no individual session was provided. If parents had problems managing their child's behaviour, they could approach the investigator individually.

Teaching strategies of the parent-based program were based on the health belief model. The health belief model has positive effects on lifestyle modification. The model is simple and practical. Parents can educate children about behavioural change for controlling obesity. Parents have a fundamental role in preventing obesity of children. The program included the health belief model, which can help parents become more sensitive to childhood obesity, its complications and severity. Parents may correct obesity-related behaviour (Abdeyazdan, Moshgdar & Golshiri, 2017). A previous study also stated that it is more effective if health training has a theoretical basis (Ghaffari, Tavassoli, Esmaillzadeh & Hasanzadeh, 2011). Social learning theory may apply to behavioural intervention. This theory emphasizes that when positive behaviours are reinforced and when negative behaviours are ignored or punished, the relationship quality improved (Johnson & Bradbury, 2015). Social learning theory may apply in teaching, to encourage parents in using positive reinforcement when they want to affect children in controlling obesity-related behaviour. This theory could empower behavioural interventions. In addition, this theory proposes real-life experience and exposure of children for shaping their behaviour. During this process, children can learn though imitation and reinforcement (O'Connor et al., 2013). It is beneficial for parents in controlling obesity-related behaviour and alleviating overweight or obesity of children indirectly.

Primary data used the Lifestyle Behaviour Checklist to assess parental self-efficacy. Parental self-efficacy is directly related to weight change of children (Kim et al., 2016; West, Sanders, Cleghorn & Davies, 2010). Anthropometric measures are used to assess

overweight and obesity of children. This study used anthropometric measures to assess overweight and obesity of children. BMI percentile, waist circumference and weight status are common tools for assessing overweight and obesity of children (Song et al., 2016). Moreover, the investigator is the only person involved in the teaching of parents. During the study period, teaching content, intervention and assessment were the same in four participating schools. Reliability of the study was maintained.

8.3.1. The Intervention Group

This program involved two components – teaching and practice. In the teaching sessions, discussion was encouraged to increase interaction among parents and the investigator. Also, they were asked to write down expected outcomes in this program and it helped the investigator understand their expectations and concerns. To control childhood obesity, regular meal and physical activity patterns are very important, and these patterns were emphasized throughout the teaching sessions. Strategies of lifestyle behavioural change were suggested, such as role modelling, home environment modification, food selection and preparation, as well as positive reinforcement. Such strategies may help parents to overcome difficulties in managing problematic behaviour of children. In addition, appropriate parenting skill, child management, and peer support were suggested in the teaching sessions to increase effectiveness of interventions. The teaching plan is shown in table 3.

Content of teaching sessions and health information sheets mainly refer to the websites of Department of Health, The Government of The Hong Kong Special

Administrative Region, Parent Academy, Centre of Food Safety and Diabetes Hong Kong and many research studies (Boutelle, Feldman & Neumark-Sztainer, 2012; West et al., 2010). The content focused on more physical activity and having a regular meal pattern, as well as adequate parenting. This content may promote healthy lifestyle behaviour of children and provide strategies for parents to manage children's behaviour that they felt was difficult to manage.

Parents realized current unhealthy habits and how these habits negatively influenced health of children. Also, they understood more strategies or alternatives to develop healthy lifestyle behaviour and manage problematic behaviour of children after the teaching sessions.

Parents were encouraged to practise their learnt knowledge or strategies on children after each teaching session. This helps parents integrate knowledge into practice in a real setting. Parents were asked to manage dietary behaviour and to increase children's physical activity. The theory of the health belief model was integrated into the teaching sessions. Therefore, parents understood the susceptibility and the consequences of childhood obesity through this program. Apart from teaching and practice, parents also received a health information sheet each week, except for the first week. The health information content was about diet, physical activity, and parenting. Parents were asked to complete evaluations after teaching sessions and read health information sheets to assess their knowledge level. They would receive an individual follow-up if their answer were wrong in the evaluation. Mobile communication applications also encouraged technology use for communication

and assistance. Some parents who live in China cannot access webpage and used WhatsApp. Due to district restriction of accessing the internet, mobile communication applications – WhatsApp and WeChat – were also used according to parents' convenience. In addition, health tips or reminders were provided every day in the intervention period to reinforce parents' efforts to enhance behavioural change of their children. During the study, parents became facilitators to use learnt health strategies and knowledge to help children in developing healthy lifestyle behaviour.

Some parents were absent for teaching sessions: 33 parents attended the 1st teaching session, 23 parents attended the 2nd teaching session, and 17 parents attended the 3rd teaching session. The investigator sent them videos about the teaching sessions. Parents were asked to complete evaluations after each teaching session to assess their knowledge level as well. They would receive an individual follow-up if they answered incorrectly in the evaluation.

Children did not need to receive any treatment during this period. According to the findings of a previous study, a negative impact was found in child participation in the intervention of a childhood obesity program. An emphasis on weight loss may put children at risk of developing a food or appearance preoccupation causing a body image disturbance and eating disorders. If the family had more than one child, and the obese child was singled out from family members, s/he may experience stigmatisation or resist change. Also, dietary restriction may be a cause for disordered eating attitudes and child behaviour that limits children's long-term dietary change (West et al., 2010). Parents should use their

knowledge to influence children in their daily behaviour, such as food selection, home environment modification, health information sharing and role modelling, etc. by their planning for lifestyle behaviour of children (Centis et al., 2012). Children were requested to complete a "Dietary and Physical Activity Pattern Record" daily during the intervention period to monitor their dietary and activity pattern and have it endorsed by parents. Parents were responsible for guiding children to complete the record. The record was collected every week for checking.

8.3.1.1. Content of Teaching Sessions

There are 3 teaching sessions provided in the program. Physical activity, dietary intervention and parenting were introduced in the teaching sessions.

The topic of the first session is called "Time to go". It means that participants prepared themselves and were ready to help children for weight management and become healthy for the long run. At the beginning of this session, an introduction was given, and the background, aims and objectives were also explained to let participants understand what to expect. Then, the dietary intake and physical activity record was introduced and some instructions were provided to let them know how to record data. To understand and facilitate parents' learning, they were encouraged to write down their expectations of this program. After the introduction, teaching was started. Firstly, healthy lifestyle behaviour was introduced. Examples were provided to explain healthy lifestyle behaviour and benefits to the health of children. On the other hand, unhealthy behaviour was also discussed and more consequences of unhealthy behaviour were provided.

Overweight/obesity was one of consequences of unhealthy behaviour. Overweight and obesity were the main focus of this teaching session, especially children with overweight and obesity. Physical and psychological impacts on children with overweight and obesity were addressed to raise parents' awareness. To control overweight and obesity, parents provide a great impact on weight management of their children since they plan their activities and diets in their daily living. Parents were encouraged to develop their own healthy lifestyle behaviour and provide strategies for facilitation, such as role modelling. Examples were given for parents' reference to become a good role model. To develop healthy lifestyle behaviour, examples were given. Also, it was recommended that parents combat unhealthy behaviour, and some examples of unhealthy behaviour were provided, and consequences were reinforced again. Physical activity and dietary intervention modification are strategies that control overweight and obesity. Dietary intervention was introduced. Breakfast is important in control of overweight and obesity (Megson, Wing, & Leahey, 2017), so breakfast was introduced. The recommendation of breakfast and a healthy breakfast was suggested. Students' preferred healthy breakfast was emphasized. Hence, meal pattern was also important, and it was recommended by the Student Health Service, Department of Health, The Government of the Hong Kong Special Administrative Region (Student Health Service 2014). The suggested meal and snack time were provided. Portion size of each meal and snacks that affect the energy intake of students was explained so that parents may control portion size of each meal and choose appropriate snacks for children. Snacks were recommended twice each day, healthy snacks were suggested, and examples were provided. To control energy intake, packaged food was described, and it was not recommended. Some simple cooking recipes were provided for parents to prepare

healthy food for children. Finally, content was summarized and reviewed again. Parents were invited to ask questions, and discuss session content and children's behaviour. An evaluation of parents' understanding was conducted by taking a quiz at the end of this session.

The topic of the second teaching session is called "To be smart parents". It means parents can control lifestyle activities by using strategies. First, expected learning outcomes were outlined, and parents were invited to share their experiences in planning their healthy activities for children. Content of the first teaching session was recapped, and some misleading questions were asked to assess parents' knowledge level of healthy lifestyle behaviour and obesity before starting the second teaching session. To develop a healthy lifestyle, dietary concerns were addressed, such as meal pattern, portion, and food selection. Strategies of changing of lifestyle behaviour and increasing energy expenditure were presented. To become smart parents, they may need to understand more about calories. Food labels were introduced, and parents were taught how to read a food label. An example of a food label was displayed, and each component was pointed out. Different units of calories were also described, and parents were taught how to calculate joules to calories because some food labels state energy by using joules. In order to control the energy intake of children, some examples of eating patterns were provided that contributed to overweight/obesity. It is not enough if parents only control the energy intake of children. Physical activity can also help individuals to consume energy. Exercises were introduced for parents' convenience that children can do at home. Exercises were combined with game components so that children became interested in engaging in the exercises. Parental

impact on physical activity engagement was emphasized, and parents were encouraged to engage in outdoor activity with children to increase energy expenditure. Parents were asked to answer several questions regarding this teaching session to evaluate their understanding.

"Fighting for children's health" is the final teaching session topic. As in the second session, expected learning outcomes were presented and parents were encouraged to share their difficulties in managing children's behaviour. After that, glycemic index was introduced and related to children's sense of hunger. Glycemic index is the term used to indicate the glucose response curve after consumption of 50g carbohydrate. It is a concept to characterize the rate of carbohydrate absorption (Ludwig, 2000). To let parent, grasp the concept related to obesity, the relationship between GI and obesity was elaborated on. Also, lower GI foods were introduced for parents. Some strategies in taking lower GI foods were also delivered and encouraged. Apart from physical activity and dietary intervention, life balance is very important. It helps parents put more activity into children's daily living rather than engaging solely in academic achievement. It makes children healthier in physical and psychological aspects, which indirectly reduces the risk of overweight and obesity. Also, the parents' role in planning children's activity was emphasized. To achieve this target, parents were taught to teach children to manage their own life by managing their time effectively. Time management is a very important component in helping children to manage their activities. A case was provided for discussion on time management and life balance for children. The key concept of life balance was addressed. An example of a timetable of daily activity for children was provided to let parents understand how to plan

children's activities adequately. In managing children's behaviour, positive motivation is important for children, so parents were encouraged to have positive reinforcement when children do the right thing. If children make mistakes, parents were encouraged to ask children for reflection to understand their errors. Finally, evaluation was provided to understand parents' knowledge level after this session.

Evaluation of each teaching session was provided. If a wrong answer was detected, the parent was informed individually by using the mobile app. Also, they were encouraged to answer the question again after some prompting. All parents could provide right answers after prompting.

Table 3.

A teaching plan of the teaching sessions in the "Healthy for Life" program

Session	Time allocation	Topics	Content	Strategies/Theories behind
1	15 minutes	Time to go	- Introduction - Aims of this study - Learning outcomes of this session	- Introduce the background of this study - Introduce the aims and objectives - Provide instructions on recording Dietary Intake and Physical activity Record (meal pattern and physical activity) -
1	15 minutes		- Expectation - Write down expectation in this program	- Understand their expected outcomes or consequences after this program

1	30 minutes	- Introduction of healthy lifestyle behaviour - Physical and psychosocial impact of unhealthy lifestyle behaviour	- Provide Information about healthy lifestyle and consequences of unhealthy behaviour (Health Belief Model) - Benefit of developing healthy behaviour
1	30 minutes	- Role of parents and their influence on children - Develop healthy lifestyle behaviour in dietary intake and physical activity - Appropriate parenting affect children performing positive behaviour	- Discussion on parents' experience managing children' behaviour - Sharing about their strategies on managing children' behaviour
1	20 minutes	- Strategies to develop healthy	- Pro and cons of developing healthy and

			dietary pattern - Introduce health benefit of breakfast - Provide examples	unhealthy dietary pattern
1	10 minutes		- Summarized the content of this session - Questions and Answers - Evaluation	- Repeat content of this workshop for parents - Provide time for them to ask questions about content or child's behaviour - Check content they understand by quiz
2	10 minutes	To be smart parents	- Learning outcomes - Difficulties sharing	- Indicate learning outcomes of this session - Discussion on experience for management of children's behaviour
2	10 minutes		- Recap content of 1st session	- Repeat content of 1st session and prepare their

		- Correct misconception of obesity	concept for understanding content of this session - Quiz on misconception of obesity and provide rationale
2	20 minutes	- Introduce healthy dietary pattern - Strategies on developing a healthy dietary pattern	- Introduce strategies to combat unhealthy habits in eating - Point out some minor points on eating habits and correct them
2	20 minutes	- Food selection	- Introduce food label and how to read - Provide food label for them to read after teaching
2	20 minutes	- Introduction of calorie	- Introduce calorie

			- Calculation of calorie - Provide examples about over-absorption
2	20 minutes	- Exercise at home - Playing with children	- Introduce several exercises for doing at home - Introduce some games at home for playing with children
2	10 minutes	- Imperative role of parents	- Social learning theory (role modelling) - Work with children - Become family gathering - Limited inactivity
2	10 minutes	- Summarized the content of this session - Questions and Answers	- Repeat content of this workshop for parents - Provide time for them to ask questions about content or child's behaviour

			- Evaluation	- Check content they understand by quiz
3	10 minutes	Fighting for children's health	- Learning outcomes - Difficulties sharing	- Indicate learning outcomes of this session - Discussion on experience for management of children's behaviour
3	30 minutes		- Introduce Glycemic Index and obesity - Eating strategies with glycemic index	- Introduce glycemic index and how it correlates to obesity - Food examples of high, medium, and low glycemic index - Introduce strategies to reduce hunger - Provide examples about some snacks with low glycemic index
3	30 minutes		- Balancing daily living	- Introduce life balance and the advantages

		- Time management	- Importance of time management - Case of inappropriate time management - Strategies to educate children having appropriate time management - Example for setting timetable
3	20 minutes	- Establish good relationship between parents and children	- Social Learning theory (positive reinforcement) - Respect children and discuss with children about time management - Strategies to minimize failure following timetable
3	20 minutes	- Challenges and difficulties	- Share experience and provide solutions - Peer support - Ignore minor misbehaviour

			- Set clear and concrete instructions - Back up instructions by consequences, quiet time, or time-out - Manage children with misreporting - Point out benefits of developing healthy lifestyle behaviour
3	10 minutes	- Summarized the content of this session - Questions and Answers - Evaluation	- Repeat content of this workshop for parents - Provide time for them to ask questions about content or child's behaviour - Check content they understand by quiz

8.3.1.2. Content of Health Information Sheet

Parents who were in the intervention group received a health information sheet weekly, except for the first week. Parents were asked to answer some questions regarding the content of the health information sheet to evaluate their understanding. Content of health information sheets stated information about overweight and obesity, physical activity, and dietary intervention, as well as parenting skill as below:

1. Overweight and obesity

   It describes the concept of overweight and obesity, prevalence trend, causes, consequences and recommendation of health loss. It helps parents to understand the negative impact of overweight and obesity.

2. Emotional eating

   It used a scenario to state the negative impact of emotional eating – overweight and obesity. Emotional eating is caused by stress. Children want to eat anytime even they are not hungry when they are stressed. Strategies to overcome emotional eating were provided, and tips were provided for stress management.

3. Letter to parents – “Pre-packaged” food

   Dietitian described the nutrition value of pre-packaged food, taught parents how to read the food label, and explained the risk of increasing energy intake. Some misleading terms of food labels were also elaborated to let parents understand more about the truth of “pre-packaged” food.

4. Children expect parents ...

   Parents understand more about children through children’s expectations. It is useful for parents teaching children. Positive reinforcement was emphasized to modify behaviour of children as well as to improve the child-parent relationship.

5. Keep fit formula

It described more about various methods for weight loss. Also, it stated some wrong concepts on weight loss. It emphasized appropriate keep fit strategies such as eating breakfast, focusing on healthy weight, and avoiding night food, etc.

6. Design a healthy receipt

To provide healthy food for children, healthy receipt was a component in cooking. It is a health information sheet to describe food selection. Healthy food ingredients focus on "3 low and 1 high" and provide a list of healthy food ingredients. Other concerns are about portion of food and saturated fat proportion as well as sugar content. Then, tips of preparation of healthy cooking, methods of healthy cooking and food handling were also addressed. Finally, the principle of "3 low and 1 high" was emphasized again.

7. Healthy breakfast

The definition and concept of a healthy breakfast was described by dietitians. Dietitians provided examples about common breakfasts and calculated calories as well as elaborating on food ingredients. A healthy breakfast was recommended, and some examples of a healthy breakfast were provided for parents' reference. Dietitians stated the principle of "3 low and 1 high" in making a healthy breakfast.

8. Healthy party

A party also was organized for a long vacation. Some healthy foods were recommended for the party. This information sheet stated some categories of healthy food. Cooking receipts were also provided for making food for a party.

9. Physical activity and development of physical and psychosocial health

It stated advantages of exercise to improve physical and psychosocial health of children. Positive consequences were addressed. Tips for starting the habit of

regular physical activity were recommended to gain long term benefit.

7.3.2. The Control Group

In the control group, parents did not need to attend teaching sessions or receive health tips every day. However, parents received a health information sheet every alternate week for 10 weeks, except for the first week. Content of health information sheets was the same as the intervention group, but they did not need to have an evaluation. However, they only received health information sheets – 1,3,4,5,6.

The same as the intervention group, children did not receive any treatment during this period. The same procedure was adopted for the children to administer the "Dietary and Physical Activity Pattern Record" daily during the intervention period to monitor their dietary and activity pattern.

8.4. Measures

8.4.1. Demographic Data Collection Form

Demographic data of parents and children were collected using an online form (via a cell phone app or website link) upon commencement of the program. This data included the parent's age, sex, ethnicity, occupation, educational level, economic status, BMI, residential placement and child's age, sex and living status.

8.4.2. The Primary Outcomes

The primary outcome is the most important among the many outcomes that are to be examined in the study (Andrade, 2015). Two primary outcomes needed to be achieved. It was expected to have significant improvement of obesity-related problem

behaviour of children and parents' self-efficacy in managing obesity-related problem behaviour of children after intervention. Parents perceived obesity-related problem behaviour of children and their self-efficacy were assessed by using the problem scale and the confidence scale of the Lifestyle Behaviour Checklist (West & Sanders, 2009).

8.4.2.1. Parent's self-efficacy

Parents' self-efficacy is important for behavioural change of children. It supports their children's development, including encouraging and limiting child behaviour, and managing child misbehaviour (Norman et al., 2018). The problem level and the confidence level of parents in managing obesity-related problem behaviour of children are included in parents' self-efficacy. It relates to the effectiveness of behavioural change of children that results in affecting weight loss of children. The Lifestyle Behaviour Checklist is a questionnaire used to assess problem behaviour of children and how parents' confidence enables them to manage their problem behaviour. This behaviour included eating, physical activity and overweight (West, Sanders, Cleghorn, & Davies, 2010).

The questionnaire was created by West and Sander in Australia (West & Sanders, 2009). According to previous studies, it was found to have higher internal consistency (α= 0.85 for the Problem scale and 0.95 for the Confidence scale) and test-retest reliability (r^s = 0.87 to 0.71 from pre-test to post-test). To become more reliable and valid, the checklist was refined again, and each factor in the checklist was re-evaluated (West, Morawska & Joughin, 2010). Higher internal consistency and content validity was reported after revision. The internal consistency for the problem scale was α= 0.87 and the confidence scale was α= 0.95, respectively. Problem behaviour on the

questionnaire correlated with lower confidence in managing such behaviour, and higher levels of dysfunctional parenting (West, Morawska & Joughin, 2010).

The Lifestyle Behaviour Checklist was divided into two parts – the problem scale and the confidence scale. The problem scale is used to measure the level of how parents perceived their children's behaviour as a problem. The confidence scale is used to measure how confident parents felt in managing the problem behaviour they perceived. It was used to assess parental perceptions on children's weight-related problem behaviour and their confidence in managing obesity-related problem behaviours, e.g. eating, physical activity, and obesity-related behaviour in children aged 4-11 and yield scores on the Problem scale and Confidence scale. Parents were asked to use the problem scale to rate the level to which they experienced each of these behaviours as a problem with their child. Higher scores of the problem scale indicate greater problems. Parents also were asked to rate how confident they feel when they manage each of these behaviours, even if they were not currently occurring, using the confidence scale. Higher scores of the confidence scale indicate greater confidence in managing these behaviours (West, Sanders, Cleghorn, Davies, 2010).

There were 28 items in the previous Lifestyle Behaviour Checklist, initially. Twenty-six items ask about the problems regarding eating, activities, and obesity-related behaviour. Two optional items were provided for parents to write down the problem behaviour of children they felt was difficult to manage. Scores of 26 items were summed from 26-182 on the problem scale to assess the level of problem behaviour of the child, and a score from 26-260 on the confidence scale was used to assess the parent's confidence to manage such lifestyle behaviour (West & Sanders,

2009). According to West et al. (2010), the recommended cut-offs of the problem scale score is greater than 50 and the confidence scale score is less than 204.

Reliability and validity of the Lifestyle Behaviour Checklist

The questionnaire was created by Dr. Felicity West (West & Sanders, 2009). The purposes of the questionnaire are to assess parental perceptions of weight-related problem behaviour regarding eating, activity, and obese issues, as well as assessing self-efficacy of these parents in managing such behaviour. Parents with overweight and obese children were assessed to have higher levels in such behaviour exhibition and lower self-efficacy in managing such behaviour in the previous study (West et al., 2010). The authors addressed that parents were concerned about the obesity-related problem behaviour of children. However, most of them were unable to manage such problem behaviour, and some of them did not want to disrupt the self-esteem of children. Parents also stated that they did not know how to assist children to change problematic behaviour. Moreover, lack of studies introduced parent's needs of knowledge of preventing and treating childhood obesity. Although the childhood obesity treatments have been evaluated, there was a lack of the measures in parenting provided (West & Sanders., 2009). On the other hand, obese children experienced more behavioural, social, emotional, and eating-related problems. The target problem behaviour related to eating, activity and obesity issues and needs to manage on a day-to-day basis (West & Sanders., 2009). This questionnaire on assessing problem behaviour is useful for assessing the treatment outcomes of the study.

The common problem behaviour of overweight and obese children related to eating, activity and overweight/obesity issues has been pointed out for rating. The

problem scale requests parents to rate the degree to which the behaviour is a problem for them and their children. A 7-point scale from 1 (not at all) to 7 (very much) is provided for rating. Following the same question, the confidence scale requests parents to rate the confidence level they feel to manage such behaviour. A 10-point scale from 1 (certain I can) to 10 (certain I can't do it) is provided for rating, as well. The range of total score on the problem scale is from 24 to 168 and the confidence scale is from 24 to 240 in the revised questionnaire (West, Morawska & Joughin, 2010). The total score of the 24-item checklist is used to understand the frequency of lifestyle-specific problem behaviour and to assess the parenting self-efficiency in managing children's lifestyle behaviour. Parents can also add some extra items about problem behaviour that is not on the list (Felicity & Sanders., 2009).

Translation

The Lifestyle Behaviour Checklist was created in an English version, and a Chinese version was created and validated with back-translation by two independent translators. One of them translated the checklist in Chinese. Another translated the checklist to English according to the translated checklist. After the back-translation, the checklist was compared with the original version by an expert in physical activity and sedentary behaviour. The results showed consistency of more than 90% of the items in the original version and translated one.

Content validity

To ensure content adequately in this questionnaire, content validity was done. Three experts were invited to review this translated questionnaire. They had expertise in conducting research studies in school health, children's health and eating habits, diet

modification, physical fitness, and nutrition assessment, respectively. Each item of the questionnaire has provided the columns of "Very Relevant", "Relevant", "Irrelevant" and "Very Irrelevant". Experts chose the item they considered to be relevant to describe weight-related problem behaviour in each item. If they thought the item was "Irrelevant" and "Very Irrelevant", they needed to fill in the column of "Suggestion for improvement" (if they rated it as "Irrelevant" or "Very Irrelevant"). Two out of three reviewers agreed the majority items of the Lifestyle Behaviour Checklist were either "Very Relevant" or "Relevant". One reviewer was concerned that some items do not relate to the weight-related problem behaviour such as items 21, 22 and 23, and these items were modified to become obesity issues/consequences. She also suggested clearly clarifying some items such as items 2, 15 and 16. The wording of these items was modified and provided examples for comparison (item 1: Eats too quickly (compared with children with same age); item 15: Watches too much television (compared with children with same age); item 16: Spends too much time playing video or computer games (compared with children with same age).

After the questionnaire was reviewed by reviewers, the 24-item checklist was modified, and two extra items were kept in this questionnaire for parents to indicate extra problem behaviour of children difficult to manage. The range of total scores on the problem scale is 24 to 168 and the confidence scale is 24 to 240, respectively.

Internal consistency

Internal consistency is important to reflect the coherence and to ensure an extent of similar scores are obtained when the scale is administered in various situations between a short period of time (McCrae et al., 2011). To ensure internal consistency of

the modified Lifestyle Behaviour Checklist, correlation coefficients and test and retest reliability of the questionnaire was done. Referring to the previous study (West & Sanders, 2009), test-retest stability was introduced, and 18 parents who were not participating in the study were invited to complete the Lifestyle Behaviour Checklist, and then were asked to complete the questionnaire again two weeks later. The scores of the questionnaire were used to check the reliability by using the test and retest method. The problem scale and the confidence scale in the questionnaire had high internal consistency (α=0.91 for the problem scale and α=0.95 for the confidence scale). High test-retest stability (over 2 weeks) was also reported (r_s=0.901, $p<0.001$ for the problem scale and r_s=0.945, $p<0.001$ for the confidence scale).

The rating scale of the problem scale and the confidence scale in the questionnaire was unchanged. A 7-point scale from 1 (Not to all) to 7 (Very Much) rates the problem behaviour of children that parents experienced. Parents also rated their confidence in managing such behaviour with a 10-point scale from 1 (Certain I can't do it) to 10 (Certain I can do it). The total score of the problem scale (from 24-168) represented frequency of problem behaviour of children parents experienced, and the confidence scale (from 24-240) represented the levels of parents' self-efficacy in managing problem behaviour of children.

The duration of the intervention period and the maintenance period of this program was 10 weeks. The primary outcome and the secondary outcome were measured before and after the intervention period after randomization. The outcomes were also measured at 5-week follow-up ad 10-week follow-up in the maintenance period.

The study outcome might help to establish a family-based childhood obesity program, through parental impact on children in changing dietary and activity behaviour, to alleviate the prevalence of childhood obesity in Hong Kong.

There was no pilot study for reference for a family-based childhood obesity program, self-efficiency of parents in managing obesity-related behaviour and anthropometric measures of children in Hong Kong. It should be the first study to explore a health program's effect on the improvement of children's problem behaviour exhibition and self-efficacy of parents on managing such behaviour of children.

8.4.3. The Secondary Outcomes

The secondary outcome concerned anthropometric measures of children. It expected a clinically significant weight loss of children in the intervention group, and the prevalence of overweight and obesity in the intervention group was expected to decrease, as reflected by improvement in anthropometric measures (BMI percentile, waist circumference). Contributing factors such as dietary and activity patterns were also observed. The differences in gender and BMI percentile categories were analyzed. The correlation between degree of weight loss and outcomes of the Lifestyle Behaviour Checklist was also examined.

8.4.3.1. Anthropometric Measurement

Anthropometric measurement was utilised in this study. Anthropometric measurement reflects health status, dietary adequacy, growth, and development over time. It is an indicator of nutritional status. Height, weight, and waist circumference are commonly measured to collect anthropometric data (Fryar et al., 2016). Height and

weight and waist circumference of children were measured in this program. Children were arranged to go to the designated room for measurement in their lunch time. An electronic portable scale to the nearest 0.1kg was used to measure body weight. A portable stadiometer to the nearest 0.1cm was used to measure body height. After measuring the height and weight of children, BMI percentiles were calculated based on their measurement and age. Their weight status was also classified as “underweight”, “healthy weight”, “overweight” and “obesity”.

Waist circumference was measured on iliac crest and from one side to the other side. Children wore a light uniform for measuring weight. To measure accurate weight, a uniform weight was measured and used to deduct from the total weight of children. To validate the scale before measurement, an electronic scale was 2-kg standard weight before measurement.

Height and weight of children was calculated for BMI percentile. If the BMI percentile was equivalent or more than 85, children were classified as overweight and obese, as adopted by Hong Kong and World Health Organization (World Health Organization, 2018). Waist circumference (cm) was taken by tape measure. BMI percentile was calculated after measuring the height and weight of children. The websites (boys: http://reference.medscape.com/calculator/body-mass-index-percentile-boys , girls: http://reference.medscape.com/calculator/body-mass-index-percentile-girls) were used to calculated BMI percentile and classify the weight status of children as “underweight”, “healthy weight”, “overweight” and “obesity”.

Some nursing students assisted for anthropometric measurement, and they were

blinded in group allocation. Nursing students were studying in year 5 of the Bachelor of Nursing in Tung Wah College. Before measurement, two nursing students measured weights and heights of the same student to ensure inter-rater reliability. The variation of weight and height was not more than 0.1kg/0.2cm. To ensure consistency in measurement, a briefing about the measurement method to be used for weight, height and waist circumference was provided. They were also asked to demonstrate their measuring method to minimize variation. In addition, they were asked to work in a group of two for double-checking before recording. They were responsible to collect anthropometric measures of children. Height and weight of children were measured before intervention, after intervention, 5 weeks after intervention and 10 weeks after intervention. They used an electronic scale and stadiometer to measure the weight and height of children. Waist circumference was measured by a soft measuring tape.

8.4.3.2. Meal Pattern and Physical Activity

The Meal Pattern and Physical Activity was recorded by children and endorsed by parents daily. The aims were to remind students to keep a regular meal pattern, engage in physical activity, and self-monitor their food intake. Diet monitoring could be promoted for weight loss even by using app, paper and pencil or memo recording (Wharton et al., 2014). Also, parents were alerted on changing unhealthy lifestyle behaviour of children. Students were suggested to have three main meals and two snacks as well as engage in physical activity on a daily basis, as recommended by Student Health Service, Department of Health, The Government of the Hong Kong Special Administrative Region (Student Health Service 2014). The suggested meal and snacking times were mentioned on the first page of the booklet to minimize inconsistency.

8.5. Data Analysis

Several data analysis methods were introduced in this study. These methods were used to assess various data. Statistic software SPSS version 24 was used for data analysis in this study.

8.5.1. Demographic data analysis

Preliminary data analysis included checks for randomization of participants to the intervention group and the control group. A T-test and chi-square test were conducted to assess homogeneity of both groups in the categorical and continuous variables at baseline. Null hypotheses were rejected, and it indicates no difference if p values in preliminary data analysis were more than 0.025.

8.5.2. Statistical analysis

The data analysis was conducted in September 2017. Also, parent's self-efficacy was performed to detect the effectiveness of intervention on primary outcomes. The outcomes of the Lifestyle Behaviour Checklist were used to analyze the problem level and the confidence level of parents in managing obesity-related problem behaviour of children. The estimation of the OR and 95% CI was used to assess the association between the intervention and the problem level and the confidence level of parents in managing behaviour of children by using a logistic model. Anthropometric analysis was performed to detect the effectiveness of the intervention on secondary outcomes. The estimation of the OR and 95% CI was used to assess the association between the intervention and overweight and obesity by using a logistic model. Previous studies reported that BMI percentile is the desirable measure of adiposity change of children

(Pearce, Webb-Phillips & Bray, 2016; Woo & Cole, 2017). The linear model tested the effect of the intervention on BMI z-scores, waist circumference, and weight status of children. A generalized estimating equation (GEE) was used to analyze the repeated measurement in regression analyses (Willmer et al., 2015) since conventional statistic methods increase type I error in hypothesis testing (Cao, Wang & Chen, 2015). GEE is commonly used to analyze data with correlated outcomes. This approach can adjust correlation among the variables. It also estimates the marginal or average covariate effect on the outcomes and does not require normal distribution of the outcome variables as a pre-assumption. GEE can also manage missing values that are completely random; parameter estimation can also produce vigorous results (Cao, Wang & Chen, 2015). Intention to Treat Analysis (ITT) was employed to avoid overoptimistic estimation of treatment effect (Gupta, 2011).

GEE was used to compare the difference in changes in measures, including the problem scale and the confidence scale in the Lifestyle Behaviour Checklist of parents, and BMI percentiles, waist circumference and weight status of children, over the four study end-points (baseline, post-test, 5-week follow-up and 10-week follow-up) between the two groups (time x group interaction effect) with adjustment, if any. The baseline data and the control were indicated as the reference. All statistical tests were two-sided, and P-value less than 2.5% was considered statistically significant.

9. Result

This chapter reports the outcomes of this study, and it consists of two sections. The first section reports the result of sample recruitment for this study. The second section describes the socio-economic and demographic characteristics of samples. The final one reports the results of the primary outcomes and the secondary outcomes, as well as correlation with the socio-economic and demographic characteristics. The study outcomes were used to compare two study groups (the intervention group and the control group) before and after the health program (intervention), 5-week and 10-week follow-up. Intention-to-treat analysis (ITT) was used to analyze the outcome data. Generalized Estimating Equation (GEE) was adopted to use for outcome analyses to investigate the effectiveness. GEE is commonly used to analyze data with correlated outcomes. This approach estimates the marginal or average covariate effect on the outcomes. Moreover, it has been used in the comparison of various outcome variables within and between subjects, even when the assumption is not normally distributed (Hubbard et al., 2010, Yelland, Salter & Ryan, 2011).

9.1. Participants' Recruitment and Drop-outs

Four hundred and thirty-two pairs of parent and child showed interest in participating in the program after distributing school notices to introduce the study. Figure 1 shows the flow of "Healthy for Life" Program and the flow of the procedure, according to the CONSORT statement (Schulz, Altman & Moher, 2010). After anthropometric measurement, 306 of children were excluded (70.6%) because they were normal weight or underweight children, and one was currently under consultation with a dietitian for weight control.

Among 136 children who were eligible, 128 children also provided parental consent. Fourteen parents (10.9%) withdrew from this program. Twelve pairs of child and parent (9.3%) withdrew from the program at baseline. Two parents stated that their children had no need to participate in the health program. One parent had queries about BMI percentile of her child. It was found that the body weight of the child was wrong because of illegible handwriting. The parent and child did not meet the inclusion criteria, so that they were not eligible to participate in the study. One grandmother asked to withdraw because of a health problem. Nine parents did not join the program after signing the written consent. In the intervention period, 3 (2.2%) pairs of parents and children in the control group dropped out. One of them claimed that the child was not suitable for weight control due to stomach illness. Two parents stated that they did not have time to complete the study. In total, 2 pairs and 10 pairs of parent and child withdrew in the intervention group and the control group at baseline. Three pairs of parent and child in the control group withdrew.

Nineteen parents did not fill in the demographic data form, and 17 parents did not fill in the Lifestyle Behaviour Checklist at baseline. Thirty parents did not fill in the Lifestyle Behaviour Checklist, and 7 children did not turn up for anthropometric measurement at the 10-week time point in the intervention period. Seventeen parents and 3 children belonged to the intervention group. Thirteen parents and 4 children belonged to the control group, respectively. Thirty parents did not fill in the Lifestyle Behaviour Checklist and 14 children did not turn up for anthropometric measurement at the 5-week time point in the maintenance period. Eighteen parents and 3 children belonged to the intervention group. Twelve parents and 4 children belonged to the control group. Twenty-nine parents did not fill in the Lifestyle Behaviour Checklist,

and 4 children did not turn up for anthropometric measurement at the 10-week time point in the maintenance period. Fourteen parents belonged to the intervention group and 15 parents and 4 children belonged to the control group, respectively. Parents who missed entering their data into the demographic data and Lifestyle Behaviour Checklist tried to make contact by phone, but in vain. A reminder was also sent by a mobile communication app, and they did not reply to this issue. The majority of children who missed turning up had applied for sick leave on that day. One pair of parent and child returned to their home country, so that they could not enter the data and turn up for anthropometric measurement. Details may be found in figure 1.

Parents who were in the intervention group were invited to participate in 3 teaching sessions in the study period. Twenty-four parents missed the 1st teaching session. Thirty-two parents missed the 2nd teaching session. Thirty-one parents missed the 3rd teaching session. Missing was random.

Table C.

Attendance of face-to-face teaching sessions

Teaching session	Number of Participants
1st Teaching Session	38
2nd Teaching Session	30
3rd Teaching Session	31

9.2. Demographic Data and Socioeconomic Status

The majority of children who studied in these schools belonged to the low to middle socioeconomic class. About 90% of children were Chinese and their dialect was Cantonese (The Census and Statistics Department, 2012). Different demographic

characteristics were found in various districts. Ma Oi Shan belongs to Shatin district. Lai Chi Kok belongs to Sham Shui Po district. Shatin holds 9.3% of the population of Hong Kong, and it is the largest populated district. Yuen Long is the second largest populated district in Hong Kong. About 9.1% of the population lives in Yuen Long. Yuen Long is also the third district with persons at prime working ages (25-44). Both Yuen Long and Sham Shui Po are the third districts with children under the age of 15 (about 12.1%) and (about 12.3%), respectively. Shatin district had the largest size of labor force of both male and female (9.1% of male and female labor force size) in 2017 (Census and Statistics Department, 2017). Average household size of different districts was 2.7 (Sham Shui Po), 2.8 (Tuen Mun) and 3 (Yuen Long and Shatin), respectively. The median age was 43 (Sham Shui Po), 41 (Tuen Mun), 40 (Yuen Long) and 42 (Shatin), respectively. The median household income per month of these districts was HKD19,000 (Sham Shui Po), HKD23,000 (Tuen Mun), HKD22,800 (Yuen Long) and HKD27,500 (Shatin). Students studying full-time as a percentage of the population was 16% (Sham Shui Po), 15% (Tuen Mun), 17% (Yuen Long) and 15.3% (Shatin). Female labour force participation rate was 48.5% (Sham Shui Po), 52.1% (Tuen Mun), 51.3% (Yuen Long and Shatin), based on data from Population and Household Statistics Analyzed by District Council District (Census and Statistics Department, 2015). These figures may account for facilities development of districts and family composition of each district. Caring models, such as parental dominance or assistance by either domestic helpers or grandparents, as well as the level of caring are also affected. It associated with the attendance at teaching sessions and the effect of interventions.

Parents

The demographic and socioeconomic data of 96 parents has been collected at

baseline (see table 4). One parent withdrew from the study after completing demographic data. Main characteristics of parents are summarized in table 4. Fathers (n=16, 13.8 %) and mothers (n=80, 69%) also participated in the program. Most of them were female (69%), aged from 38-42(n= 28, 24.1%). Most were Chinese (81.9%), the educational level of most parents was secondary level (41.4%), and their occupations were "Others" and were not included in the below categories (36.2%). The majority of mothers were housewives. The better socioeconomic status of families was submitted. Their family income was mostly classified as HKD50,000 or above (29.3%), and they lived in an apartment (51.7%) with their child. The mean BMI of parents was 23.81 (±3.86), and it classified as slightly more than normal range (18.5-22.9). The majority of parents were living in an apartment (62.5%). The majority of children were living with their parents (85.4%).

Table 4.

Demographic Profile and Weight Status of Parents (n=116)

	Intervention (n=62)	Control (n=54)	X^2	P
Demographic				
Gender			4.56	0.10
1(Male) n (%)	5 (8.10)	11 (24.40)		
2(Female) n (%)	46 (74.20)	34 (75.60)		
Age Range	5.08	5.38	8.54	0.29
Mean (SD)	(1.25)	(1.56)		
2(23-27)		1		
3(28-32)	3	2		
4(33-37)	14	13		
5(38-42)	20	8		
6(42-46)	8	12		
7(47-51)	2	2		
8(51 or above)	4	7		

Ethnicity Mean (SD)	1 (0)	1.02 (0.15)	2.02	0.36
1 (Chinese)	51	44		
2 (Other)		1		
Educational Level Mean (SD)	2.98 (1.09)	2.77 (1.04)	2.39	0.79
1 (Primary Level)	1	1		
2 (Secondary level)	23	25		
3 (Associate degree level or equivalent)	7	4		
4 (University level)	16	13		
5 (Master Level)	4	2		
6 (Doctor level)				
Occupation Mean (SD)	5.94 (3.35)	5.31 (3.27)	9.55	0.30
1 (Managers and administrators)	10	6		
2 (Professionals)	4	9		
3(Associate Professionals)		2		
4 (Clerical Support Workers)	4	3		
5 (Service and Sales Workers)	6	7		
6 (Plants and Machine Operators and Assemblers)	1			
7 (Elementary Occupations)	2			
8 (Others)	24	18		
Family Income (HKD) Mean (SD)	4.14 (1.70)	4.04 (1.87)	7.36	0.29
1 (Less than 10,000)	4	4		
2 (10,000-20,000)	7	8		
3 (20,001-30,000)	8	10		
4 (30,001-40,000)	7	1		
5 (40,001-50,000)	9	4		
6 (50,001 or above)	16	18		
Residence Mean (SD)	2.04 (0.80)	2.13 (0.79)	1.46	0.84
1(Public Housing)	11	7		
2 (Apartment)	31	29		
3 (House)	5	5		
4 (Others)	4	4		
Parent Body Mass Index (BMI) (BMI Weight Status)	2.11 (0.96)	2.37 (0.91)	3.92	0.42

Mean (SD)				
1 (Normal 18.5-22.9)	15	9		
2 (Overweight 23-24.9)	13	8		
3 (Obesity more than 25)	14	19		
4 (Underweight less than 18.5)	3	2		
Child Living Status	1.17	1.49	10.61	0.06
Mean (SD)	(0.74)	(0.94)		
1 (Living with parents)	48	34		
2 (Living with grandparents)		3		
3 (Living with parents and grandparents)	1	5		
4 (Living with guardian)	1	3		
5 (Others)	1			

Children

Demographic characteristics and anthropometric data of children are summarized in table 5. The mean BMI and waist circumference of them was 93.96th percentiles (±4.78) and 69.7th percentiles (±11). To find the gender difference, the mean BMI and waist circumference of boys were 94.94th percentiles (± 4.63) and 70.68th percentiles (± 11.37). The mean BMI and waist circumference of girls were 91.10th percentiles (±4.46) and 67.86th percentiles (±10.03).

Table 5.

Demographic Profile and Anthropometric of Children (n=116)

	Intervention group n=62	Control Group n=54	X^2	P
Gender			15.21	0.00
n (%)				
Male	41 (66.1)	38 (70.4)		
Female	21 (33.9)	16 (29.6)		
Ethnicity			1.16	0.28
n (%)				
Chinese	62 (100)	53 (98.1)		
Other	0 (0)	1 (1.9)		
Weight Status			3.57	0.06
n (%)				
Overweight	27 (43.1)	33 (61.1)		
Obesity	35 (56.5)	21 (38.9)		
Waist Circumference Mean (SD)	71.92 (11.42)	67.33 (10.05)	58.39	0.54

Male	73.89 (11.29)	67.22 (10.55)
Female	68.07 (10.93)	67.59 (9.06)

Table 6a and 6b summarize the gender and age distribution of children. The gender distribution was well balanced for the intervention group and the control group. The average age of the intervention group (7.52 years) is slightly older than the control group (7.30 years).

Table 6a.

Gender Distribution of Children

	Intervention Group			Control Group				
Variable	Boys	Girls	Total	Boys	Girls	Total	X^2	p-value
Gender								
Baseline	41	21	62	38	16	54	0.239	0.63
First Follow-up	38	19	57	37	16	53	2.397	0.30
Second Follow-up	38	19	57	36	16	52	1.050	0.59
Third Follow-up	38	19	57	35	16	51	0.330	0.85

Table 6b.

Age Distribution of Children

	Intervention Group			Control Group				
Age	n	M	SD	n	M	SD	t	p-value
Baseline	62	7.52	1.11	54	7.30	1.09	1.071	0.29
First Follow-up	57	6.77	2.84	53	7.15	1.66	-0.848	0.40
Second Follow-up	57	6.77	2.84	52	6.96	2.07	-0.403	0.69
Third Follow-up	57	6.77	2.84	51	6.82	2.40	0.319	0.93

Homogeneity of the Intervention Group and the Control Group at Baseline

Homogeneity of the outcome measures between two groups at baseline was assessed, to identify the potential covariance in the analysis (Berger & Weinstein, 2004). Chi-square test was used to find out any difference between groups and the categorical

variables.

As indicated in table 4, the two study groups were balanced in gender, BMI, ethnicity, occupation, family income, residence, parent's BMI, child's weight status, and child's living status. Approximately more than half of the parents were female, and age range was 38 to 42. Their ethnicity was Chinese and educational level was secondary level. Their weight status was either overweight or obesity. Their child was living with the parent.

No significant difference between groups was reported in baseline BMI percentile ($p = 0.06$) and weight status of children ($p = 0.21$) as well as waist circumference ($p = 0.54$). Anthropometric measures of the intervention group were slightly higher than the control group.

The mean scores on the outcome measures (the problem scale and the confidence scale) at the baseline are shown in table 7. The mean scores on the problem scale ($p = 0.77$) and the confidence scale showed no significant difference between groups ($p = 0.78$). No significant differences between groups on the problem scale of activity ($p = 0.09$) and obesity-related behaviour ($p = 0.10$) and the confidence scale of eating ($p = 0.07$) and obesity-related behaviour ($p = 0.45$) were reported at baseline. However, there was significant difference between groups on the problem scale of eating ($p = 0.01$) and the confidence scale of activity ($p = 0.00$).

Dose of the Intervention

The duration of the study period was 10 weeks, and the maintenance period was 10 weeks in the current study. There were three teaching sessions for the intervention group in the study period. They also received nine health information sheets in the study period. No teaching sessions were provided to the control group. They received four health information sheets in the study period. The anthropometric data of the child was collected by volunteers. Also, health information was delivered to both groups in different time periods. Parents were asked to complete the Lifestyle Behaviour Checklist at baseline, after the study period, at 5-weeks follow-up and at 10-weeks follow-up in the maintenance period. Children completed four anthropometric measures at baseline, after the study period, at 5-weeks follow-up and at 10-weeks follow-up in the maintenance period.

Correlation Analysis

To observe correlation between all the variables and for factor analysis. The correlation analysis was conducted between groups and potential covariates such as demographic data, anthropometric measures, and parents' self-efficacy.

As predicted, the estimated child's anthropometric measures were related to demographic factors. BMI percentile correlated with the child's ethnicity (OR= 121.747, $p<0.01$). Waist circumference correlated to the child's age (OR= 14.673, $p<0.01$), the child's gender (OR=7.799, $p<0.01$) and the child's ethnicity (OR= 93.692, $p<0.01$). The child's weight status correlated to the child's ethnicity (OR= 66.063, $p<0.01$).

The correlation between parents' self-efficacy and demographic factors was also predicted. Firstly, the correlation of the problem scale and the demographic factors was

reported. Parents' management of the child's obesity-related problem behaviour was assessed by the problem scale in Lifestyle Behaviour Checklist. The problem scale correlated with the child's age (OR= 11.553, p=0.01). Parents' confidence in managing obesity-related problem behaviour of children was assessed by the confidence scale in the Lifestyle Behaviour Checklist. The confidence scale correlated with the child's gender (OR= 8.142, p<0.01) only.

Result of children's physical activity and daily intake

Forty-six children belonging to the intervention group and 33 children belonging to the control group returned their completed Dietary and Physical Activity Pattern Record.

All children had three main meals (breakfast, lunch, and dinner) every day. Twelve (5 children in the intervention group and 7 children in the control group) children sometimes consumed snacks. All of them engaged in more physical activity on Saturday and Sunday, except during the examination period. In holiday time, 30 children and 27 children engaged in more physical activity, compared to school days.

9.3. Primary Outcomes

One hundred and twenty-six children participated in the study; 116 parents completed the Lifestyle Behaviour Checklist. Parents were asked to complete the Lifestyle Behaviour Checklist before and after the study, 5 weeks, and 10 weeks after the study.

Parent's Self Efficacy Changes

To find out group differences in the problem scale and the confidence scale of the

Lifestyle Behaviour Checklist between and within groups accurately, generalized estimating equation (GEE) was more appropriate to estimate findings of two scales of Lifestyle Behaviour Checklist with various parameters in repeated measurement. Parents were asked to fill in the Lifestyle Behaviour Checklist before and after intervention, and at 5-week and 10-week follow-up. They needed to fill in two parts – the problem scale and confidence scale – of the checklist. Due to the optional questions of question 25 and 26, those questions were analyzed exclusively. Table 5 shows group differences on both scales of the Lifestyle Behaviour Checklist.

Table 7 shows the problem scale and the confidence scale of the Lifestyle Behaviour Checklist of the intervention group and the control group. The problem scale decreased from 58.83 to 53.32 (decrease 5.51) in the intervention group. The control group also reported a decrease in the problem scale from 58.53 to 51.89 (reduce 6.64). Parents reported the alleviation of the problem level in managing obesity-related problem behaviour of their child, but the higher improvement was found in the control group. There was a different change in the confidence scale in both groups. The confidence scale increased from 159.17 to 166.06 (increase 6.89) in the intervention group but decreased from 171.25 to 158.90 (decrease 12.35) in the control group. Parents reported their improved confidence level in managing obesity-related behaviour of their child in the intervention group, but not in the control group.

Table 7.

The Finding of Lifestyle Behaviour Checklist in the Intervention and the Control Groups at Baseline and Follow-up

Lifestyle Behaviour Checklist	Baseline n (%)		Post-Intervention n (%)		5-week follow-up n (%)		10-week follow-up n (%)	
	Intervention	Control	Intervention	Control	Intervention	Control	Intervention	Control

Participants	62 (100.0)	54 (100.0)	62 (100.0)	54 (100.0)	62 (100.0)	54 (100.0)	62 (100.0)	54 (100.0)
The Problem Scale								
M (SE)	58.83 (4.09)	58.53 (4.27)	52.80 (4.52)	59.44 (4.69)	57.32 (5.29)	60.80 (5.55)	53.32 (4.88)	51.89 (5.28)
The Confidence Scale								
M (SE)	159.17 (8.13)	171.25 (8.14)	159.04 (8.76)	162.04 (8.40)	157.11 (9.32)	157.70 (9.31)	166.06 (8.99)	158.90 (10.00)

Group Difference on the Problem Scale and the Confidence Scale

Sixty-two and 54 parents were under the intervention group and the control group, respectively. The problem scale was reported higher in the control group, compared to the intervention group. The confidence scale was also reported higher in the intervention group.

Table 7 shows the changes in the problem scale and the confidence scale between groups and within groups. Although no significant group difference was found in the ITT population on the problem scale (p=0.23) and the confidence scale (p=0.29) throughout the study period, parents reported a better effect on improvement of their problem level in managing obesity-related problem behaviour of their child in the study period (OR=-2.514). Parents also reported their higher confidence in managing obesity-related problem behaviour of their child (OR=6.885). However, there was no statistical difference in both scales.

To observe the change in managing eating, activity, and obesity-related problem behaviour, parents reported a lower level in the intervention group, compared to the control group, although there was no statistical significance. Parents reported their confidence level was improved in these three behaviours. However, there was no

statistically significant behaviour found in the alleviation of their confidence level.

In order to find out the interaction effect in group and time, there was no significant effect on the problem scale (p=0.79) or in the subscale of eating (p=0.96), activity (p=0.40) and obesity-related behaviour (p=0.89). Also, no significant effect was found within groups (p=0.15).

The interaction effect between groups and time was assessed. There was no statistical significance between groups and time in both the problem scale and the confidence scale.

The Problem Scale and the Confidence Scale Change within Groups

The change of the problem level and the confidence level of parents in managing obesity-related problem behaviour of their child within groups was also reported. No statistically significant change of these two scales was reported within group.

Table 8.

Comparison of Mean Scores on the Problem Scale and the Confidence Scale of the Lifestyle Behaviour Checklist between the Intervention group and the Control Group

	Intervention Group (n=62)	Control Group (n=54)	OR (95% CI)	GEE		Within group	Group* time		Intervention group (n=62)	Control Group (n=54)	OR (95% CI)	GEE		Within group	Group* time
	Mean (SE)	Mean (SE)		Wald X^2	P	P	P		Mean (SE)	Mean (SE)		Wald X^2	P	P	P
Problem Scale	55.61 (2.01)	56.98 (2.34)	-2.514 (-6.614,1.586)	1.444	0.23	0.15	0.79	Confidence Scale	165.54 (4.53)	158.65 (4.57)	6.885 (-5.746,19.516)	1.141	0.29	0.71	0.16
Eating (Questions 1-16)	38.21 (1.34)	39.74 (1.64)	-1.376 (-4.320,1.568)	0.839	0.36		0.96	Eating (Questions 1-16)	109 (3.00)	104.19 (3.06)	-5.415 (-12.193,1.362)	2.452	0.12		0.13
Activity (Questions 17-21)	11.32 (0.51)	11.25 (0.52)	-0.801 (-1.865,0.262)	2.180	0.14		0.40	Activity (Questions 17-21)	34.48 (0.99)	33.05 (1.00)	-2.420 (-4.816, -0.25)	3.920	0.05		0.08
Obesity-related Behaviour (Questions 17-21)	4.87 (0.27)	5.14 (0.30)	-0.353 (-0.986,0.280)	1.197	0.27		0.89	Obesity-related Behaviour (Questions 17-21)	21.96 (0.60)	21.48 (0.60)	-1.240 (-2.660,0.180)	2.928	0.08		0.20

The Problem Scale and the Confidence Scale of Each Problem Behaviour on the Lifestyle Behaviour Checklist

The Lifestyle Behaviour Checklist has 26 questions to show different obesity-related problem behaviours. Specific behaviour affecting parents' confidence in management of their child's behaviour was explored. Table 7 shows group differences of problem behaviour mean scores in the Lifestyle Behaviour Checklist. Questions 25 and 26 are open-ended questions, and parents answered these two questions if they found their child had another obesity-related problem behaviour. After the study, it was found that less than 15% parents opted to answer questions 24 and 25. Table 9 shows group differences of mean scores for each question.

The Problem Scale

Negative correlation was reported on the majority of behaviours on the problem scale. Twenty-one out of twenty-four problem behaviours reported negative correlation. Parents reported lower scores on the problem scale in the intervention group than those in the control group, except for problem behaviours 3, 11, 12, 17, 18 and 19. All problem behaviour did not show significant correlation between group differences on the problem scale.

The Confidence Scale

Twenty-two questions reported positive correlation. Parents reported a higher score on the confidence scale in the intervention group, compared with the control group, expect for problem behaviour 2. No significant correlation was reported in most of the problem behaviours between groups.

Table 9.

Comparison of each behaviour in the Problem scale and the Confidence scale of Lifestyle Behaviour Checklist with Group Difference

Question	The Problem Scale					The Confidence Scale			GEE	
	Intervention Group Mean (SE)	Control Group Mean (SE)	OR (95% CI)	GEE Wald X^2	P	Intervention group Mean (SE)	Control Group Mean (SE)	OR (95% CI)	Wald X^2	P
1. Eats too quickly (compared with children with same age)	2.41 (0.12)	2.43 (0.13)	-0.22 (-0.372,0.328)	0.015	0.90	6.52 (0.21)	6.32 (0.22)	-0.200 (-0.388,0.789)	0.444	0.51
2. Eats too much (Compared with children with same age)	2.97 (0.12)	3.00 (0.14)	-0.031 (-0.391,0.329)	0.028	0.87	5.98 (0.19)	6.01 (0.23)	-0.036 (-0.617,0.545)	0.015	0.90
3. Eats unhealthy snacks	3.00 (0.12)	2.94 (0.13)	0.062 (-0.286,0.409)	0.121	0.73	6.31 (0.19)	6.10 (0.21)	0.539 (-0.039,1.117)	3.335	0.07
4. Whinges or whines about food	2.50 (0.13)	2.81 (0.13)	-0.309 (-0.671,0.052)	2.811	0.09	6.70 (0.21)	6.16 (0.21)	-0.149 (-1.187,0.889)	0.079	0.78
5. Yells about food	1.81 (0.16)	2.07 (0.12)	-0.265 (-0.578,0.048)	2.754	0.09	7.23 (0.20)	7.02 (0.22)	0.216 (-0.383,0.815)	0.498	0.48
6.Throws a tantrum about food	1.87 (0.10)	2.05 (0.12)	-0.181 (-0.501,0.138)	1.237	0.27	7.25 (0.22)	6.97 (0.22)	0.278 (-0.335,0.891)	0.789	0.37
7. Refuses to eat certain foods (i.e. fussy eating)	3.07 (0.11)	3.29 (0.13)	-0.222 (-0.562,0.118)	1.639	0.20	6.14 (0.19)	5.54 (0.21)	0.605 (0.056,1.154)	4.667	0.03
8. Argues about food (e.g. when you say no more)	2.47 (0.10)	2.54 (0.13)	-0.069 (-0.402,0.264)	0.166	0.68	6.73 (0.19)	6.43 (0.22)	0.297 (-0.280,0.874)	1.016	0.31
9. Requests food continuously	2.39 (0.11)	2.43 (0.13)	-0.039 (-0.379,0.301)	0.051	0.82	6.81 (0.21)	6.65 (0.22)	0.157 (-0.451,0.765)	0.256	0.62
10. Demands extra helpings at meals	2.51 (0.10)	2.58 (0.13)	-0.070 (-0.387,0.247)	0.187	0.67	6.75 (0.22)	6.49 (0.12)	0.258 (-0.355,0.872)	0.682	0.41
11. Sneaks food when they know they are not supposed to	2.44 (0.12)	2.38 (0.13)	0.051 (-0.297,0.399)	0.082	0.77	6.90 (0.21)	6.47 (0.21)	0.431 (-0.165.1.026)	2.011	0.16
12. Hides food	1.76 (0.11)	1.74 (0.11)	0.017 (-0.292,0.326)	0.012	0.91	7.42 (0.22)	7.26 (0.21)	0.157 (-0.449,0.764)	0.259	0.61
13.Steals food (e.g. from other children's lunchboxes)	1.42 (0.10)	1.48 (0.12)	-0.067 (-0.379,0.244)	0.179	0.67	7.67 (0.22)	7.61 (0.23)	0.056 (-0.572,0.683)	0.030	0.86
14. Eats food to comfort themselves when feeling let down or depressed	1.99 (0.10)	2.08 (0.12)	-0.085 (-0.394,0.223)	0.292	0.59	7.41 (0.22)	6.97 (0.21)	0.439 (-0.157,1.034)	2.087	0.15
15. Watches too much television (compared with children with same age)	2.61 (0.12)	2.86 (0.13)	-0.254 (-0.609,0.102)	1.958	0.16	6.63 (0.22)	6.26 (0.21)	0.369 (-0.225,0.963)	1.481	0.22
16. Spends too much time playing video or computer games (compared with children with same age)	3.04 (0.12)	3.16 (0.15)	-0.127 (-0.497,0.242)	0.458	0.50	6.27 (0.22)	6.06 (0.22)	0.213 (-0.400,0.827)	0.465	0.50
17. Complains about	2.52	2.46	0.061	0.113	0.74	6.71	6.50	0.211	0.498	0.48

doing physical activity (e.g. this is boring, I'm too tired, my leg hurts)	(0.13)	(0.12)	(-0.292,0.414)			(0.21)	(0.22)	(-0.374,0.796)		
18. Refuses to do physical activity	2.24	2.14	0.100	0.335	0.56	6.89	6.66	0.232	0.609	0.44
	(0.12)	(0.13)	(-0.239,0.438)			(0.21)	(0.21)	(-0.351,0.816)		
19. Complains about being unfit or feeling low in energy	2.43	2.37	0.056	0.104	0.74	6.80	6.67	0.129	0.174	0.68
	(0.13)	(0.12)	(-0.285,0.398)			(0.22)	(0.22)	(-0.477,0.735)		
20. Complains about being overweight	2.44	2.45	-0.009	0.003	0.96	6.68	6.42	0.258	0.634	0.43
	(0.12)	(0.12)	(-0.355,0.336)			(0.21)	(0.23)	(-0.376,0.891)		
21. Complains about being teased	1.71	1.86	-0.149	0.910	0.34	7.32	6.86	0.455	2.267	0.13
	(0.11)	(0.11)	(-0.456,0.158)			(0.21)	(0.21)	(-0.137,1.047)		
22. Complains about not having enough friends	1.60	1.74	-0.141	0.832	0.36	7.29	7.12	0.171	0.336	0.56
	(0.10)	(0.11)	(-0.445,0.162)			(0.21)	(0.21)	(-0.408,0.751)		
23. Complains about being unattractive	1.50	1.55	-0.045	0.102	0.75	7.37	7.19	0.185	0.405	0.53
	(0.09)	(0.10)	(--0.318,0.229)			(0.20)	(0.21)	(-0.385,0.755)		
24. Complains about not fitting into clothes	1.79	1.86	-0.067	0.189	0.66	7.27	7.19	-0.083	0.074	0.79
	(0.10)	(0.12)	(-0.371,0.236)			(0.22)	(0.22)	(-0.517,0.683)		
25. Problem level of another weight-related behaviour/ situation	2.53	2.46	0.069	0.134	0.71	6.23	6.10	0.135	0.174	0.67
	(0.12)	(0.15)	(-0.299,0.436)			(0.19)	(0.25)	(-0.499,0.770)		
26. Problem level of another weight-related behaviour/ situation	2.33	2.24	0.095	0.329	0.57	6.43	6.16	0.278	0.807	0.37
	(0.10)	(0.12)	(-0.230,0.421)			(0.18)	(0.25)	(-.328,0.883)		

The Long-Term and Short-Term Intervention Effect

The correlation between various covariates and the change of the problem level and the confidence level of parents' efficacy in managing obesity-related problem behaviour respectively is shown in table 10. Although no significant correlation was reported between pre-intervention and various time-points, the problem scale was reduced at each time-point in the intervention group; whereas, the control group had reduction of the problem scale between pre-intervention and 10-week follow-up only. A significant correlation was reported between the problem scale and the problem scale at baseline ($p<0.01$) in the intervention group. In the control group, a significant correlation was found between the problem scale and the problem scale at baseline ($p<0.01$), too. There were no other factors having significant correlation with the problem scale in both groups. It indicated a higher score on the problem scale at baseline, and a higher problem level in final outcomes in the intervention group (OR=0.565) and the control group (OR=0.614).

No significant correlation was reported between pre-intervention and various time-points. However, the intervention group was found to have alleviation of their confidence level between pre-intervention and 10-week follow-up, whereas, the control group did not have improvement in their confidence level. The confidence scale was associated with the child's age ($p<0.01$) and scores on the problem scale at baseline, in general. In the confidence scale, a significant correlation was reported for the child's age (<0.01) and scores on the confidence scale at baseline (<0.01) in the intervention group. Also, a significant correlation was reported on the score of the confidence scale at baseline (<0.01). The confidence level of parents with an older child was higher than

those with a younger child (OR=-6.242) in the intervention group, but no significance was reported on this factor in the control group. Similar to the problem scale, the higher confidence scale at baseline, the higher confidence level in final outcomes in the intervention group (OR=0.322) and the control group (OR=0.665).

Table 10.
Parameter estimation in GEE Analysis for Lifestyle Behaviour Checklist

Dependent Variables	Parameters	OR (95% CI)	X^2	p
Dependent Variables	Parameters	OR (95% CI)	X^2	p
The Problem Scale				
Intervention	Pre-Intervention Versus Post Intervention	6.044 (-0.373,12.462)	3.408	0.07
	Pre-Intervention Versus 5-week Follow-up	1.525 (-6.559,9.609)	0.137	0.71
	Pre-Intervention Versus 10-week Follow-up	5.525 (-0.908,11.959)	2.834	0.09
	Post Intervention Versus 5-week Follow-up	4.519 (-1.304,10.434)	2.313	0.13
	Post Intervention Versus 10-week Follow-up	0.260 (-2.119,2.638)	0.046	0.83
	Parental normal versus overweight	-8.604(-26.230,9.022)	0.915	0.34
	Parental normal versus obesity	5.047 (-6.057,16.151)	0.794	0.37
	Boys versus Girls	-2.784 (-8.966,3.397)	0.779	0.38
	Parent's Age	-0.891(-3.515,1.733)	0.443	0.51
	Child's Age	0.271 (-2.620,3.162)	0.034	0.85
	Chinese versus Others	8.276 (-5.797,22.350)	1.329	0.25
	Parent's educational level	-2.527 (-6.333,1.279)	1.693	0.19
	Parent's Occupation	-0.674 (-1.619,0.271)	1.953	0.16
	Family income	2.510 (0.681,4.339)	7.234	0.05

	Fathers versus Mothers	-4.596 (-11.190,1.998)	1.867	0.17
	Child's living status	2.821 (0.054,5.588)	3.994	0.05
	The problem scale at baseline	0.565 (0.353,0.778)	27.233	<0.01
Control	Pre-Intervention Versus Post Intervention	-0.919 (-9.012,7.175)	0.049	0.82
	Pre-Intervention Versus 5-week Follow-up	-2.274 (-11.187,6.639)	0.250	0.62
	Pre-Intervention Versus 10-week Follow-up	6.633 (-1.938,15.205)	2.301	0.13
	Post Intervention Versus 5-week Follow-up	1.356 (-7.594,10.305)	0.088	0.77
	Post Intervention Versus 10-week Follow-up	-3.776 (-7.838,0.286)	3.320	0.07
	Parental normal versus overweight	-8.340 (-27.454,10.775)	0.731	0.39
	Parental normal versus obesity	-7.586 (-19.772,4.601)	1.489	0.22
	Boys versus Girls	1.617 (-7.490,10.724)	0.121	0.73
	Parent's Age	1.898 (-1.763,5.559)	1.032	0.31
	Child's Age	0.710 (-3.922,5.343)	0.090	0.76
	Chinese versus Others	21.010 (-1.244,43.265)	3.424	0.06
	Parent's educational level	0.408(-4.124,4.939)	0.031	0.86
	Parent's occupation	1.595(0.053,3.136)	4.112	0.05
	Family Income	3.897 (1.386,6.408)	9.254	0.04
	Fathers versus Mothers	-3.021 (-16.451,10.408)	0.194	0.66
	Child's living status	-1.670 (-7.210,3.870)	0.349	0.56
	The problem scale at baseline	0.614 (0.448,0.779)	52.954	<0.01
Dependent Variables	Parameters	OR (95% CI)	X^2	p
The Confidence Scale				
Intervention	Pre-Intervention Versus Post Intervention	0.132 (-15.350,15.614)	0.0000	0.99
	Pre-Intervention Versus 5-week Follow-up	2.065 (-13.380,17.509)	0.069	0.79

	Pre-Intervention Versus 10-week Follow-up	-6.887 (-23.511,9.737)	0.659	0.41
	Post Intervention Versus 5-week Follow-up	-1.932 (-12.946,9.082)	0.118	0.73
	Post Intervention Versus 10-week Follow-up	3.510 (-0.422,7.442)	3.060	0.08
	Parental normal versus overweight	0.280 (-23.268,23.827)	0.001	0.98
	Parental normal versus obesity	21.031 (0.546,41.517)	4.049	0.05
	Boys versus Girls	3.100(-8.188,14.388)	0.290	0.59
	Parent's Age	-0.450(-5.060,4.159)	0.037	0.85
	Child's Age	-6.242(-10.977,1.507)	66.76	<0.01
	Chinese versus Others	23.909(4.537,43.281)	5.852	0.05
	Parent's educational level	-2.660(-10.590,5.270	0.432	0.51
	Parent's occupation	2.059 (0.379,3.739)	5.768	0.05
	Family Income	2.065(-2.454,6.585)	0.802	0.37
	Fathers versus Mothers	3.486(-14.075,21.048)	0.151	0.70
	Child's living status	-2.316(-7.143,2.511)	0.885	0.35
	The confidence scale at baseline	0.322 (0.154,0.490)	14.165	<0.01
Control	Pre-Intervention Versus Post Intervention	9.211 (-4.950,23.373)	1.625	0.20
	Pre-Intervention Versus 5-week Follow-up	13.552 (-2.387,26.491)	2.777	0.10
	Pre-Intervention Versus 10-week Follow-up	12.348 (-5.045,29.741)	1.936	0.16
	Post Intervention Versus 5-week Follow-up	-4.341 (-17.773,9.092)	0.401	0.53
	Post Intervention Versus 10-week Follow-up	-1.569 (-8.735,5.598)	0.184	0.67
	Parental normal versus overweight	0.514 (-27.854,28.882)	0.001	0.97

Parental normal versus obesity	-27.158 (-48.685, -5.630)	6.114	0.05
Boys versus Girls	5.860(-9.649,21.369)	0.548	0.46
Parent's Age	2.623(-2.878,8.124)	0.873	0.35
Child's Age	5.455(-0.725,11.635)	2.993	0.08
Chinese versus Others	NA		
Parent's educational level	9.233(2.988,15.478)	8.397	0.05
Parent's occupation	2.948 (0.377,5.519)	5.049	0.05
Family Income	0.907(-3.795,5.609)	0.143	0.71
Fathers versus Mothers	-3.224(-25.042,18.595)	0.084	0.77
Child's living status	2.017(-8.751,12.786)	0.135	0.71
The confidence scale at baseline	0.665(0.490,0.841)	55.430	<0.01

The Correlation between Anthropometric Measures and the Problem Scale/the Confidence Scale of the Lifestyle Behaviour Checklist

To assess the effectiveness of parental education in control of childhood obesity, the correlation between anthropometric measures and the problem scale/the confidence scale was analyzed. There was no clinically significant correlation between anthropometric parameters (BMI percentile, waist circumference and weight status of children) and Lifestyle Behaviour Checklist (the problem scale and the confidence scale). Table 11 shows a significant correlation between BMI percentile and the problem scale in the intervention group was reported ($p=0.02$), but no significant correlation was found on the confidence scale. The problem scale was reported statistically significant ($p<0.01$), but no statistical significance was found in the confidence level in the control group. For the waist circumference, the problem scale was reported statistically significant in the control group only. The weight status was found to have significant correlation with the problem scale in the intervention group

(p=0.02). In the control group, weight status significantly correlated with the problem scale and the confidence scale. It shows a positive correlation between anthropometric measures and the problem scale and the confidence scale.

Table 11.
Parameter estimation in GEE Analysis for Anthropometric Measures and Lifestyle Behaviour Checklist

Dependent Variables	Parameters	OR (95% CI)	X^2	p-value
BMI Percentile				
Intervention	The problem scale	0.189 (0.016,0.362)	4.570	0.02
	The confidence scale	0.099 (-0.006,0.204)	3.399	0.05
Control	The problem scale	0.178 (0.022,0.334)	4.990	<0.01
	The confidence scale	0.130 (0.041,0.219)	8.147	0.03
Waist Circumference				
Intervention	The problem scale	0.121 (-0.008,0.251)	3.355	0.07
	The confidence scale	0.066 (-0.10,0.142)	2.893	0.09
Control	The problem scale	0.180 (0.058,0.302)	8.371	0.01
	The confidence scale	0.092 (0.014,0.171)	5.329	0.05
Weight Status				
Intervention	The problem scale	0.008 (0.00,0.016)	3.592	0.02
	The confidence scale	0.004 (-0.002,0.009)	1.986	0.16
Control	The problem scale	0.11 (0.03,0.18)	8.581	<0.01
	The confidence scale	0.006 (0.002,0.10)	10.084	0.02

9.4. Secondary Outcomes

One hundred and twenty-eight children participated in the study. One hundred and seven children completed all anthropometric measurements over the study period. Children were asked to measure their weight and height to calculate BMI percentile, classifying children falling in the categories of “normal weight”, “overweight” or “obese” and waist circumference before and after the study, and 5 weeks and 10 weeks after the study.

Overweight and Obesity Prevalence Changes

Table 12 shows the prevalence of overweight and obesity at baseline to the 4th follow-up of the intervention group and the control group. The prevalence of obesity decreased from 56.5% to 52.7% (reduced 3.8%) in the intervention group. The control group reported a decrease in the prevalence of obesity from 38.9% to 29.6% (reduced 9.3%). The alleviation of the prevalence of overweight changed from 43.5% to 31.6% (reduced 11.9%) in the intervention group and from 61.1% to 29.3% (reduced 31.8%) in the control group. The percentage of children with normal weight increased 15.7% and 22.2% in the intervention group and the control group, respectively.

BMI Percentiles Change

Children’s BMI was reported to have alleviation in both groups. However, the intervention group (reduced 7.76 percentiles) had less reduced BMI percentile, compared to those children in the control group (reduced 10.77 percentiles) during the study period.

Waist Circumference Changes

To observe the change of child's waist circumference for both intervention and control groups in the study period, a reduction of waist circumference was reported in both groups. Child's waist circumference decreased from 71.92 cm to 69.40 cm (reduced 2.54cm) and from 67.33cm to 64.67 cm (reduced 2.66 cm) in the control group.

Table 12.

Anthropometric Measures in the Intervention and the Control Groups at Baseline and Follow-up

Child's Waist Status	Baseline n (%)		Post-Intervention n (%)		5-week follow-up n (%)		10-week follow-up n (%)	
	Intervention	Control	Intervention	Control	Intervention	Control	Intervention	Control
Normal	0 (0.0)	0 (0.0)	5 (8.6)	10 (17.6)	9 (15.8)	11 (21.2)	9 (15.8)	12 (22.2)
Overweight	27 (43.5)	33 (61.1)	17 (30.0)	20 (37.8)	18 (31.5)	23 (44.2)	18 (31.5)	23 (29.3)
Obesity	35 (56.5)	21 (38.9)	35 (61.4)	17 (32.0)	30 (52.7)	18 (34.6)	30 (52.7)	16 (29.6)
Total	62 (100.0)	54 (100.0)	57 (100.0)	53 (100.0)	57(100.0)	52 (100.0)	57(100.0)	51 (100.0)
BMI Percentiles								
n	62	54	57	53	57	52	57	51
M (SE)	94.24	93.62	86.57	86.41	85.14	83.89	86.48	82.85
	(0.39)	(0.16)	(3.22)	(3.02)	(3.16)	(3.43)	(3.19)	(3.84)
Waist Circumference								
n	62	54	57	53	57	52	57	51
M (SE)	71.92	67.33	69.48	68.29	69.06	65.72	69.40	64.67
	(1.44)	(1.35)	(2.68)	(2.18)	(2.61)	(2.44)	(2.69)	(2.83)

Anthropometric Measures Changes between Groups

Sixty-two children belonged to the intervention group and 54 children were under the control group. Anthropometric measures were found higher in the intervention group, compared to the control group at baseline. A higher BMI (0.62 percentile higher), waist circumference (4.59 cm more) and weight status (0.56 more) was marked for the intervention group.

Table 13 shows the differences in anthropometric changes of children between groups and within groups. Although no significant group difference was found in the ITT population (p=0.73) throughout the study period, the intervention group had a better effect of BMI reduction in the study period (OR=-0.475). To observe the change of child's weight status, the intervention group had a better effect of alleviating child's weight status (OR=-0.014), but there was no statistical significance (p=0.68). The odds of waist circumference for the intervention group and the control group was 0.789. It indicates that the intervention group was less likely to increase waist circumference. The finding did not have statistical significance (p=0.83). These anthropometric measures were reported higher in the intervention group, compared to the control group from baseline to the final follow-up.

The findings of the differences between time-points showed there was no significant difference of anthropometric measures between groups.

Anthropometric Measures Changes within Groups

The change of anthropometric measures was also reported. The intervention group had a better effect of change of BMI and weight status, compared to the control group.

BMI percentile (p<0.01) and weight status (p=0.019) was found to be statistically significant. However, waist circumference did not report statistical significance (p=0.34). The interaction effect between groups and time was not statistically significant in BMI percentile (p=0.55), waist circumference (p=0.93) and weight status (p=0.68).

Table 13.

Comparison of the Anthropometric Measures of Children

	Intervention Group n=62 Mean (SE)	Control Group n=54 Mean (SE)	OR (95%CI)	GEE X^2	GEE p	Within Groups P	Group x time P
BMI Percentile	89.65 (1.88)	87.74 (2.04)	-0.475 (-3.194,2.244)	0.117	0.73	<0.01	0.55
Waist circumference (cm)	68.96 (1.39)	67.90 (1.54)	0.789 (-2.531,4.109)	0.217	0.64	0.34	0.93
* Weight Status	2.27 (0.09)	2.21 (0.11)	-0.014 (-0.140,0.112)	0.048	0.83	0.019	0.68

*1=normal weight, 2=overweight and 3=obese, #p=<0.025

Intervention Effects on Obesity and Overweight

Intervention (intervention and control), time (baseline, post-intervention, 5-week follow-up and 10-week follow-up), interaction of intervention and time, gender (boy/girl); age (continuous variable), BMI category of parents

(normal/overweight/obesity) and children's BMI at baseline (continuous) were independent variables in GEE regression analysis. Dependent variables were child's weight status (normal/overweight/obesity).

Due to no statistically significant interaction between intervention and time, this variable was not excluded. Table 14 shows the association between intervention and other factors with excess weight gain. The intervention was effective for alleviating the odds of developing obesity, although both had statistical significance. The odds of developing overweight differed significantly between both groups in the study period (OR=-0.282). The negative relationship between overweight and intervention was established. The possibility of developing overweight in the intervention group decreased; whereas, children in the control group were found as having a higher chance to develop overweight. This was in contrast to the odds of developing obesity in the intervention group (OR= 2.824). It indicated the possibility of developing obesity in the intervention group was higher than the control group.

Table 14 shows that the intervention decreased the mean weight status in both groups. There was no statistical significance between groups and time in the change of child's waist circumference.

Table 14.

OR and 95% CI for Intervention Associated with Weight Status of Child

Dependent Variables	Parameters	OR (95% CI)	X^2	p-value
Overweight	Intervention and Control	-0.282 (-0.616,0.053)	2.728	0.01
Obesity	Intervention and Control	2.824 (2.566,3.082)	460.205	<0.01

The Long-Term and Short-Term Intervention Effect of BMI Percentiles

There was significant difference of BMI percentile between pre-intervention and 10-wefollow-upwup (p=0.01), except for the comparison of pre-intervention and 5-week follow-up in the intervention group. In the intervention group, OR of various time-points was a positive value, and it indicates that BMI percentile of all time-points was lighter than pre-intervention measurement. The interaction effect between intervention and time was statistically significant between post-intervention and 5-week follow-up in the intervention group (p=0.01), but not in the control group. Table 15 shows that the intervention decreased the mean BMI percentile in both groups. Although the largest decrease (-2.406) was in the control group and the smallest decrease (-0.136) was in the intervention group, it did not show statistical significance. There was a decrease trend in mean BMI percentile over the study period in both the intervention and the control group, but the proportion of BMI percentile reduction was different at the various cut-off points. The short-term intervention effect of BMI percentiles was reported in the intervention group, but not in the control group. Both groups did not report the long-term intervention effect on the change of BMI percentiles.

The Correlation between Different Factors and the Change of BMI Percentiles

BMI percentile of children was associated with ethnicity only. Table 10 also shows the association between various factors and the change of BMI percentiles. A significant correlation was reported between BMI percentile and ethnicity (p<0.01) in both groups. It is the significant factor affecting BMI percentile of children. After intervention, the OR of BMI percentile on post intervention versus 5-week follow-up was -1.511,

indicating children's BMI percentile on post intervention measurement was lighter than children's BMI percentile at the 5-week follow-up measurement.

Table 15.
Parameter estimation in GEE Analysis for BMI Percentiles

Variables	Parameters	OR (95% CI)	X^2	p-value
BMI Percentile				
Intervention	Pre-Intervention Versus Post Intervention	7.581 (1.433,13.730)	5.840	0.02
	Pre-Intervention Versus 5-week Follow-up	9.093 (3.090,15.095)	8.815	0.03
	Pre-Intervention Versus 10-week Follow-up	7.853 (1.821,13.885)	6.511	0.01
	Post Intervention Versus 5-week Follow-up	-1.511 (-2.670, -0.352)	6.530	0.01
	Post Intervention Versus 10-week Follow-up	-0.136 (-0.828,0.557)	0.148	0.70
	Parental normal versus overweight	3.973 (-0.105,8.051)	3.647	0.06
	Parental normal versus obesity	1.606 (-1.432,4.644)	1.074	0.30
	Boys versus Girls	-4.207 (-7.820, -0.593)	5.205	0.03
	Parent's Age	0.297 (-1.022,1.617)	0.195	0.66
	Child's Age	-1.087 (-3.327,1.154)	0.903	0.34
	Chinese versus Others	39.818 (33.573,46.062)	156.20	<0.01
	Parent's educational level	0.603 (-1.482,2.688)	0.321	0.57
	Parent's Occupation	-0.40 (-0.729,0.648)	0.013	0.91
	Family Income	-0.608(-4.233,1.016)	1.443	0.23
	Fathers versus Mothers	-0.769 (-6.878,5.340)	0.061	0.80
	Child's living status	0.107 (-2.811,3.025)	0.05	0.94
	BMI at baseline	1.197 (0.133,2.261)	4.866	0.03
Control	Pre-Intervention Versus Post Intervention	7.323 (1.589,13.057)	6.266	0.01
	Pre-Intervention Versus 5-week Follow-up	9.730 (3.236,16.223)	8.625	0.03
	Pre-Intervention Versus 10-week Follow-up	10.693 (3.399,17.988)	8.255	0.04
	Post Intervention Versus 5-week Follow-up	-2.406 (-6.217,1.404)	1.532	0.21
	Post Intervention Versus 10-week Follow-up	-1.685 (-4.257,0.886)	1.650	0.20
	Parental normal versus overweight	0.573 -5.585.6.732)	0.033	0.86
	Parental normal versus obesity	0.447 (-3.453,4.347)	0.051	0.82
	Boys versus Girls	1.579 (-6.157,9.314)	0.160	0.69

Parent's Age	1.983 (-0.460,4.427)	2.531	0.11
Child's Age	0.458 (-2.472,3.387)	0.094	0.76
Chinese versus Others	21.665 (6.932, 36.397)	8.307	<0.01
Parent's educational level	0.713 (-1.476,2.902)	0.407	0.53
Parent's Occupation	0.382 (-0.750,1.514)	0.437	0.51
Family Income	0.941 (-0.962,2.845)	0.939	0.33
Fathers versus Mothers	0.014 (-6.269,6.296)	0.00	1.00
Child's living status	-1.769 (-4.443,0.905)	1.681	0.20
BMI at baseline	0.987 (0.200,1.775)	6.035	0.05

The Long-Term and Short-Term Intervention Effect of Waist Circumference

There was no significant difference between pre-intervention and various time-point measurements. The interaction effect between intervention and time on the change of waist circumference in both groups did not show as statistically significant between post-intervention and 5-week follow-up in the intervention group and between post-intervention and 10-week follow-up. It indicates no short-term and long-term intervention effect in the change of waist circumference.

The Correlation between Different Factors and the Change of Waist Circumference

Table 16 also shows the association between various factors and the change of waist circumference. A significant correlation was reported between waist circumference and parent's normal weight versus overweight ($p<0.01$) and ethnicity ($p<0.01$) in the intervention group. In the control group, a significant correlation was found between waist circumference and waist circumference at baseline ($p<0.01$). In the intervention group, the OR of waist circumference for parents with normal weight versus overweight was 8.412, indicating the child would be less likely to increase waist circumference if their parents were at normal weight. Waist circumference also

indicated that the greater waist circumference at baseline, the greater waist circumference in final outcomes in the control group (OR=0.846).

Table 16.
Parameter estimation in GEE Analysis for Waist Circumference

Dependent Variables	Parameters	OR (95% CI)	X^2	p-value
Waist Circumference				
Intervention	Pre-Intervention Versus Post Intervention	2.441 (-2.787,7.669)	0.837	0.36
	Pre-Intervention Versus 5-week Follow-up	2.857 (-2.444,8.158)	1.116	0.29
	Pre-Intervention Versus 10-week Follow-up	526 (-2.696,7.748)	0.899	0.34
	Post Intervention Versus 5-week Follow-up	-0.416 (-1.613,0.781)	0.464	0.50
	Post Intervention Versus 10-week Follow-up	1.192 (-5.580,7.964)	0.119	0.73
	Parental normal versus overweight	8.412 (3.257,13.568)	10.227	<0.01
	Parental normal versus obesity	2.785 (-1.042,6.612)	2.034	0.15
	Boys versus Girls	-1.993 (-7.293,3.306)	0.543	0.46
	Parent's Age	-1.375 (-2.523, -0.226)	5.500	0.05
	Child's Age	-0.379 (-3.508,2.750)	0.056	0.81
	Chinese versus Others	37.264 (32.464,42.063)	231.574	<0.01
	Parent's educational level	0.857 (-1.792,3.505)	0.402	0.53
	Parent's Occupation	-0.150 (-0.539,0.239)	0.571	0.45
	Family Income	-0.250 (-1.802,1.302)	0.100	0.75
	Fathers versus Mothers	-5.171 (-10.879,0.538)	3.152	0.08
	Child's living status	-0.127 (-3.502,3.249	0.005	0.94
	Waist Circumference at baseline	0.967 (0.308,1.625)	8.281	0.05
Control	Pre-Intervention Versus Post Intervention	-0.955 (-4.905,2.996)	0.224	0.64
	Pre-Intervention Versus 5-week Follow-up	1.609 (-3.334,6.552)	0.407	0.53
	Pre-Intervention Versus 10-week Follow-up	2.666 (-2.910,8.241)	0.878	0.35
	Post Intervention Versus 5-week Follow-up	-2.406 (-6.217,1.404)	1.532	0.21
	Post Intervention Versus 10-week Follow-up	4.727 (-2.927,12.381)	1.465	0.23
	Parental normal versus overweight	-3.400 (-12.497,5.697)	0.537	0.46
	Parental normal versus obesity	-1.385 (-6.489,3.719)	0.283	0.60
	Boys versus Girls	4.798 (0.028,9.568)	3.887	0.05

Parent's Age	2.216 (0.829,3.603)	9.809	0.05
Child's Age	-0.578 (-2.465,1.309)	0.360	0.55
Chinese versus Others	7.663 (-0.212,15.539)	3.637	0.06
Parent's educational level	-0.150 (-1.903,1.602)	0.028	0.87
Parent's Occupation	0.443 (-0.4679,1.354)	0.906	0.34
Family Income	1.309 (0.024,2.594)	3.984	0.03
Fathers versus Mothers	1.437 (-3.360,6.233)	0.345	0.60
Child's living status	1.692 (0.060,3.323)	4.131	0.04
Waist Circumference at baseline	0.846 (0.661,1.031)	80.368	<0.01

The Long-Term and Short-Term Intervention Effect of Weight Status of Children

The interaction effect between intervention and time on the change of weight status of child in both groups was examined. In general, a significant difference was reported in weight status comparison between pre-intervention measurement and 5-week follow-up, as well as at pre-intervention and 10-week follow-up in the intervention group. No significant factor was found in affecting the weight status of children. Significance was found in the short-term effect and the long-term effect in changing of weight status. However, the effect happened within groups.

Table 17.
Parameter estimation in GEE Analysis for Weight Status

Dependent Variables	Parameters	OR (95% CI)	X^2	p-value
Weight Status				
Intervention	Pre-Intervention Versus Post Intervention	0.314 (0.029,0.599)	4.655	0.03
	Pre-Intervention Versus 5-week Follow-up	0.447 (0.173,0.722)	10.192	0.01
	Pre-Intervention Versus 10-week Follow-up	0.355 (0.072,0.638)	6.035	0.01
	Post Intervention Versus 5-week Follow-up	-0.133 (-0.245, -0.022)	5.511	0.05
	Post Intervention Versus 10-week Follow-up	-0.021 (-0.097,0.056)	0.275	0.60

Control	Pre-Intervention Versus Post Intervention	0.342 (0.051,0.632)	5.314	0.02
	Pre-Intervention Versus 5-week Follow-up	0.498 (0.167,0.829)	8.683	0.03
	Pre-Intervention Versus 10-week Follow-up	0.453 (0.073,0.832)	5.470	0.02
	Post Intervention Versus 5-week Follow-up	-0.175 (-0.392,0.042)	2.501	0.11
	Post Intervention Versus 10-week Follow-up	-0.056 (-0.190,0.079)	0.654	0.42

10. Discussion

The main outcomes reported in the last chapter are discussed. Positive effects and study limitations are also explained. There are several sections in this discussion. The first part focuses on discussion of the effect of the parent-based education program implemented and outcomes of the study contribution to the hypotheses, with literature support. The difference in parental self-efficacy in managing problem behaviour and anthropometric measures of children is also emphasized. The study evaluated the effectiveness of a parent-based education program in reducing the obesity of children and enhancing parents' confidence in managing obesity related problem behaviour. These six hypotheses were tested and supported.

The second part discusses the strengths of this study of the health program for parents with overweight and obese children for clinical trial, as well as the main contribution of this research study. The final part is about the limitations of this study. Weaknesses of the study are pointed out and discussed. The implications and significance of this study are also emphasized.

The completed study can provide evidence about the effects of a 10-week childhood obesity program for parents. Apart from parental involvement, a combination of interventions of dietary intervention and physical activity was introduced for a randomly assigned group of parents with 10-week intervention and was compared with a control group. Parents and children were assessed at 5-week follow-up and 10-week follow-up. The percentage of overweight and obese children was 29.16% for recruited participants in this study. The percentage was high, compared to the survey of overweight and obesity rate of Hong Kong Primary Students. The survey reported 17.6% of primary school students become overweight or obese (Centre for Health

Protection, 2018). After a 20-week program, the prevalence of childhood overweight and obesity and overweight declined by 15.8% in the intervention group. The main reason for the decline in the intervention group was due to a decrease in overweight (12%) rather than obesity (3.8%). It is likely that the intervention given lowered the odds of developing overweight by about one-fifth, whereas, it lowered the odds of developing obesity by several percentages only. The prevalence of obesity did not change substantially because the number of overweight children moving into the normal weight group was greater than the number of obese children moving into the overweight group. The intervention had a positive effect on moving children from overweight to normal weight in addition to reducing weight gain.

Before commencement of the study, all parents were requested to fill in a demographic data form. A majority of them (70.7%) were living with children, so that parents are the key persons to manage the behaviour of children. In analyzing demographic data, it was found that mothers were more concerned about overweight or obesity of children. This was in line with a previous study (He & Evans, 2007). Parents who were slightly overweight were found, and genetic factors may be factors contributing to childhood obesity (Vos & Welsh, 2010).

Parental health knowledge is significantly important since parents are in the best position to affect behavioural change in their children. The previous study stated that parents provided more instrumental support for healthy eating and physical activity. Although the number of children and parents consuming fruits and vegetables would increase, parents' self-efficacy for healthy eating and physical activity was not enhanced (Kulik, et al., 2018). Although children did not initiate change in obesity-

related behaviour, parental knowledge was vital to monitor their children's behaviour and to plan children's activities. Although weight loss cannot be observed in the short period of time, it is beneficial for children to make behavioural change and have weight loss over the long run.

10.1. The Effectiveness of "Health for Life" Program

This study sought to evaluate a parent-based education program in controlling childhood obesity by improving parental self-efficacy. For parental self-efficacy, there was no significant difference between the intervention group and the control group. Parents reported significant confidence in managing physical activity-related behaviour of children in the intervention group. BMI percentile and weight status of children were improved within groups. The intervention group had a better effect in changing of BMI and weight status. Few studies were RCT study design with assessing parental self-efficacy in controlling childhood obesity. Previous studies assessed anthropometric measures and lifestyle behaviour of children. These studies did not assess parental self-efficacy in managing obesity-related problem behaviour of children, either did they employ an RCT or non-RCT design (Lumeng, et al., 2017; Yang et al., 2017).

The focus of a parent-based education program in control of childhood obesity included enhancing parental self-efficacy, since parents play a main role in taking care of children (Suhaimi, Hussin & Hashim, 2017). The parent as an agent proves effective in alleviation of childhood obesity (Ek et al., 2019; Eldridge et al., 2016). Since parents establish healthy eating and activity behaviours in their children, parents may modify their behaviour after enhancing their health knowledge regarding childhood obesity. They may understand and avoid potential risks that contribute to the obesity of children.

In addition, warm, responsive, and consistent parenting improve the quality of the parent-child relationship, whereby children may agree to change their lifestyle behaviour. Otherwise, children may not be responsive to change (Domoff & Niec, 2018). Previous studies also showed that parent-based intervention is effective in decreasing dietary intake of children, promoting parenting skill (Heerman et al., 2017) and improving parental self-efficacy in managing obesity-related problem behaviour (West et al., 2010). This study assumed to have a positive effect on controlling childhood obesity and improving the problem level and the confidence level of parents in managing obesity-related behaviour. Compared to previous studies, the current study did not find significant improvement in control of BMI percentile, waist circumference and weight status of children between the intervention group and the control group. Parental self-efficacy – the problem level and the confidence level – also contributed to insignificant change in anthropometric measures of children in the intervention group. High parental involvement and targeted child behaviour management caused successful reduction of weight in obese children (Domoff & Niec, 2018). Parental involvement and child behaviour management were mentioned in this study. It reflected that parental involvement and child behaviour management were not enough to alleviate children's overweight and obesity. For BMI percentile and weight status, significant improvement within the intervention group was found, and parents reported that the confidence scale for physical activities was significantly improved in the intervention group. It is believed that BMI percentile and weight status of children were improved because parents took action to help children engage in more physical activity. Although WHO recommends that children should engage in moderate and vigorous intensity physical activity (table 2) for at least 60 minutes (World Health Organization, 2017), the current study did not underline this recommendation. It is better to develop a child's habit of

becoming physically active, and light-intensity activity can protect children from obesity (Kwon, et al., 2011). In addition, the parent-child relationship is important to increase responsive and warm parent-child interactions for controlling childhood obesity. The parent-child relationship plays a role in the prevention of obesity, and parenting style is predictive of child BMI, according to a longitudinal study (Domoff & Niec, 2018). Positive reinforcement and authoritative parenting were suggested in the current study. Parent-based strategies, such as group sessions, were proved to have a significant effect in controlling childhood obesity (Eldridge et al., 2016; West et al., 2010). Although more teaching sessions could increase parental effectiveness in control of childhood obesity, parents were requested to work after official working hours, and this did not allow them to balance their work and family lives (Wong & O'Driscoll, 2018). Internet-based teaching sessions are recommended rather than face-to-face teaching. It avoids difficulties in scheduling and attendance at education sessions for parents and minimizes the likelihood of them to be absent from teaching sessions (Kim et al., 2016).

The 10-week intervention period with a 10-week maintenance period involved direct parental involvement strategies, such as teaching sessions and health information sheets, might be associated with insignificant results in the outcome variables. Intervention strategies of parent-based intervention for childhood obesity, such as group teaching sessions and interviewing, can produce significant change in BMI and healthy behaviour, as well as parental self-efficacy (Ek et al., 2019; Gerards et al., 2015; Reilly et al., 2019; Skouteris et al., 2016; West et al., 2010). Although the effectiveness of intensive health education for parents is unclear, three teaching sessions were not enough to make significant change in the BMI percentile among children, since

previous studies provide intensive teaching sessions (10 sessions or above) (Eldridge et al., 2016; West et al., 2010). Few teaching sessions may be convenient for parents. Parents commented that they read all information sheets and watched video of teaching sessions in the current study. They appreciated the delivery of health information regarding childhood obesity and parenting skill. However, they did not have time to complete the evaluation afterwards. This is in line with previous studies. Parents always claimed insufficient time to manage student-related issues, even in academic aspects (Wu & Chen, 2018). Wong & O'Driscoll, (2018) stated that people have difficulties in balancing their work and family lives. They are always asked to work after official working hours. This caused them not to have enough time and energy for family-related activity, including tackling child-related issues. Also, the teaching session arrangement could not allow parents to attend more sessions and affected their work in the current study. However, BMI percentiles and weight status still had significant improvement within the intervention group. Intensive text messages and health information sheets were intensively distributed to parents by mobile communication apps in the current study. Text messages (health tips, exercise and dietary reminders and parenting skill) were provided daily during the study period. Mobile communication apps were effective in facilitating communication, enhancing learning, and improving parent caregiving. This was also effective for health education (Kamel Boulos et al., 2016). The use of mobile communication apps for learning was found to have a positive impact on attitude and achievement levels of learners (Amry, 2014). In addition, text messages are simple and convenient. Interventions using information sheets or newspapers were effective in promoting healthy eating patterns and dietary self-efficacy of children (Kim et al., 2016). Extending the length of the study period may help parents to maintain changes in parenting in the long run, since parents may comment on their desire for

more sessions (West et al., 2010). The attendance of teaching sessions may need to be considered, and it is better to use internet-based intervention for a childhood obesity program.

The parent-based program for childhood obesity employed direct strategies – intensive teaching sessions – and their study found reduced BMI and improved parental self-efficacy in managing obesity-related problem behaviour (West et al., 2010). In addition, this arrangement may reduce attrition (Spence et al., 2017). Parents absenteeism from teaching sessions may affect their knowledge level. Apart from provision of teaching sessions, health information sheets were also distributed. Although the attendance rate of teaching sessions was low in the current study, an internet-based childhood obesity program (videos of teaching sessions were uploaded to the website) was recommended instead. An internet-based childhood obesity program was conducted, and it focused on parent-based education. The outcomes were not significant in change of body weight, but significant in improving parental stress on child feeding and dietary behaviour of children (Hammersley, et al., 2019). To avoid difficulties in scheduling and attendance at education sessions, internet-based learning is a good choice for delivering knowledge to parents. In future studies, internet-based learning could be considered useful in conducting a parent-based childhood obesity program. To enhance BMI improvement, text messages and health information sheets/newsletters would be supplemented to increase dietary self-efficacy of children. It will change eating habits and further contribute to reduction of BMI among children (Kim et al., 2016).

Parental self-efficacy is defined as parents' beliefs about their capacity to

raise their children. This influences children's development throughout the course of childhood. West and Sander (2009) studied the higher problem level and the lower confidence level of parents with obese children in managing obesity-related lifestyle problem behaviour, compared to parents with normal weight children. The current study outcomes are in line with the previous study. Parents' self-efficacy is a central construct for parents to take up the role of childhood obesity treatment and prevention (Heerman et al., 2017). Parents' confidence is one of the components that determines success or failure of childhood obesity prevention intervention. In the current study, parents had more confidence to manage physical activity obesity-related behaviour. If parents engage in physical activity with their child, it can increase the child's motivation to engage in physical activity. Children's physical activity can control their body fat and can be reflected in their weight status (Horodyska et al., 2018). Parental behaviour is associated with increasing their child's physical activity, such as parents' own physical activity, positive reinforcement by parents, and parents' instrumental behaviour (providing transport and equipment) can also increase the physical activity of children (Pyper et al., 2016). The improvement of the confidence level of parents in managing obesity-related problem behaviour (physical activity) of children was observed. Parents can demonstrate or use strategies, such as role modelling, and positive reinforcement in a real setting. It is vital to encourage children to engage in physical activity. Parents' motivational support can enhance the competency and behavioural intentions of children. This was in line with a previous study (Pyper et al., 2016). Parental behaviour was influenced by their perceptions regarding physical activity. In addition, parental perceptions of safety were correlated to childhood obesity. Parents restricted child's outdoor physical activity to keep them safe from external harm (Barnes et al., 2016). To consider this issue, parents may use alternatives (e.g. indoor activity) to maintain

children's physical activity, which was one of the strategies taught in the teaching sessions. Therefore, a significant reduction on BMI percentile and weight status of children was found within the intervention group. However, lifestyle behaviour included eating, activity and obesity-related behaviour. It is not enough, as parents had to have confidence in managing problem behaviour related to physical activity. Dietary and obesity-related behaviours of children are also important in affecting parents' self-efficacy. Parents' confidence did not increase in managing dietary behaviour and obesity-related behaviour. This could be reflected to some behaviour in the Lifestyle Behaviour Checklist, such as "eats unhealthy snacks", "snacks on food when they know they are not supposed to", "hides food" and "complains about being unfit or feeling low in energy".

Davidson created the Ecological Model of model of predictors of childhood overweight (Davison & Birch, 2001). It addressed many factors that affect child weight status direct or indirectly. Parenting styles and family characteristics provide a great impact on child weight status. While families are groups of people living together, they influenced each other's behaviour. Children are affected by their primary environment – family. Family is a microsystem influencing children, including perceptions, behaviours, and attitudes. It also interacts with the mesosystem and other microsystems, such as school, neighborhood, and community, as well as the exosystem (e.g. social service and media), and macrosystem (e.g. culture) (Bates et al., 2018). Children's behaviour such as eating, activity and sleeping patterns are influenced by family patterns, parent-child characteristics, and home environment (Bates et al., 2018). Parental influence may affect healthier food behaviour of children. Parents and siblings who eat more healthy foods act as role models for children (dos Santos et al., 2019).

Parental characteristics (income and education) affected children to exhibit healthy lifestyle behaviour. Parental perceptions on neighborhood safety may hinder children to engage in physical activity. The intervention group had better performance than the control group. The significant difference in the child's BMI percentile was found within groups. In line with this model, parents had a great impact to affect the daily lifestyle activities of their child, as well as their weight status.

Although previous study found that parental characteristics (income and education) are strong predictors of childhood obesity (dos Santos et al., 2019), no significant correlation was found between these parental characteristics and childhood obesity as well as parental self-efficacy, in the current study.

The pattern of physical activity and dietary intake was recorded by children and counter-signed by their parents in both groups. According to their records, all children did not engage in physical activity, and this was allowed by parents during the examination period. Some children did not engage in physical activity in the school day. This is in line with parents' perceptions about the importance of pursuing academic achievement. During the examination period, studying and review are the main priority. Physical activity engagement is neglected. Engaging in physical activity could control body fat (Horodyska et al., 2018). However, the examination period may hinder children to engage in physical activity because they were asked to study and review. Children need to do their homework, and parents did not have time to accompany them to engage in physical activity in the school day. This circumstance was also in line with previous study (Wong & O'Driscoll, 2018). A healthy meal pattern (3 major meals with 1-2 snacks per day) was suggested for children daily. The record showed that they may

have a tendency to reduce meal frequency, especially to skip breakfast. Children who skipped breakfast had a significantly increased risk of childhood obesity (Dykstra et al., 2016). Skipping breakfast leads to weight gain. When parents did not take breakfast, children would follow this habit. Since parents provide a great impact in developing the daily lifestyle behaviour of children, children also develop the same habits, and children increase their risks of contributing to obesity (Patro-Gołąb et al., 2016). Preventing breakfast skipping was focused on children, but not on parents in the current study. To prevent breakfast skipping, it is necessary to focus on children as well as parents in future studies.

Long-term follow-up of parental involvement in intervention can enhance parental monitoring and communication, as well as increase parental attention to children's behaviour (Van Ryzin & Nowicka, 2013). A short-term follow-up period cannot make significant change in the BMI of children. A previous study reported insignificant BMI change after the intervention among children in both groups. The small change in BMI was reported to be due to short-term follow-up (Kim et al., 2016). A longer study period with follow-up is expected to have significant reduction on weight and making change of lifestyle behaviour. Lifestyle interventions are also more beneficial and produce desirable health outcomes for children (Romanelli et al., 2019; Seo et al., 2019). Weight management necessitates multiple behavioural changes. The significant effect of parents in managing obesity-related behaviour was found in the current study, although multiple interventions were applied. Geller and their colleagues (2017) pointed out that multiple interventions would be recommended to reduce negative health outcomes. It is vital to understand how to change multiple health behaviours. In addition, sustainable interventions should be developed to reach results that will have lasting effects.

Interdisciplinary and ambitious approaches were recommended to help individuals adopt and maintain multiple interventions. To design future research studies, researchers may consider designing interventions with an interdisciplinary approach and long study period.

The outcomes of this study were difficult to compare with previous studies due to differences in research methods, treatment and intervention period, follow-up period and population. For example, the previous study assessed associations between parental concerns about preschoolers' weight, eating and parental feeding practices (Ek et al., 2016). The Lifestyle Behaviour Checklist is one of the tools for analyzing such associations. Although negative association was reported between parental confidence and some eating behaviours, parental confidence was represented as a predictor of parenting practices rather than acting as an independent factor to assess parents' confidence on handling obesity-related problematic behaviour of children. Also, it was a cross-sectional design study and could not reflect the obesogenic phenomena (Ek et al., 2016). A study by Kim et al. (2016) intended to enhance parents' skill in managing obese-related behaviour and improve the child-parent relationship in Korea. There was a 5-week intervention period provided, but no maintenance period. A Lifestyle Behaviour Checklist and child-parent relationship scale was used to assess outcomes. It was a parent-child involvement study instead of a parent-only study. Moreover, analysis of variance (ANOVA) was used for analyzing the data rather than using the generalized estimating equation (GEE) to predict the outcomes (Kim et al., 2016). The variation of analyzing methods and study designs may cause various outcomes with childhood obesity studies. A parent-only study was conducted by West (2010). It is a study similar to this study that provides intervention for parents to affect behavioural

change of children. The program was introduced, and its effectiveness assessed. Intensive interventions were provided in that program, and the follow-up period was about one year. The data analysis method was also different. Multivariate analysis of variance (MANOVA) was used instead of the generalized estimating equation (GEE). MANOVA is used for repeated measurement, but it is not able to incorporate covariates. GEE is more likely to use responses from the same individual trend and incorporate within-subject and between-subject variations into the model. It can improve efficiency of the estimation and the power (Wang, 2014).

Family-centered childhood obesity interventions reported significant reduction on BMI. Apart from significant improvements in their rate of obesity, the physical activity, sedentary behaviour and dietary intake were also improved (Davison et al., 2013). Parents increased their confidence in managing obesity-related (physical activity) problem behaviour in the current study, but children's physical activity self-efficacy was not measured. Physical activity self-efficacy is one of the contributing factors for longer-term physical activity engagement in children. Increased physical self-efficacy of children may control childhood obesity through parental encouragement and support as well as their role modelling (Efrat, 2017; Garriguet, Bushnik & Colley, 2017). It is expected that to increase physical activity self-efficacy, one should develop the habit of physical activity engagement. It is beneficial for parents to manage obesity-related problem behaviour (physical activity) more effectively and for children to have further reduction of BMI in the intervention group of the current study.

The current study found that 10-week parent-based interventions was effective to reduce BMI percentile of children and improve confidence level of parents in managing

obesity-related problem behaviour (physical activity). Since parenting skill was delivered in the current study, the child-parent relationship should be enhanced. Parents may support children in their weight control efforts as a role model. Parent involvement may increase their awareness of obesity-related issues, and they may provide more guidance to assist children on weight management. To develop future parent-based interventions, long-term effectiveness of the intervention should be evaluated. Strategies to elicit active participation of parents should also be incorporated.

The six study hypotheses were partially supported. The first and the second hypotheses are partially achieved. Parents reported that they reduced the problem level in perceiving obesity-related problem behaviour as a problem in the intervention group (M=55.61), compared to the control group (M=56.98), but this did not have statistical significance. Parents reported their confidence level in managing obesity-related behaviour improved in the intervention group (M=165.54), compared to the control group (M=158.65). However, this did not have statistical significance. Children's BMI percentile was reduced more in the control group (M=10.77) than those in the intervention group (M=7.76), but this did not have statistical significance. The third hypothesis was not achieved. Children reduced waist circumference in the intervention group (M=4.52) more than the control group (M=2.66), but this did not have statistical significance. The fourth hypothesis was partially achieved. The number of overweight and obese children was fewer in the control group (n=39), compared to the intervention group (n=48). The fifth hypothesis was not achieved. Parents' self-efficacy was evaluated by the problem scale and the confidence scale in the Lifestyle Behaviour Checklist. Childhood obesity was evaluated by BMI percentile, waist circumference and weight status of children. Parents reported the problem level

in managing obesity-related problem behaviour associated with alleviation of BMI percentile and weight status only, whereas, the confidence scale did not associate with alleviation of childhood obesity. The sixth hypothesis was partially achieved.

The current study aimed to enhance health knowledge and parenting skill in control of childhood obesity. Although health knowledge regarding childhood obesity is important to enhance parents' awareness of childhood obesity, adequate parenting skill is associated with childhood obesity. The current study did not mention the parent-child relationship and improving parenting skill could alleviate the quality of the parent–child relationship (Armstrong et al., 2018). A positive parent-child relationship was associated with weight loss, eating healthily and more physical activity engagement of children (Pinquart, 2014). Although there was no significant finding, compared to both groups. Parents reported an improvement of confidence in managing obesity-related problem behaviour (physical activity) between groups. Effective parenting and self-efficacy may improve confidence of parents in managing obesity-related behaviour (physical activity). In addition, the sample size is small in the current study. It would be useful to conduct a childhood obesity study with a larger sample size. It may identify mediators and moderators of intervention effectiveness.

10.2. Strengths and Contribution of the Study

Strengths of the Study

Lower Dropout Rate in Childhood Obesity Program

High dropout rate is a common challenge in obesity intervention programs (Malecka-Tendera & Mazur, 2006, Skelton & Beech 2011). This study also confronted this challenge, and investigators used many methods to retain participants in the study.

Before commencement of the program, 128 pairs of parent and child participated in this health program and 116 pairs remained in the study. The dropout rate of this study was 9.4%. Referring to previous studies, the dropout rate was more than 20%. The longer the duration of obesity intervention, the more dropout rate was reported (Golan, 2006, Savoye et al., 2011, Skelton & Beech, 2011). The previous review addressed such study – with 12-week, the dropout rate was 27% and 55% (Skelton & Beech, 2011). To minimize dropout of participants, a short message may have a positive effect to increase participants' retention (De Niet et al., 2012). Observing interventions of this study, participants received reminders, social support, encouragement, and reinforcement of positive change through messages from mobile communication apps. The dropout rate was below 20%. The dropout rate seemed to be acceptable because the duration of the study was a 10-week intervention with 10-week follow-up.

Statistical Variation

The differences of problem scale and the confidence scale between groups were analyzed by ANOVA and MANOVA in previous studies (Kim et al., 2016, West & Sanders, 2009). However, the assumptions of normality, homogeneity of variance and homogeneity of variance-covariance matrices were not met in ANOVA (West & Sanders, 2009). Although AVONA and MANOVA could be used in repeated measurement, these data analysis methods cannot incorporate covariates for analyzing. GEE is an approach based on a quasi-likelihood function and provides the population-averaged estimates of the parameters. It could treat complex parameters and easily fit to the model (Wang, 2014). The current study used GEE to assess the problem level and the confidence level of parents in managing obesity-related behaviour and anthropometric parameters of children. To find out the results with nuisance parameters,

GEE is an appropriate data analyzing method to use on an obesity intervention program. This study could become a reference for relevant research studies in the future.

Cost-Effective Intervention

The current study provided interventions for parents only and did not involve different health disciplines in control of childhood obesity. Apart from teaching sessions, mobile communication apps were used to enhance communication among parents and investigators. All interventions were simple and inexpensive. Although the intervention period had 10 weeks for implementing interventions and the follow-up period was 10 weeks, text messages and information were sent through mobile communication apps daily in the intervention group during the study period intensively. Health lifestyle behaviour was promoted through sending some hints of eating in festivals and being physically active in daily living. In comparing parent-based childhood obesity programs and programs with parents and children, the cost of the parent-only interventions was relatively lower than programs with children and parents (Janicke et al., 2009). This program may be a cost-effective childhood obesity program. It may develop as a longitudinal study if there is no time constraint.

Contribution of the Study

The Combined Program

This study was a childhood obesity program that included dietary intake and physical activity in Hong Kong. Although many recent studies regarding childhood obesity were conducted, it was rare to find a childhood obesity program focusing on weight loss of children and parental education in Hong Kong. Many studies reviewed the epidemiology and medical consequences (Ko & Chow, 2010) and investigated the

association with various risk factors and various lifestyles (Leung et al., 2011; Mak et al., 2010; So et al., 2011). Some studies explored the current circumstance of childhood obesity and parental concerns of physical activity participation (Ha, Macdonald & Pang, 2010, Pang & Ha, 2008). Fewer interventional studies regarding childhood obesity were found. These studies focused on the effectiveness of unique intervention instead of making change of daily lifestyle behaviour (Kong et al., 2014, Wong & Cheng, 2013). To improve the effectiveness of interventions for childhood obesity, interventions can be applied in daily living and be made easy to follow. The content of this program focused on daily lifestyle behaviour modification. Parents can apply strategies to modify behaviour of children in daily living, and it became habitual behaviour. Such change is beneficial for the health of children in the long run.

Blended Learning

Blended learning was used in this program. It is an innovative teaching approach for a childhood obesity program, especially for parental education. Blending learning combines face-to-face learning with distance learning. This teaching methodology is commonly used in teaching students in institutions. Blended learning provides an effective learning environment to enhance the teaching and learning process in using new information and communication technologies. It had a positive effect in reducing the attrition rate and improve learning outcomes (López-Pérez, Pérez-López & Rodríguez-Ariza, 2011). The parents' main task is taking care of children and their families, not for studying. Some of them are "working parents". Time was precious and it was difficult for parents to squeeze in the time to attend teaching sessions of the program. To face the critical health problem happening to these children, parents must have proper health concepts and adequate health information regarding childhood

obesity. When they have this, they can modify he behaviour of their children according to their needs. As mentioned in the recent study, adults have difficulty in focusing if they have a class after a day of work inside or outside the home. Blended learning required a demanding engagement with content and peers outside the classroom as well as feedback interaction (Korr et al., 2012). It is an adequate method to maximize their learning. Parents attended face-to-face sessions with discussion on obesity-related problem behaviour they perceived, where they could get mutual support among parents with the same situation. On the other hand, they received information through mobile communication apps and accessed it anytime. They could obtain that knowledge easily. It was convenient for them to develop an understanding of healthy information and transform it immediately into daily behaviour. The discussion was welcome when they faced difficulties and were able to share experiences with other parents anytime, whether in face-to-face sessions or through mobile communication apps. Blended learning is beneficial for parents to develop higher-order thinking, to reach high levels of cognitive presence and learning outcomes (Akyol & Garrison, 2011).

Teaching and practicing were combined in the study. Parents could apply all taught knowledge into a real setting and sought assistance when they encountered difficulties. Teaching was provided in the intervention period and practice was requested over the study period and the maintenance period. Although children recorded their dietary intake and physical activity in the intervention period only, practicing was required, and data collection was also asked for at 5-week and 10-week intervals after the intervention period. This arrangement may let parents make use of health knowledge and hints for

alleviating overweight and obesity of children, as well as minimize the gap between theory and practice (Dalkir, 2013).

After completion of the program, several parents verbalized that the information was useful, and they would try to follow interventions I taught. Extending the duration of the program was recommended. There may be alterations in making change of obesity-related problem behaviour and anthropometric measures of children.

Generalizability

The current study focused on improvement of health knowledge regarding childhood obesity and parenting skill in managing obesity-related problem behaviour of overweight/obese children. A parent-based education program may apply to different real settings. Apart from parents in this study, parents with overweight/obese children underestimated their children's weight status (Almoosawi et al., 2016; Cullinan & Cawley, 2017). Parents may not be alert to the negative health consequences of children with overweight and obesity. On the other hand, parenting skill is very important for parents in managing obesity-related problem behaviour. Children exhibited obesity-related problem behaviour causing deterioration of their health. Adequate parenting skill may reduce childhood obesity and improve parental self-efficacy (West et al., 2010). It can also establish a positive parent-child relationship and benefit children to help them demonstrate healthy lifestyle behaviour (Pinquart, 2014). Although healthy lifestyle behaviour of children was not well-demonstrated in the current study, it is better for parents to modify healthy lifestyle behaviour (physical activity) of children and BMI reduction of children, as was found within the intervention group.

10.3. Implication of the study

Interventions of the program emphasized parental involvement and participation in health education. It benefited children. Through learning health knowledge and supervising obesity-related problem behaviour of children, parents had more awareness on how to control their behaviour and body weight. Obesity prevention may be ineffective if parents did not become aware of their children's weight status (Howe, Alexander & Stevenson, 2017). Howe and their colleagues (2017) investigated factors associated with parents' underestimation of child weight status. Their limited health literacy caused them to underestimate child weight status. This circumstance was also found in this study (Wen & Hui, 2011, Lundahl, Kidwell & Nelson, 2014) before commencement of the interventions. Apart from underestimating child weight status, parents also showed a lack of knowledge of healthy eating, portion sizes and physical activity, prevalence of obesity and negative health consequences (Vittrup & McClure, 2018). To correct these situations and alleviate childhood obesity, parental education in health may become more important. It not only increases parents' awareness on obesity-related issues, but also provides guidance for them to assist in the weight management of their children.

Girls were more likely to become overweight and obese than boys. Many previous studies concluded that boys are more likely to become overweight and obese (Cao, Wang & Chen, 2015; Fradkin et al., 2015; Tichá et al., 2018). Some factors contribute to overweight and obesity of girls. As mentioned before, physical activity can reduce energy storage in the body of individuals. In body composition, girls had a higher level of body fat during pre-pubescence than boys. On the other hand, parents' encouragement for the child to be physically active was higher among boys, compared

to girls (Telford et al., 2016). It caused fewer girls to engage in physical activity, and as result, more girls become overweight/obese. In addition, boys had better physical fitness than girls. Girls were also less physically active than boys. (Toriola & Monyeki, 2012). Previous studies also revealed that girls spend more of their time on screen time, compared to boys (Christofaro, et al., 2016). This caused girls to engage in more sedentary behaviour, and it was associated with overweight/obesity (Chen et al., 2016). Although girls were more focused on their body image and more sensitive to weight gain than boys, western dietary practice and culture affected children. This circumstance was the same for the prevalence of childhood obesity in western countries. Differences in body composition, weight change patterns, and hormone biology between boys and girls also affected their weight (Wisniewski & Chernausek, 2009).

Parental self-efficacy was the primary outcome of the current study, and it may affect secondary outcomes (anthropometric measures). The prevalence of childhood obesity cannot be found because overweight and obese children were recruited in the current study only. However, 15.8% children returned to normal weight, compared to their pre-study weight. Parental self-efficacy was improved, although it was not significant. The decreased number of overweight and obese children indicated certain intervention effect in the current study. In addition, the experience of the current study may provide a reference for childhood obesity control in Hong Kong.

10.4. Significance of the Study

Role of Parents

The pivotal role of parents in developing healthy behaviour of children was confirmed in the current study. The program resulted in improving confidence of parents in managing obesity-related problem behaviour (physical activity). Parental influence was quite important to behavioural change of children and showed in the study. There were about 70.7% parents living with children in this study, and the majority were mothers. It showed that parents were the key persons caring for children and affecting the behaviour of children. On the other hand, parents' confidence in managing lifestyle behaviour of children is a determinant for childhood obesity. Morawska & West (2013) conducted a cross-sectional study to investigate the relationship of ineffective parenting skills and childhood obesity. It used multiple measures of child and family functioning to clarify such a relationship. The outcomes revealed that parents with obese children were lacking in confidence in managing lifestyle behaviour of children by using permissive and coercive discipline techniques. In contrast, parents with healthy weight children promoted healthy lifestyle behaviour by using specific approaches. Although no measurement about the effectiveness of parenting skill of parents is used in the current study, improving parents' confidence in managing problematic behaviour of overweight and obese children is required. Parents' confidence can make change in children's behaviour, being overweight, and keeping healthy behaviour (Taveras, Mitchell & Gortmaker, 2009). As a result, the parental role in the childhood obesity treatment program was identified.

Health knowledge enhancement of parents was one of the main strategies in this study. Health knowledge of parents affected the eating behaviour of children and contributed to childhood obesity. A study by Lally (2012), addressed the misperception

of social norms affecting healthy behaviour formation. Parents misperceived children's snacking by overestimating the frequency of unhealthy snacking of children. Other parents also allowed this circumstance. Such misperceptions misled parents and they encouraged such behaviour. Consequently, it was difficult to develop and keep healthy behaviour. It also stressed that successful childhood obesity programs should involve and work with parents from the earlier stage of childhood development to support healthy behaviour both inside and outside of the home (Lindsay et al., 2006). Healthy or obesogenic environment was determined by parents. Apart from parents affecting children in behavioural change, parents' weight status was found to have significant correlation on the problem scale. Parents who were overweight perceived problems on managing behaviour of children because they were experiencing difficulties in maintaining healthy weight on their own, had lower self-motivation and could not be a role model to modify lifestyle behaviour of children (Iñiguez, Yap & Mager, 2014). A recent study also investigated the similar outcomes with the current study (Kim et al., 2016). It evaluated the effectiveness of increasing parents' skill in managing obesity-related behaviour through parental involvement intervention for childhood obesity. The results did not show significance on the problem level and the confidence level of parents in managing obesity-related problem behaviour. It is likely associated with the insignificant change in anthropometric measures on children. Both results were consistent with the current study. Knowledge enhancement of parents with overweight and obese children is essential. Parents may be alerted to the negative health consequences of childhood obesity and make changes in obesity-related problem behaviour of children as soon as possible.

Enhance Health of Parents and Children

Health of parents and children was important, even in managing behavioural change of children. Obviously, parents' knowledge regarding childhood obesity was enhanced. The current program intended to improve parental self-efficacy of parents and reduce body size (BMI percentile and waist circumference) of children through enhancing parents' health knowledge. Despite no significant effect on the change of anthropometric measures between the two groups of participants, healthy behaviour of children may be formed due to the improvement of parent's self-efficacy in managing their problematic behaviour. Parents' confidence is a main factor that affects mutual relationships and behaviour development of children, although insignificant difference was reported. A positive relationship between parent and child was established and the child's behaviour has positively changed after increasing confidence of parents in managing behaviour of children (Walker & Cheng, 2007). If parents were lacking in confidence, they exhibited stress in managing behaviour of children. As mentioned in a study, stress was produced by parental dissatisfaction (Sepa, Frodi & Ludvigsson, 2004). Health of parents would have a negative impact if parents felt stress in managing behaviour of children. Evidence showed that parents' self-efficacy negatively associated with parental depressive symptoms (Heerman, et al., 2017). If parents had elevated depressive symptoms, their self-efficacy was also influenced. Depression has implications for negative health outcomes for both parent and child health (Heerman, et al., 2017). A review also stated that parents' self-efficacy was related to parental mental health, including psychological distress, satisfaction with the parental role, and adaptation to parenthood (Albanese et al., 2019). Low parental self-efficacy has been identified as a risk factor for experiencing more symptoms of depression (Albanese et al., 2019).

Unhealthy dietary and activity patterns caused weight gain over time (Davison, Francis & Birch, 2005). Anthropometric measures needed much time to change and evidences were proved in previous studies (Centis et al., 2012, Elder et al., 2014, Kalavainen, Korppi & Nuutinen, 2011, Rausch, Kovalskys & De Gregorio, 2013). Behavioural change is a strategy to maintain the health of children in the long run and minimizes the risk for adulthood obesity. Therefore, healthy behaviour must be continuously exhibited and become habitual. Healthy behaviour does not only provide long term benefit for children reducing or maintaining their weight, but also enhances health and body function, such as strengthening cardiopulmonary function in engaging in aerobic exercise. Apart from alleviating childhood obesity, parenting skill was also delivered, aiming to help parents in managing obesity-related behaviour of children. It may increase parents' self-efficacy and confidence. The study of Rhee and colleagues (2005) focused on the readiness of parents in making change of overweight children. Parents may be ready to make behavioural change of children when they realize their children are overweight. Many parents did not know their children were overweight before commencement of the program. After explanation of children's BMI percentile measurement, they understood the different measurements between adult and children. Also, the fact that overweight and obesity are health problems and hold negative health consequences was delivered in teaching sessions. This may increase the readiness of parents in making change in their children's behaviour, as parents reported more confidence in making change. On the other hand, parenting skill was delivered in the program, and this was expected to help parents to effectively manage behaviour of their children. This skill would affect the weight status of children and the parent-child relationship. Pinquart, M. (2014) assessed the associations of general parenting and the parent-child relationship with child weight status, dietary intake, and physical activity.

Positive parent-child relationship and appropriate parenting skill, such as higher level of parental responsiveness, associated with lower weight status of children, healthy eating, and physical activity. Effective parenting skill may build up a positive parent-child relationship, and it may benefit the psychological health of parents and children.

10.5. The Limitations of the Study

The limitations of the current study include the results to overweight and obese children. Since significant improvement of previous study (West et al., 2010), it was found the generalizability of the results was limited. Another limitation was contamination bias. Participants of both groups were recruited in the same schools. The short study period (10 weeks) and maintenance period (10 weeks) may cause timing bias. This may influence the effects of the parent-based education program on childhood obesity. Short-term study may cause inconsistent outcomes on parents and children, compared to the outcomes of a long-term study. Parents may follow or neglect interventions, even though reminders and hints were given daily. For example, a parent sought advice about childhood obesity during the study period. I provided numerous pieces of advice for their consideration, and she refused them. Her reasons for not accepting them were that she was busy working and taking care of their family, as well as focusing on the academic performance of her children. Compliance bias may occur, and it may be necessary to find some strategies to reduce such limitation.

11. Conclusion

The “Health for Life” program is a parent-based program to control overweight and obesity of children. Anthropometric parameters of children remained high after completion of the program. In comparing both groups, although significant reduction

on BMI and weight status were found within the intervention group, BMI, waist circumference and weight status of children were not significantly reduced after teaching parents. On the other hand, the problem level, and the confidence level of parents in managing obesity-related behaviour did not have significant improvement, even though parents reported improvement on the problem scale and the confidence scale. During implementation of this study, many unpredictable factors were found. These factors also affected the study outcomes. Further studies were suggested to have better planning in managing unpredictable factors before implementation of various childhood obesity programs.

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Appendices
Appendix 1

Consent Form and Information Sheet for SCHOOLS

THE HONG KONG INSTITUTE OF EDUCATION
Department of Health and Physical Education

CONSENT TO PARTICIPATE IN RESEARCH (FOR SCHOOL)

" The Effectiveness of "Healthy for Life" Program in Promoting Healthy Lifestyles and In Controlling Body Weight and for Primary School Students "

My school hereby consents to participate in the captioned project supervised by Dr. SUN Fenghua and conducted by Ms LO Sze Wan, who are staff / students of Department of Health and Physical Education in the Hong Kong Institute of Education.

I understand that information obtained from this research may be used in future research and may be published. However, our right to privacy will be retained, i.e., the personal details of my students'/teachers' will not be revealed.

The procedure as set out in the **attached** information sheet has been fully explained. I understand the benefits and risks involved. My students'/teachers' participation in the project are voluntary.

I acknowledge that we have the right to question any part of the procedure and can withdraw at any time without negative consequences.

Signature: _____
Name of Principal/Delegate*: _____ (Prof/Dr/Mr/Mrs/Ms/Miss*)
Post: _____
Name of School: _____
Date: _____
(please delete as appropriate)*

INFORMATION SHEET

" The Effectiveness of "Healthy for Life" Program in Promoting Healthy Lifestyles and In Controlling Body Weight and for Primary School Students "

Your school is invited to participate in a project supervised by Dr. SUN Fenghua and conducted by Ms LO Sze Wan, who are staff / students of Department of Health and Physical Education in the Hong Kong Institute of Education.

The introduction of the research

A) The aim of this study

The aim of this study is to investigate the effectiveness of "Healthy for Life" program promote healthy lifestyles and in controlling children weight for primary school students

B) Reasons for choosing this particular group of participants

Children with aged 5-9, are influenced by parents and teachers. These children adapted

school life and can take care of themselves independently in school. Parents contribute to great impact on physiological and psychological development of children so that they are also invited to participate in this study.

The methodology of the research

A) Sample size: 128 pairs parent and child

- *64 pairs parent and child will be divided into the experimental group and the control group.*
- *Participants are requested to return consent form and provide phone number for contact after the briefing session.*

B) Procedure of the research

The duration of the study is about 21 weeks.

- Participants of the experimental group will participate in "Healthy for Life" program. "Healthy for Life" program involve teaching and practice. Parents will participate in

teaching session and will receive knowledge about weight control and healthy lifestyle for children. The teaching session will be held on weekday or weekend. In teaching session,

parents will learn parenting skills and strategies in managing problem behaviour of

children as well.

Children are requested to follow the regular meal and activity pattern in 10 weeks of

practical session. Parents become facilitators to help them complete the meal and activity

pattern. During the treatment period, researchers and parents will use communicate mobile application (WhatsApp) for communication to enhance mutual support and solve parents' problems that happened in real setting.

Participants of the control group will receive health information of children'

weight loss and daily lifestyle monthly and are encouraged to share the information with their children in the treatment period.

During the treatment period, children are requested to record their dietary intake and physical activity in the Dietary and Physical Activity Pattern Record. Parents are requested to check the record and signature.

Before and after the intervention, children are requested to measure weight, height and waist circumference. Parents are requested to fill in the Lifestyle Behaviour Checklist.

C) Potential benefits

To appreciate their assistance, souvenir will be sent to the particular school after completion
of the study.

The potential risks of the research

No risk or discomfort in this study

Please understand that your students'/teachers' participation are voluntary. They have every right to withdraw from the study at any time without negative consequences. All information related to your students'/teachers' will remain confidential, and will be identifiable by codes known only to the researcher.

Describe how results will be potentially disseminated

- *The study outcome will be sent to the particular school by mail or email.*

If you would like to obtain more information about this study, please contact Ms LO Sze Wan at telephone number or their supervisor Dr. SUN Fenghua at telephone number .

If you have any concerns about the conduct of this research study, please do not hesitate to contact the Human Research Ethics Committee by email at hrec@ied.edu.hk or by mail to Research and Development Office, The Hong Kong Institute of Education. .

Thank you for your interest in participating in this study.

LO Sze Wan
Principal Investigator

香港教育學院
健康與體育學系

參與研究同意書(學校)

<【健康為本】計劃是否對於改善不良生活習慣及控制學童體重有效>

本校同意參加由孫風華博士負責監督,盧詩韻負責執行的研究計劃。她/他們是香港教育學院教員/學生 。

本人理解此研究所獲得的資料可用於未來的研究和學術發表。然而本人有權保護本校學生/教師的隱私,其個人資料將不能洩漏。

研究員已向本人充分解釋所附資料的有關步驟。本人理解可能會出現的風險。本人是自願讓本校學生/教師參與這項研究。

本人理解本人及本校學生/教師皆有權在研究過程中提出問題,並在任何時候決定退出研究, 更不會因此而對研究工作產生的影響負有任何責任 。

簽署: _____

校長/ 學校代表*姓名: _____ (教授/博士/先生/女士/小姐*)

職位: _____

學校名稱: _____

日期: _____

(**請刪去不適用者*)

香港教育學院
健康與體育學系

參與研究同意書(學校)

<【健康為本】計劃是否對於改善不良生活習慣及控制學童體重有效>

誠邀 貴校參加孫風華博士負責監督, 盧詩韻負責執行的研究計劃。她/他們是香港教育學院教員/學生 。

研究計劃簡介

A) 研究計劃目的:

用於了解「健康為本」計劃對於改善不良生活習慣及控制學童體重的效果。

B) 選擇 5-9 歲學童及家長原因:

在 5-9 歲的階段的學童，受家長及老師影響最大; 由於他們已適應學校生活，能獨立照顧自己; 是一適合的參與此研究的人選。家長對學童身心發展有極大影響，所以，此計劃需要家長參與。

研究方法

A) 參與人數: 128 對家長及學童

- *實驗組及控制組各 64 對家長及學童。*
- *在簡介會中，參與者需要交回參與研究同意書及留下電話以便聯絡。*

B) 研究過程

整個研究為期二十一星期。

實驗組參與者需要接受「健康為本」計劃。「健康為本」計劃內容包括教學及實踐兩方面。家長先行參與學童控制體重及日常生活習慣有關的教學座談會，此座談會將於星期天或星期六舉行。在座談會中，家長會收到有關一些糾正不良生活習慣的策略及家長管教的技巧外，亦會學習學童控制體重的訊息。

學童則要求在十星期的實踐中，根據既定的飲食及運動模式施行於生活裡。家長則以他們協助學童的十星期的生活實踐中，完成既定的飲食及運動模式。在整個實踐的時段中，研究員及家長會以流動通訊軟件溝通，協助家長解決施行上的困難。

控制組參與者在十星期裡，每月經電郵接收有關學童控制體重及日常生活習慣的資訊，鼓勵家長可以與學童分享。

在參與研究期間，學童需要每天記錄飲食及運動於飲食及運動型態記錄冊中，家長則每天需要審視其子女的記錄冊並簽署。

在參與研究前後，學童需要量度體高體重及腰圍, 家長則需要填寫「日常生活行為一覽表」(Lifestyle Behaviour Checklist)。

C) 利益
整個研究完成後，貴校會收到紀念品以表謝意。

風險
此研究並無任何風險及引起不良的後果。

貴校學生/教師的參與純屬自願性質。所有參加者皆享有充分的權利在研究開始前或後決定退出這項研究, 更不會因此引致任何不良後果。凡有關 貴校學生/教師的資料將會保密,一切資料的編碼只有研究人員得悉。

描述將如何發佈研究結果
研究結果將會在完成研究後，經電郵或書信通知貴校。

如閣下想獲得更多有關這項研究的資料,請電郵與本人盧詩韻( ) 或本人的導師孫風華博士( )聯絡。

如閣下對這項研究的操守有任何意見,可隨時與香港教育學院人類實驗對象操守委員會聯絡(電郵: hrec@ied.edu.hk; 地址:香港教育學院研究與發展事務處)。

謝謝閣下有興趣參與這項研究。

盧詩韻
首席研究員

Appendix 2

Consent Form and Information Sheet for PARENTS

THE HONG KONG INSTITUTE OF EDUCATION

Department of Health and Physical Education

CONSENT TO PARTICIPATE IN RESEARCH

" The Effectiveness of "Healthy for Life" Program in Promoting Healthy Lifestyles and In Controlling Body Weight and for Primary School Students "

I _____ hereby consent to my child participating in the captioned research supervised by Dr. SUN Fenghua and conducted by Ms LO Sze Wan.

I understand that information obtained from this research may be used in future research and may be published. However, our right to privacy will be retained, i.e., the personal details of my child will not be revealed.

The procedure as set out in the **attached** information sheet has been fully explained. I understand the benefits and risks involved. My child's participation in the project is voluntary.

I acknowledge that we have the right to question any part of the procedure and can withdraw at any time without negative consequences.

Name of participant _____

Signature of participant _____

Name of Parent or Guardian _____

Signature of Parent or Guardian _____

Date _____

INFORMATION SHEET

" The Effectiveness of "Healthy for Life" Program in Promoting Healthy Lifestyles and In Controlling Body Weight and for Primary School Students "

You are invited to participate with your child in a project supervised by Dr. SUN Fenghua and conducted by Ms LO Sze Wan, who are staff / students of the Department of Health and Physical Education in The Hong Kong Institute of Education.

The introduction of the research

A) The aim of this study

The aim of this study is to investigate the effectiveness of "Healthy for Life" program promote healthy lifestyles and in controlling children weight for primary school students

B) Reasons for choosing this particular group of participants

Children with aged 5-9, are influenced by parents and teachers. These children adapted school life and can take care of themselves independently in school. Parents contribute to great impact on physiological and psychological development of children so that they are also invited to participate in this study.

The methodology of the research

A) Sample size: 128 pairs parent and child

64 pairs parent and child will be divided into the experimental group and the control group.

Participants are requested to return consent form and provide phone number for contact after the briefing session.

B) Procedure of the research

The duration of the study is about 21 weeks.

- Participants of the experimental group will participate in "Healthy for Life" program. "Healthy for Life" program involve teaching and practice. Parents will participate in teaching session and will receive knowledge about weight control and healthy lifestyle of children. The teaching session will be held on weekday or weekend. In teaching session, parents will learn parenting skills and strategies in managing problem behaviour of children as well.

Children are requested to follow the regular meal and activity pattern in 10 weeks of practical session. Parents become facilitators to help them complete the meal and activity pattern. During the treatment period, researchers and parents will use communicate mobile application (WhatsApp) for communication to enhance mutual support and solve parents' problems that happened in real setting.

Participants of the control group will receive health information of children' weight loss and daily lifestyle monthly and are encouraged to share the information with their children in the treatment period.

During the treatment period, children are requested to record their dietary intake and physical activity in the Dietary Intake and Physical Activity Pattern Record. Parents are requested to check the record and signature.

Before and after the intervention, children are requested to measure weight, height and waist
circumference. Parents are requested to fill in the Lifestyle Behaviour Checklist.

C) Potential benefits

Children' health will have positive influence after participating in the study. To appreciate their assistance, cash coupon will be sent to each parent and child after completion of the study.

The potential risks of the research

No risk or discomfort in this study

Your child's participation in the project is voluntary. You and your child have every right to withdraw from the study at any time without negative consequences. All information related to your child will remain confidential, and will be identifiable by codes known only to the researcher.

Describe how results will be potentially disseminated

- *The study outcome will be sent to the particular schools by mail or email.*

If you would like to obtain more information about this study, please contact Ms LO Sze Wan at telephone number or their supervisor Dr. SUN Fenghua at telephone number

If you or your child have/ has any concerns about the conduct of this research study, please do not hesitate to contact the Human Research Ethics Committee by email at hrec@ied.edu.hk or by mail to Research and Development Office, The Hong Kong Institute of Education.

Thank you for your interest in participating in this study.

LO Sze Wan
Principal Investigator

香港教育學院
健康與體育學系

參與研究同意書(家長)

<【健康為本】計劃是否對於改善不良生活習慣及控制學童體重有效>

誠邀 貴校參加孫風華博士負責監督, 盧詩韻負責執行的研究計劃。她/他們是香港教育學院教員/學生 。

研究計劃簡介

C) 研究計劃目的:

用於了解「健康為本」計劃對於改善不良生活習慣及控制學童體重的效果。

D) 選擇 5-9 歲學童及家長原因:

在 5-9 歲的階段的學童，受家長及老師影響最大; 由於他們已適應學校生活，能獨立照顧自己; 是一適合的參與此研究的人選。家長對學童身心發展有極大影響，所以，此計劃需要家長參與。

研究方法

D) 參與人數: 128 對家長及學童

- *實驗組及控制組各 64 對家長及學童。*
- *在簡介會中，參與者需要交回參與研究同意書及留下電話以便聯絡。*

E) 研究過程

整個研究為期二十一星期。

實驗組參與者需要接受「健康為本」計劃。「健康為本」計劃內容包括教學及實踐兩方面。家長先行參與學童控制體重及日常生活習慣有關的教學座談會，此座談會將於星期天或星期六舉行。在座談會中，家長會收到有關一些糾正不良生活習慣的策略及家長管教的技巧外，亦會學習學童控制體重的訊息。

學童則要求在十星期的實踐中，根據既定的飲食及運動模式施行於生活裡。家長則以他們協助學童的十星期的生活實踐中，完成既定的飲食及運動模式。在整個實踐的時段中，研究員及家長會以流動通訊軟件溝通，協助家長解決施行上的困難。

控制組參與者在十星期裡，每月經電郵接收有關學童控制體重及日常生活習慣的資訊，鼓勵家長可以與學童分享。

在參與研究期間，學童需要每天記錄飲食及運動於飲食及運動型態記錄冊中，家長則每天需要審視其子女的記錄冊並簽署。

在參與研究前後，學童需要量度體高體重及腰圍, 家長則需要填寫「日常生活行為一覽表」(Lifestyle Behaviour Checklist)。

F) 利益
整個研究完成後，貴校會收到紀念品以表謝意。

風險
此研究並無任何風險及引起不良的後果。

貴校學生/教師的參與純屬自願性質。所有參加者皆享有充分的權利在研究開始前或後決定退出這項研究, 更不會因此引致任何不良後果。凡有關 貴校學生/教師的資料將會保密,一切資料的編碼只有研究人員得悉。

描述將如何發佈研究結果
研究結果將會在完成研究後，經電郵或書信通知貴校。

如閣下想獲得更多有關這項研究的資料,請電郵與本人盧詩韻( ) 或本人的導師孫風華博士( )聯絡。

如閣下對這項研究的操守有任何意見,可隨時與香港教育學院人類實驗對象操守委員會聯絡(電郵: hrec@ied.edu.hk; 地址:香港教育學院研究與發展事務處)。

謝謝閣下有興趣參與這項研究。

盧詩韻
首席研究員

香港教育學院
健康與體育學系
參與研究同意書

<【健康為本】計劃是否對於改善不良生活習慣及控制學童體重有效>

茲同意敝子弟_____參加由孫風華博士負責監督，盧詩韻執行的研究項目。

本人理解此研究所獲得的資料可用於未來的研究和學術發表。然而本人有權保護敝子弟的隱私,其個人資料將不能洩漏。

研究員已向本人充分解釋所附資料的有關步驟。本人理解可能會出現的風險。本人是自願讓敝子弟參與這項研究。

本人理解本人及敝子弟皆有權在研究過程中提出問題,並在任何時候決定退出研究，更不會因此而對研究工作產生的影響負有任何責任。

參加者姓名: _____

參加者簽名: _____

父母姓名或監護人姓名: _____

父母或監護人簽名: _____

日期: _____

有關資料

<【健康為本】計劃是否對於改善不良生活習慣及控制學童體重有效>

誠邀閣下及貴子女參加孫風華博士負責監督, 盧詩韻負責執行的研究計劃。她/他們是香港教育學院學生/教員。

研究計劃簡介

A) 研究計劃目的:

用於了解「健康為本」計劃對於改善不良生活習慣及控制學童體重的效果。

B) 選擇 5-9 歲學童及家長原因:

在 5-9 歲的階段的學童，受家長及老師影響最大; 由於他們已適應學校生活，能獨立照顧自己; 是一適合的參與此研究的人選。家長對學童身心發展有極大影響，所以，此計劃需要家長參與。

研究方法

A) 參與人數: 128 對家長及學童

實驗組及控制組各 64 對家長及學童。

在簡介會中，參與者需要交回參與研究同意書及留下電話以便聯絡。

B) 研究過程

整個研究為期二十一星期。

實驗組參與者需要接受「健康為本」計劃。「健康為本」計劃內容包括教學及實踐兩方面。家長先行參與學童控制體重及日常生活習慣有關的教學座談會，此座談會將於星期天或星期六舉行。在座談會中，家長會收到有關一些糾正不良生活習慣的策略及家長管教的技巧外，亦會學習學童控制體重的訊息。

學童則要求在十星期的實踐中，根據既定的飲食及運動模式施行於生活裡。家長則以他們協助學童的十星期的生活實踐中，完成既定的飲食及運動模式。在整個實踐的時段中，研究員及家長會以流動通訊軟件溝通，協助家長解決施行上的困難。

控制組參與者在十星期裡，每月經電郵接收有關學童控制體重及日常生活習慣的資訊，鼓勵家長可以與學童分享。

在參與研究期間，學童需要每天記錄飲食及運動於飲食及運動型態記錄冊中，家長則每天需要審視其子女的記錄冊並簽

署。

在參與研究前後，學童需要量度體高體重及腰圍，家長則需要填寫「日常生活行為一覽表」(Lifestyle Behaviour Checklist)。

C) 利益
是次研究學童健康有莫大裨益；整個研究完成後，家長及學童會收到現金券以表謝意。

風險
此研究並無任何風險及引起不良的後果。
閣下及 貴子女的參與純屬自願性質。閣下及 貴子女享有充分的權利在任何時候決定退出這項研究,更不會因此引致任何不良後果。凡有關 貴子女的資料將會保密,一切資料的編碼只有研究人員得悉。

描述將如何發佈研究結果
研究結果將會在完成研究後，經電郵或書信通知貴校。

如閣下想獲得更多有關這項研究的資料,請與盧詩韻聯絡,電話 或聯絡她/他們的導師孫風華博士,電話 。

如閣下或 貴子女對這項研究的操守有任何意見,可隨時與香港教育學院人類實驗對象操守委員會聯絡(電郵:hrec@ied.edu.hk; 地址:香港教育學院研究與發展事務處)。

謝謝閣下有興趣參與這項研究。

盧詩韻
首席研究員

APPENDIX 3

個人資料收集表
DEMOGRAPHIC DATA COLLECTION FORM

填寫於此表格的個人資料將獲嚴格保密，提供的資料只限作統計、學術研究及與學習有關之用途。

Personal data provided on this form will be treated strictly confidential and will be used by the Institute for statistical, research and study-related purposes.

家長/監護人
Parent/Guidance

姓名 Name:	(ENG)_____(中文)_____
性別 Gender:	□男 Male □女 Female
種族 Ethnicity;	□中國 Chinese, □其他 Others: _____
年齡 Age:	□18-22 □23-27 □28-32 □33-37 □38-42
	□42-46 □47-51 □above 51
教育程度 Educational Level:	□小學程度 Primary-level □中學程度 Secondary-level
	□副學士或相關程度 Associate-degree-level or equivalent
	□大學程度 University-level □碩士程度 Master level
	□博士程度 Doctoral level □其他 Others:_____
職業 occupation:	□經理及行政級人員 Managers and administrators
	□專業人員 Professionals
	□輔助專業人員 Associate Professionals
	□文書支援人員 Clerical support workers
	□服務工作及銷售人員 Service and sales workers
	□工藝及有關人員 Craft and related workers
	□機台及機器操作員及裝配員 Plant and machine operators and assemblers
	□非技術工人 Elementary occupations
	□其他 Others:_____
家庭收入 Family income (Hong Kong Dollar)	□ 少於$10,000/Less than $10,000
	□$10,000-20,000
	□ $20,000-30,000
	□ $30,000-40,000

	□$40,000-50,000
	□多於$50,000/More than 50,000
住所 Residence	□公共屋邨 Public Housing
	□大廈 Apartment
	□平房 House
	□其他 Others:_____
身高 Height/	身高 Height:_____cm
體重 Weight	體重 Weight:_____Kg

學童 Student

姓名 Name:	(ENG)_____(中文)_____
性別 Gender:	□男 Male □女 Female
年齡 Age:	□5 □6 □7 □8 □9
種族/Ethnicity;	□中國 Chinese, □其他 Others: _____
學校名稱	_____
School Name:	_____
居住情況 Living status:	□與父母同住 Live with parents □與祖父母/外祖父母同住 Live with grandparents □與監護人同住 Live with guidance □其他 Others:_____
住所 Residence	□公共屋邨 Public Housing
(如非與父母/監護人同住 Not live with parents/guidance)	□大廈 Apartment □平房 House □其他 Others:_____
身高 Height	身高 Height:_____cm
體重 Weight	體重 Weight:_____Kg

APPENDIX 4

Dietary and Physical Activity Pattern Record

飲食及運動型態記錄冊

Aim: It is the diary to record dietary and physical activity pattern of children. The aim is to encourage children to develop healthy lifestyle behaviour to reduce the risk of chronic illnesses and obesity. Parents are encouraged to check their record and review it daily with their children.

目的: 此日誌主要記錄學童日常生活飲食及運動型態. 目的在於鼓勵學童養成健康日常生活習慣以減少他們罹患慢性疾病及肥胖的機會. 鼓勵父母每天也跟孩子一同評鑑當天的運動及飲食習慣以作出改善.

Student Name/學童姓名:

Gender/性別:

Class/班別:

School Name/學校名稱:

Suggested time slots for meals 建議進餐時段
Meals 規定餐數:
3 meals /三餐主餐

Main Meals/主要餐數	Time slots/進餐時段
Breakfast/早餐	7:00AM – 9:00AM
Snacking/小食	9:00AM-11:00AM
Lunch/午餐	12:00PM- 2:00 PM
Snacking/小食	2:00PM -5:00PM
Dinner/晚餐	6:00 PM-9:00PM

Physical activity/運動:

主要是一些動態活動

Running /跑步 Jogging/慢跑, Running/跑步, Marathon 馬拉松	Games/遊戲: Playing in park/公園遊玩, Playing in playground/遊樂場遊玩
Swimming/游泳	Gymnastics/健身
Cycling/騎單車	Ball games/球類活動
Dancing/跳舞	Walking/走路

Please put a "tick" when you have meal in the below column if you took it.

若果已進食以下規定餐數，請在以下方格填上 "√" .

Week /週 (1)	Mon/ 星期一	TUE/ 星期二	WED/ 星期三	THUR/ 星期四	FRI/ 星期五	SAT/ 星期六	SUN/ 星期日
Date/日期							
Breakfast/早餐							
Snacking/小食							
Lunch/午餐							
Snacking/小食							
Dinner/晚餐							

Please write down the types of physical activity and the duration(minutes) in the below column/請在以下方格填寫運動類型及持續時間(分鐘)

Physical activity/ 運動							
Minutes/ 分鐘							
Parent sign/家長簽名							

Please put a "tick" when you have meal in the below column if you took it.

若果已進食以下規定餐數，請在以下方格填上 "√" .

Week /週 (2)	Mon/ 星期一	TUE/ 星期二	WED/ 星期三	THUR/ 星期四	FRI/ 星期五	SAT/ 星期六	SUN/ 星期日
Date/日期							
Breakfast/早餐							
Snacking/小食							
Lunch/午餐							
Snacking/小食							
Dinner/晚餐							

Please write down the types of physical activity and the duration(minutes) in the below column/請在以下方格填寫運動類型及持續時間(分鐘)

Physical activity/ 運動							
Minutes/ 分鐘							
Parent sign/家長簽名							

Please put a "tick" when you have meal in the below column if you took it.

若果已進食以下規定餐數，請在以下方格填上 "√" .

Week /週 (3)	Mon/ 星期一	TUE/ 星期二	WED/ 星期三	THUR/ 星期四	FRI/ 星期五	SAT/ 星期六	SUN/ 星期日
Date/日期							
Breakfast/早餐							
Snacking/小食							
Lunch/午餐							
Snacking/小食							
Dinner/晚餐							

Please write down the types of physical activity and the duration(minutes) in the below column/請在以下方格填寫運動類型及持續時間(分鐘)

Physical activity/ 運動							
Minutes/ 分鐘							
Parent sign/家長簽名							

Please put a "tick" when you have meal in the below column if you took it.

若果已進食以下規定餐數，請在以下方格填上 "√" .

Week /週 **(4)**	Mon/ 星期一	TUE/ 星期二	WED/ 星期三	THUR/ 星期四	FRI/ 星期五	SAT/ 星期六	SUN/ 星期日
Date/日期							
Breakfast/早餐							
Snacking/小食							
Lunch/午餐							
Snacking/小食							
Dinner/晚餐							

Please write down the types of physical activity and the duration(minutes) in the below column/請在以下方格填寫運動類型及持續時間(分鐘)

Physical activity/ 運動							
Minutes/ 分鐘							
Parent sign/家長簽名							

Please put a "tick" when you have meal in the below column if you took it.

若果已進食以下規定餐數，請在以下方格填上 "√" .

Week /週 (5)	Mon/ 星期一	TUE/ 星期二	WED/ 星期三	THUR/ 星期四	FRI/ 星期五	SAT/ 星期六	SUN/ 星期日
Date/日期							
Breakfast/早餐							
Snacking/小食							
Lunch/午餐							
Snacking/小食							
Dinner/晚餐							

Please write down the types of physical activity and the duration(minutes) in the below column/請在以下方格填寫運動類型及持續時間(分鐘)

Physical activity/ 運動							
Minutes/ 分鐘							
Parent sign/家長簽名							

Please put a "tick" when you have meal in the below column if you took it. **若果已進食以下規定餐數，請在以下方格填上 "√" .**							
Week /週 **(6)**	Mon/ 星期一	TUE/ 星期二	WED/ 星期三	THUR/ 星期四	FRI/ 星期五	SAT/ 星期六	SUN/ 星期日
Date/日期							
Breakfast/早餐							
Snacking/小食							
Lunch/午餐							
Snacking/小食							
Dinner/晚餐							

Please write down the types of physical activity and the duration(minutes) in the below column/請在以下方格填寫運動類型及持續時間(分鐘)							
Physical activity/ 運動							
Minutes/ 分鐘							
Parent sign/家長簽名							

Please put a "tick" when you have meal in the below column if you took it.

若果已進食以下規定餐數，請在以下方格填上 "√" .

Week /週 (8)	Mon/ 星期一	TUE/ 星期二	WED/ 星期三	THUR/ 星期四	FRI/ 星期五	SAT/ 星期六	SUN/ 星期日
Date/日期							
Breakfast/早餐							
Snacking/小食							
Lunch/午餐							
Snacking/小食							
Dinner/晚餐							

Please write down the types of physical activity and the duration(minutes) in the below column/請在以下方格填寫運動類型及持續時間(分鐘)

Physical activity/ 運動							
Minutes/ 分鐘							
Parent sign/家長簽名							

Please put a "tick" when you have meal in the below column if you took it. **若果已進食以下規定餐數，請在以下方格填上 "√" .**							
Week /週 **(9)**	Mon/ 星期一	TUE/ 星期二	WED/ 星期三	THUR/ 星期四	FRI/ 星期五	SAT/ 星期六	SUN/ 星期日
Date/日期							
Breakfast/早餐							
Snacking/小食							
Lunch/午餐							
Snacking/小食							
Dinner/晚餐							

Please write down the types of physical activity and the duration(minutes) in the below column/請在以下方格填寫運動類型及持續時間(分鐘)							
Physical activity/ 運動							
Minutes/ 分鐘							
Parent sign/家長簽名							

Please put a "tick" when you have meal in the below column if you took it. **若果已進食以下規定餐數，請在以下方格填上 "√".**							
Week /週 **(10)**	Mon/ 星期一	TUE/ 星期二	WED/ 星期三	THUR/ 星期四	FRI/ 星期五	SAT/ 星期六	SUN/ 星期日
Date/日期							
Breakfast/早餐							
Snacking/小食							
Lunch/午餐							
Snacking/小食							
Dinner/晚餐							

Please write down the types of physical activity and the duration(minutes) in the below column/請在以下方格填寫運動類型及持續時間(分鐘)							
Physical activity/ 運動							
Minutes/ 分鐘							
Parent sign/家長簽名							

APPENDIX 5

LIFESTYLE BEHAVIOUR CHECKLIST

Below is a list of behaviours parents with overweight children often have to manage. For each item: (1) circle the number that best describes how much of a problem that behaviour has been with your child in the last month, and (2) rate how confident you are in dealing with it. If that behaviour is not currently occurring, rate how confident you are that you could successfully deal with your child's behaviour if it did occur. Remember to put a confidence rating for *every* item.

Rate your confidence from 1 (Certain I can't do it) to 10 (Certain I can do it).

		TO WHAT EXTENT HAS THIS BEHAVIOUR BEEN A PROBLEM FOR YOU WITH YOUR CHILD?							HOW CONFIDENT ARE YOU IN DEALING WITH IT?
		Not at all	A little		Somewhat	Much		Very Much	
1.	Eats too quickly (compared with children with same age)	1	2	3	4	5	6	7	□
2.	Eats too much (compared with children with same age)	1	2	3	4	5	6	7	□
3.	Eats unhealthy snacks	1	2	3	4	5	6	7	□
4.	Whinges or whines about food	1	2	3	4	5	6	7	□
5.	Yells about food	1	2	3	4	5	6	7	□
6.	Throws a tantrum about food	1	2	3	4	5	6	7	□
7.	Refuses to eat certain food (i.e. fussy eating)	1	2	3	4	5	6	7	□
8.	Argues about food (e.g. when you say No more)	1	2	3	4	5	6	7	□
9.	Requests food continuously	1	2	3	4	5	6	7	□
10.	Demands extra helpings at meals	1	2	3	4	5	6	7	□
11.	Sneaks food when they know they are not supposed to	1	2	3	4	5	6	7	□
12.	Hides food	1	2	3	4	5	6	7	□
13.	Steals food (e.g. from other children's lunchboxes)	1	2	3	4	5	6	7	□

14.	Eats food to comfort themselves when feeling let down or depressed	1	2	3	4	5	6	7	□
15.	Watches too much television (compared with children with same age)	1	2	3	4	5	6	7	□
16.	Spends too much time playing video or computer games (Compared with children with same age)	1	2	3	4	5	6	7	□
17.	Complains about doing physical activity (e.g. This is boring, I'm too tired, My leg hurts)	1	2	3	4	5	6	7	□
18.	Refuses to do physical activity	1	2	3	4	5	6	7	□
19.	Complains about being unfit or feeling low in energy	1	2	3	4	5	6	7	□
20.	Complains about being overweight	1	2	3	4	5	6	7	□
21.	Complains about being teased	1	2	3	4	5	6	7	□
22.	Complains about not having enough friends	1	2	3	4	5	6	7	□
23.	Complains about being unattractive	1	2	3	4	5	6	7	□
24.	Complains about not fitting into clothes	1	2	3	4	5	6	7	□
25.	Write down another weight-related behaviour/situation not mentioned in the checklist	1	2	3	4	5	6	7	□

26	Write down another weight-related behaviour/situation not mentioned in the checklist	1	2	3	4	5	6	7	□

Note. Adapted from “The Lifestyle Behaviour Checklist: A measure of weight-related problem behaviour in obese children,” by
F. West & M.R. Sanders, in press, International Journal of Pediatric Obesity.

日常生活行為一覽表

以下一系列是過重孩童們之家長需要處理的行為。 於每項 (1) 圈出最適合描述上一個月，你的小童問題行為的程度的一個數字，以及 (2)你對自己有多少信心處理這些問題的評分；如現時這些行為並未出現，就按照你估計行為出現時，你有多少信心處理這些問題作評分。緊記每一項請填上信心指數。

你的信心指數，由 1 (我肯定做不到) 至 10 (我肯定能做到).

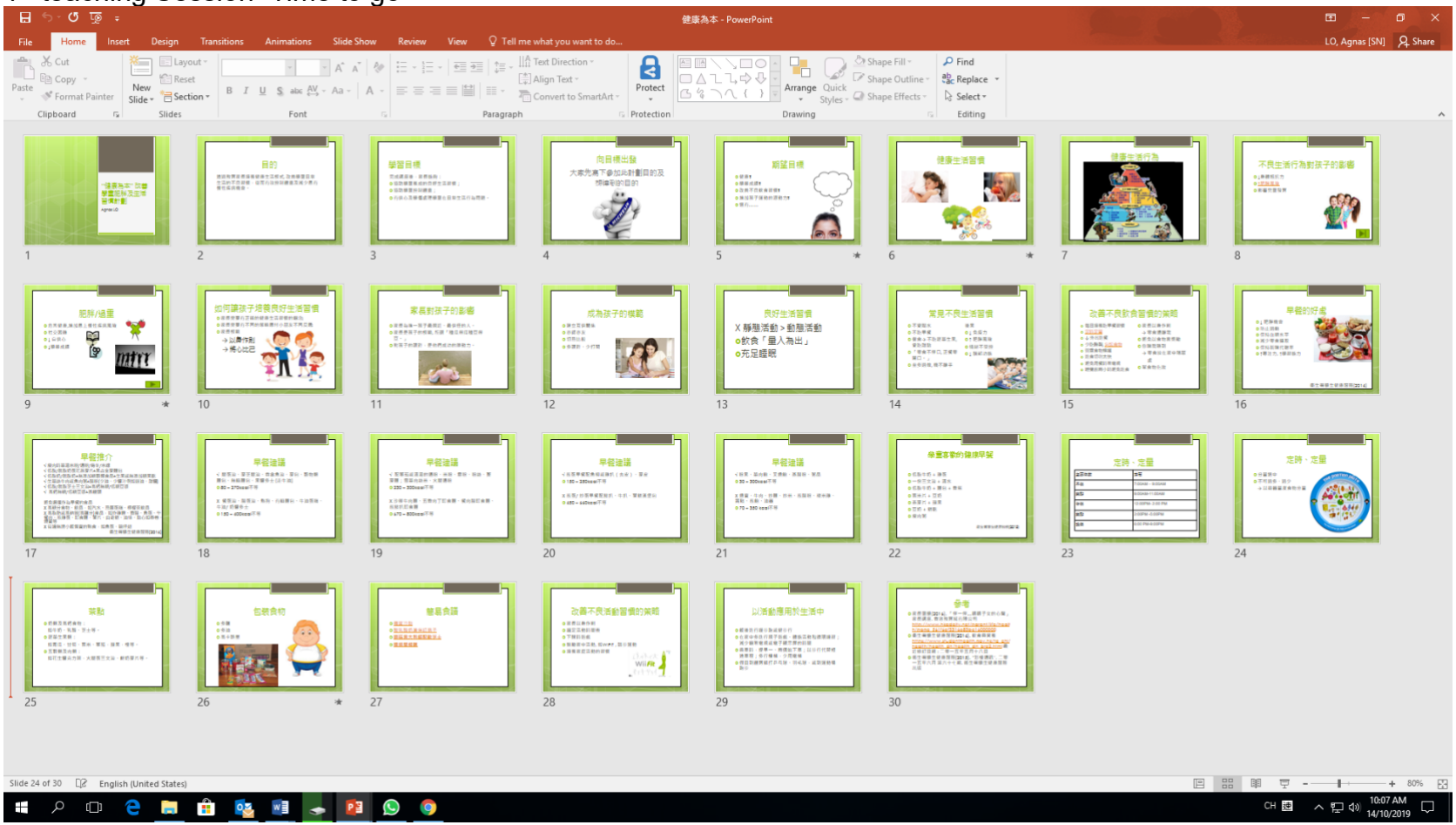
		這行為到何等程度會讓你及小童構成問題？							你有多少信心處理這問題
		一點也不	少		有點兒	多		非常多	
1.	吃得過快(與同齡孩子比較)	1	2	3	4	5	6	7	□
2.	吃得過多(與同齡孩子比較)	1	2	3	4	5	6	7	□
3.	吃不健康的零食	1	2	3	4	5	6	7	□
4.	抱怨或對食物抱怨	1	2	3	4	5	6	7	□
5.	對食物吼叫	1	2	3	4	5	6	7	□
6.	對食物發脾氣	1	2	3	4	5	6	7	□
7.	拒絕吃某些食物(如：偏食)	1	2	3	4	5	6	7	□
8.	為某些食物起爭執(例如: 當你制止其進食)	1	2	3	4	5	6	7	□
9.	不論任何時間都索取食物	1	2	3	4	5	6	7	□
10.	持續性地在正餐之間要求食物	1	2	3	4	5	6	7	□
11.	明知不應該仍偷偷進食	1	2	3	4	5	6	7	□
12.	偷偷地收藏食物	1	2	3	4	5	6	7	□
13.	偷取食物（例如: 在其他小孩午餐盒中偷取食物）	1	2	3	4	5	6	7	□
14.	當孩子情緒低落時，進食可讓他們感到舒暢	1	2	3	4	5	6	7	□
15.	看電視時間過長(與同齡孩子比較)	1	2	3	4	5	6	7	□
16.	玩電子遊戲或電腦遊戲時間過長(與同齡孩子比較)	1	2	3	4	5	6	7	□
17.	抱怨需要做運動（例如: 做運動很悶，做運動讓我感	1	2	3	4	5	6	7	□

	到很疲倦，我的腳因運動受傷了.)								
18.	拒絕做運動	1	2	3	4	5	6	7	□
19.	投訴做運動時，力有不逮	1	2	3	4	5	6	7	□
20.	投訴體重過重	1	2	3	4	5	6	7	□
21.	投訴被欺凌	1	2	3	4	5	6	7	□
22.	抱怨沒有什麼朋友	1	2	3	4	5	6	7	□
23.	抱怨自己不夠吸引	1	2	3	4	5	6	7	□
24.	投訴衣服不合身	1	2	3	4	5	6	7	□
25.	寫下其孩子出現與體重有關行為/情況	1	2	3	4	5	6	7	□
26.	寫下其孩子出現與體重有關行為/情況	1	2	3	4	5	6	7	□

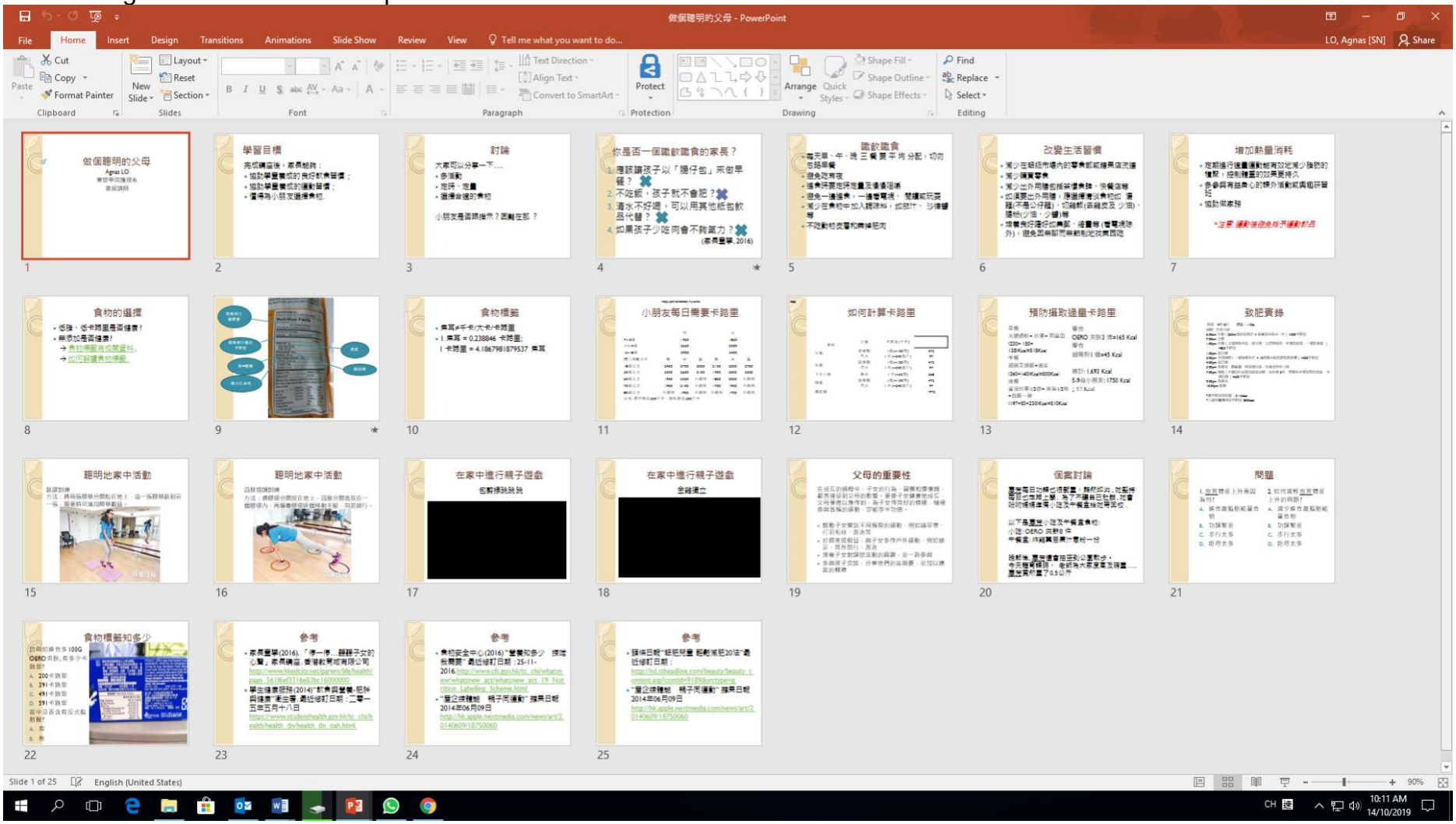
Note. Adapted from “The Lifestyle Behaviour Checklist: A measure of weight-related problem behaviour in obese children,” by
F. West & M.R. Sanders, in press, International Journal of Pediatric Obesity.

Appendix 6

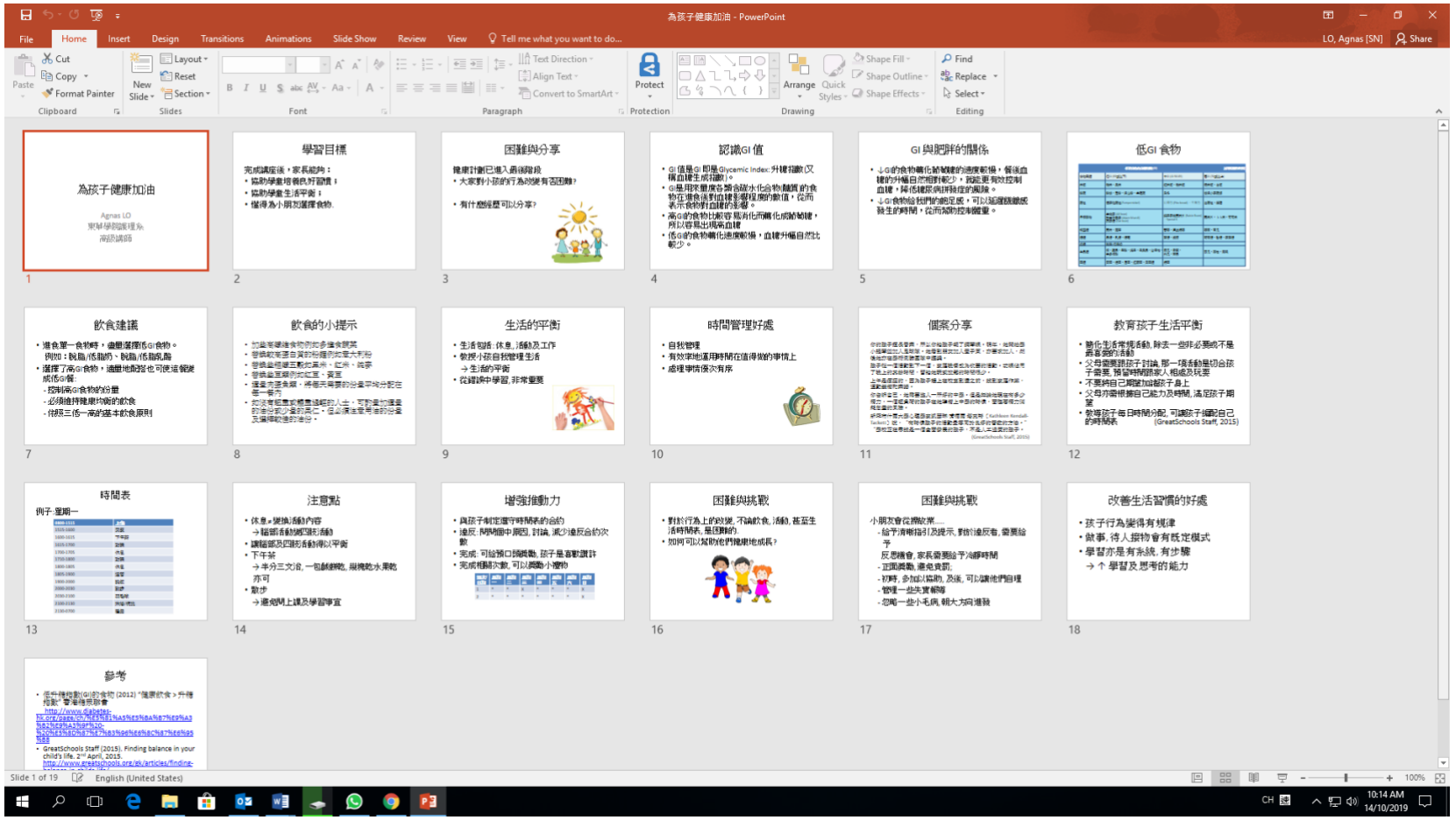
1st teaching Session- Time to go



2nd teaching Session- To be smart parents



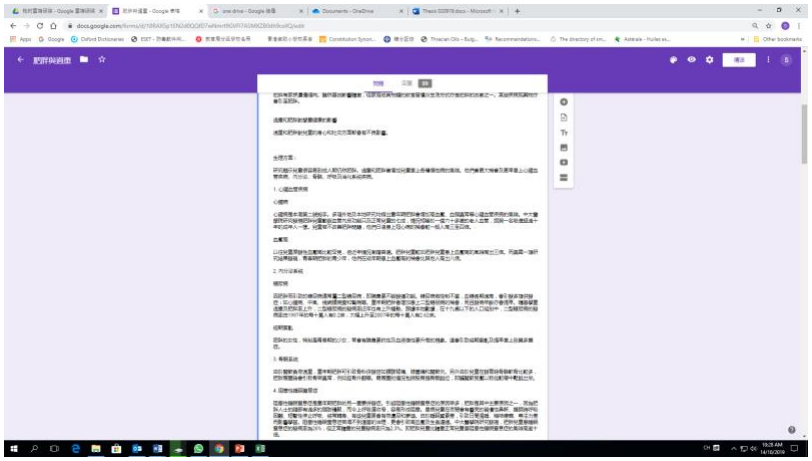
3nd teaching session- Fighting for children's health

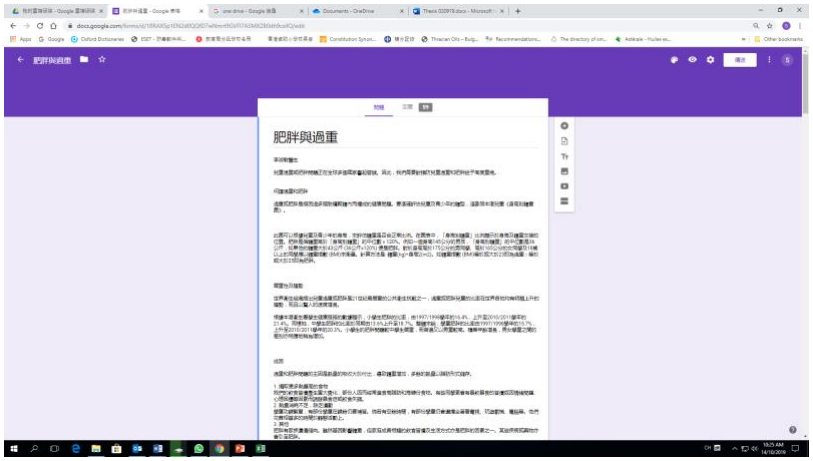


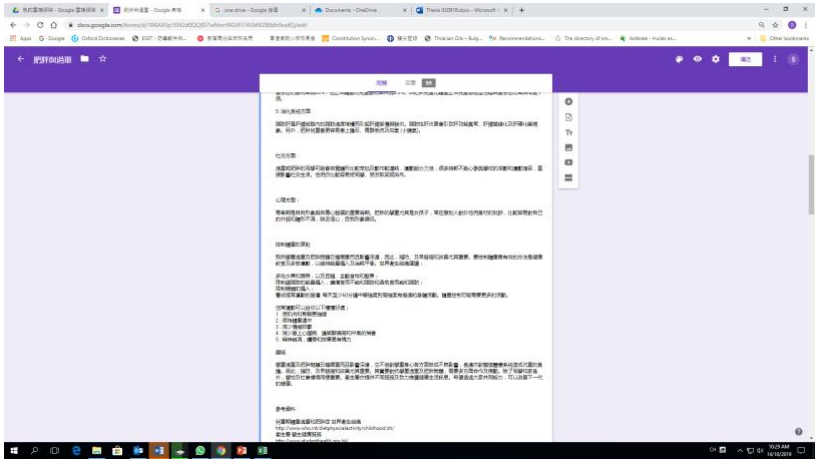
Appendix 7

Content of health information sheet

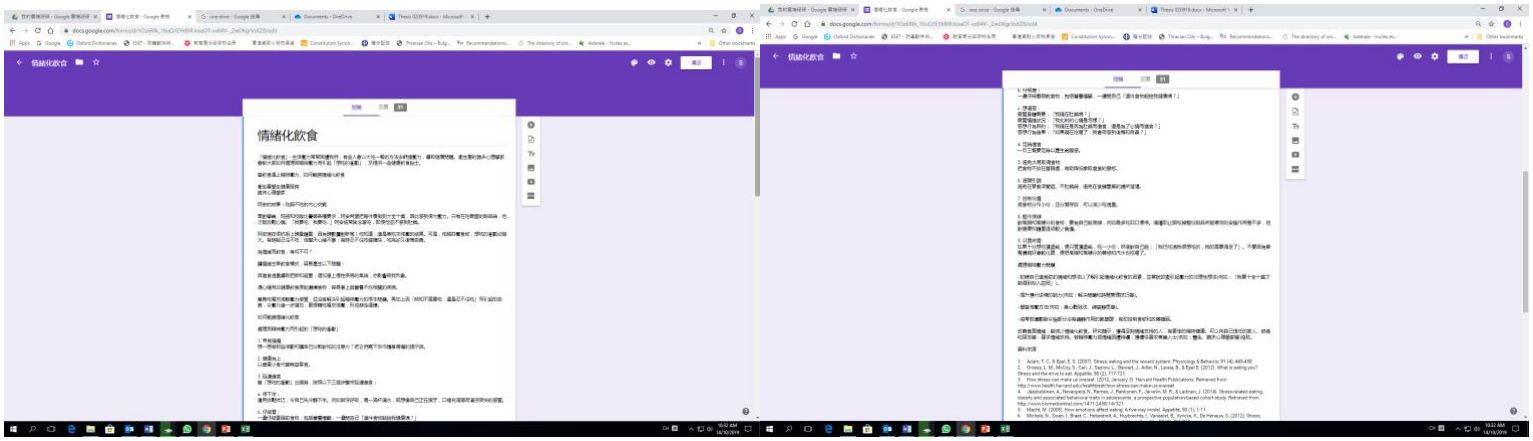
1. Overweight and obesity





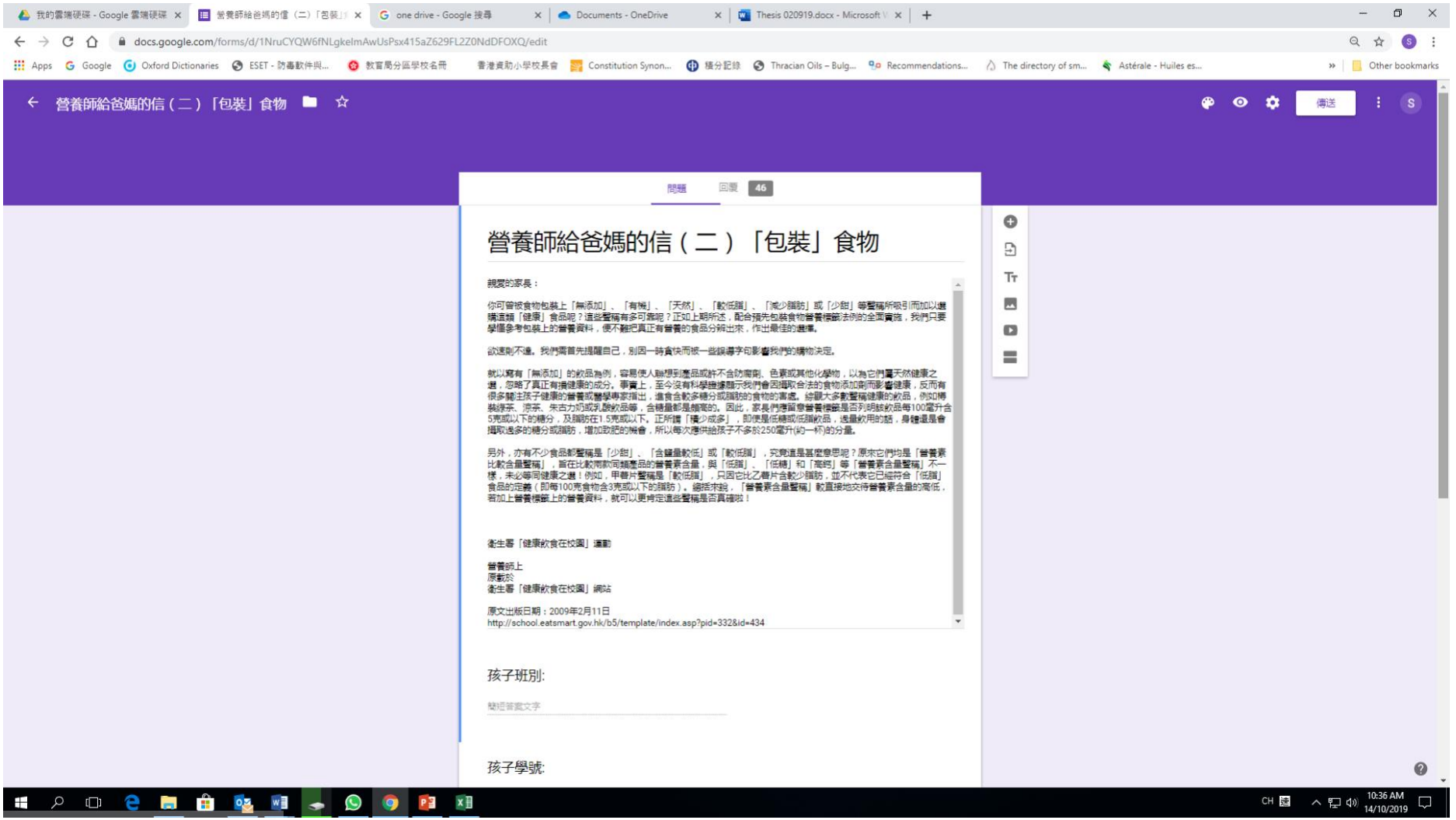


2. Emotional eating



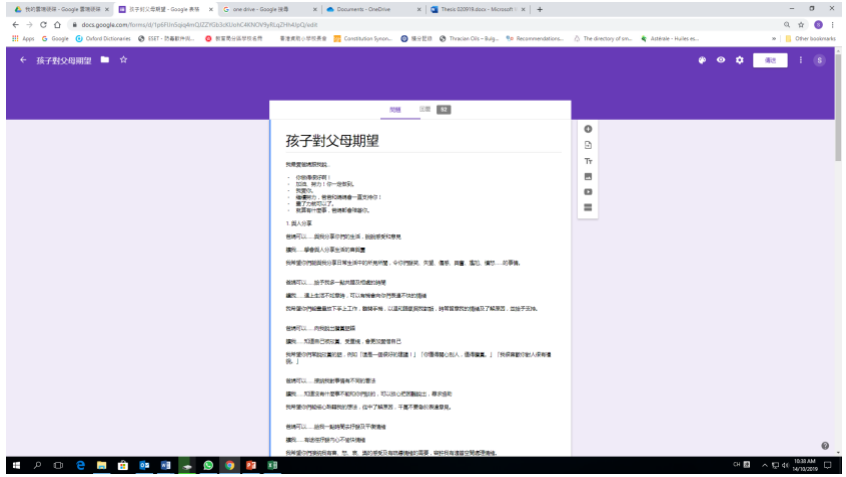
Remark: P= the Problem Scale; C= the Confidence Scale

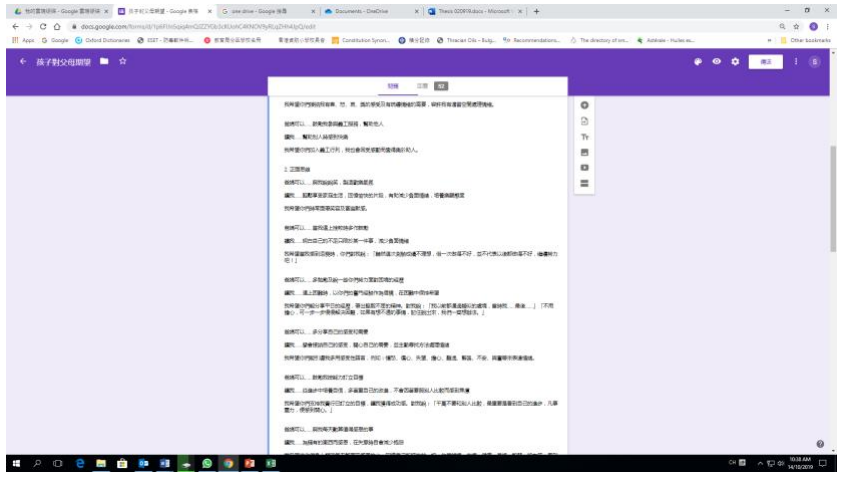
3. Letter to parents – “Pre-packaged” food

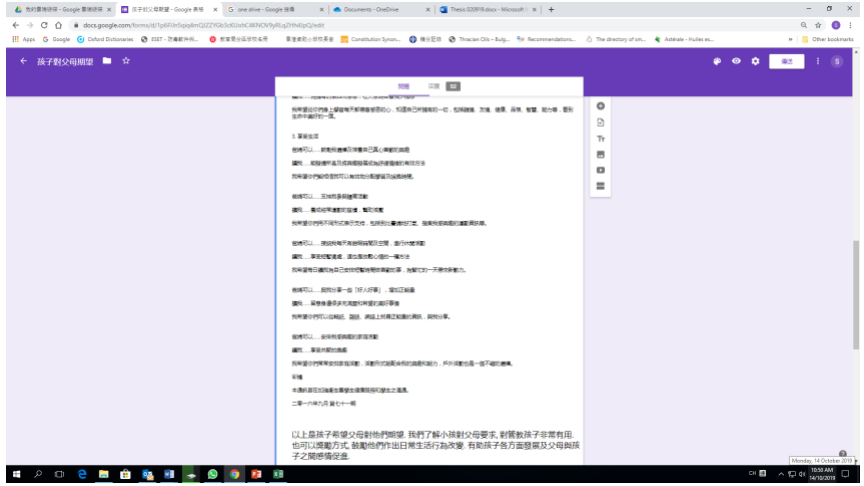


Remark: P= the Problem Scale; C= the Confidence Scale

4. Child expect parents…

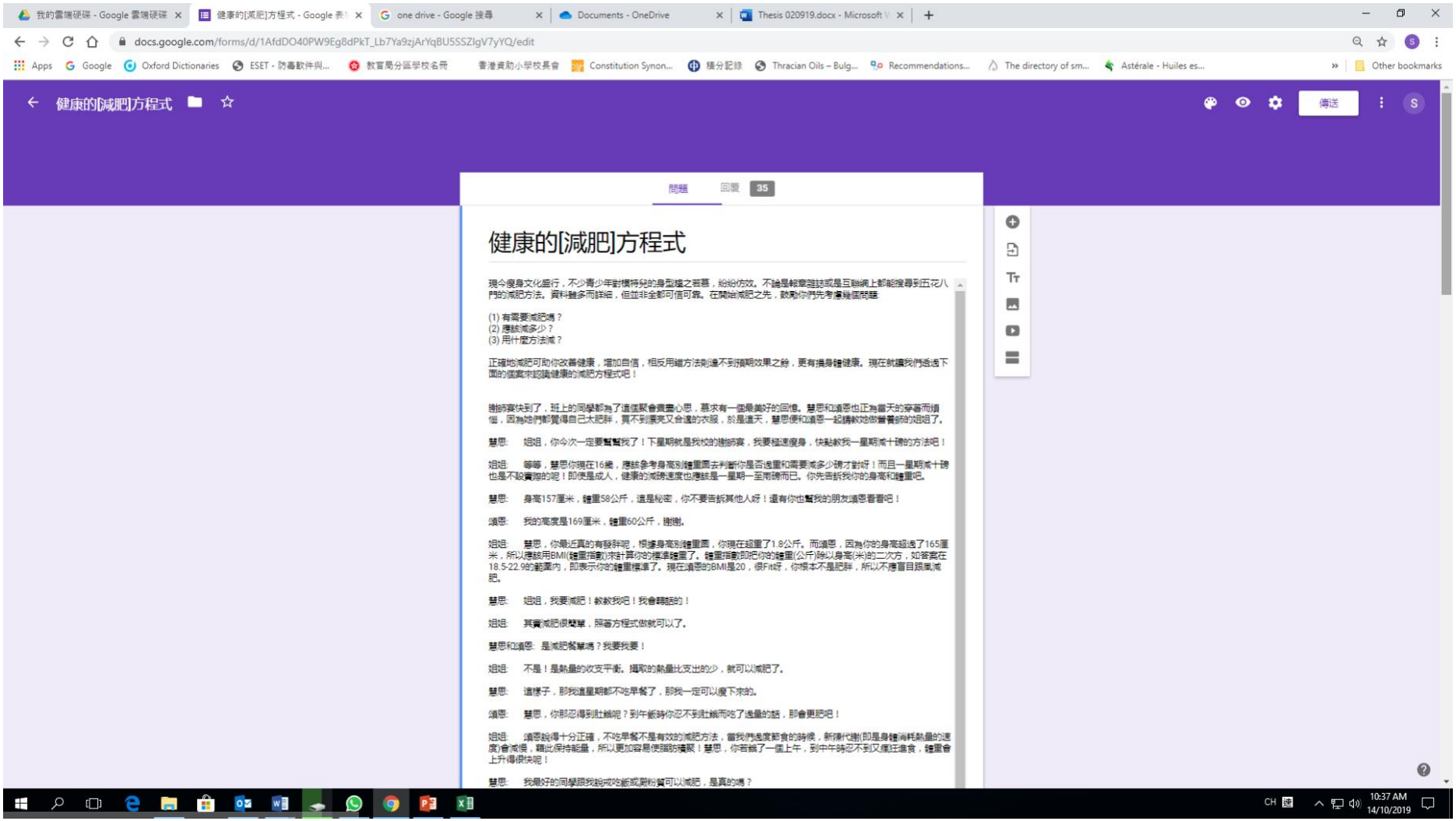






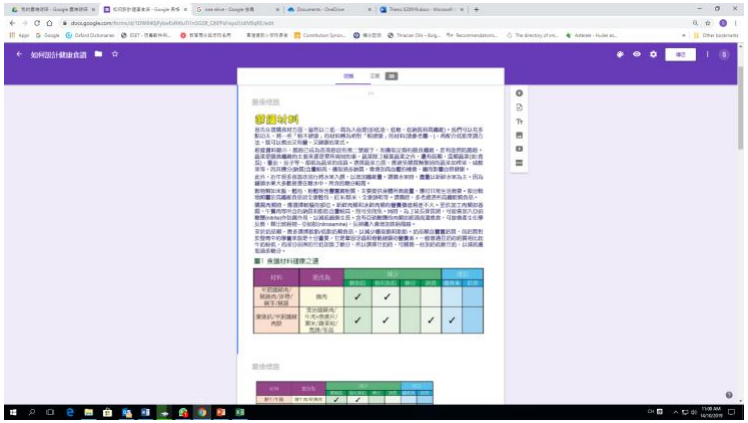
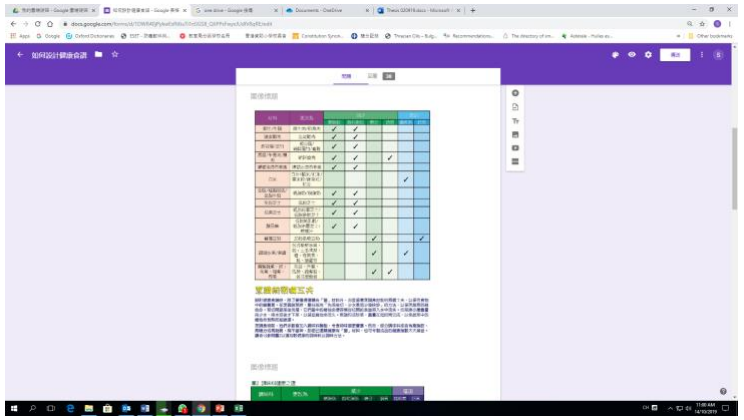
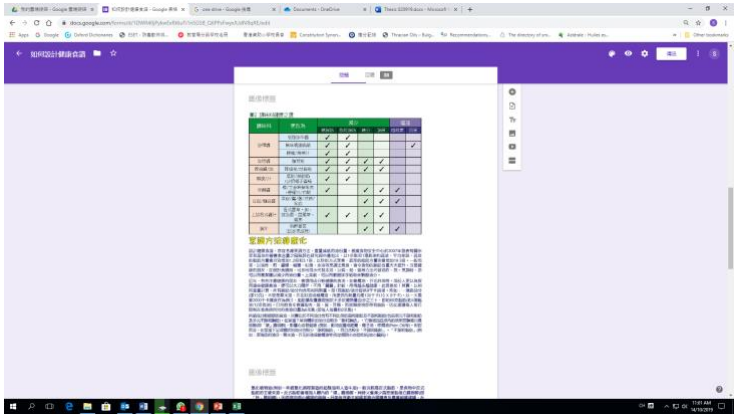
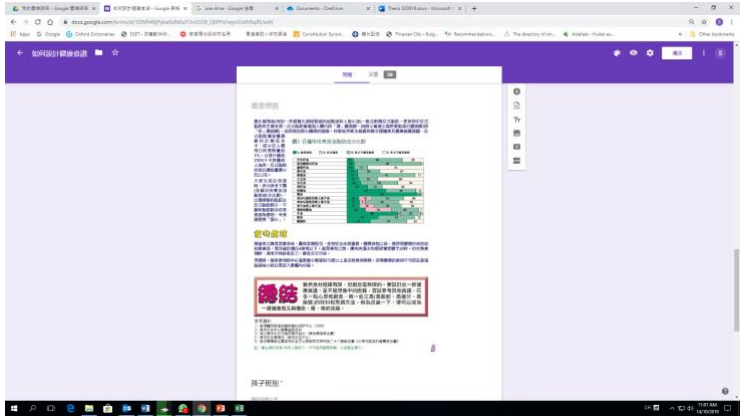
Remark: P= the Problem Scale; C= the Confidence Scale

5. “Keep fit” formula



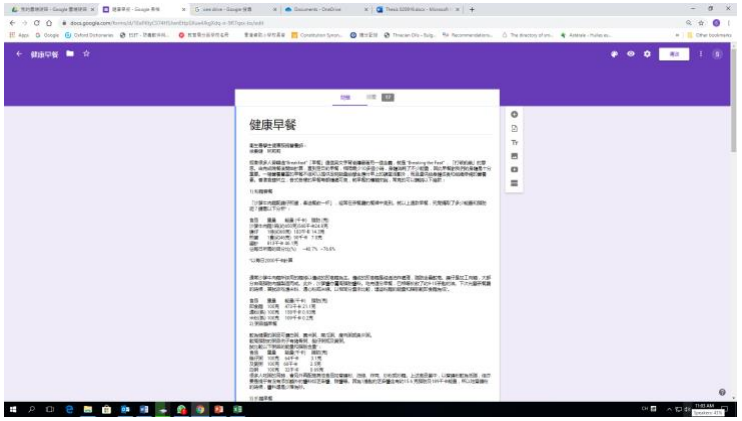
Remark: P= the Problem Scale; C= the Confidence Scale

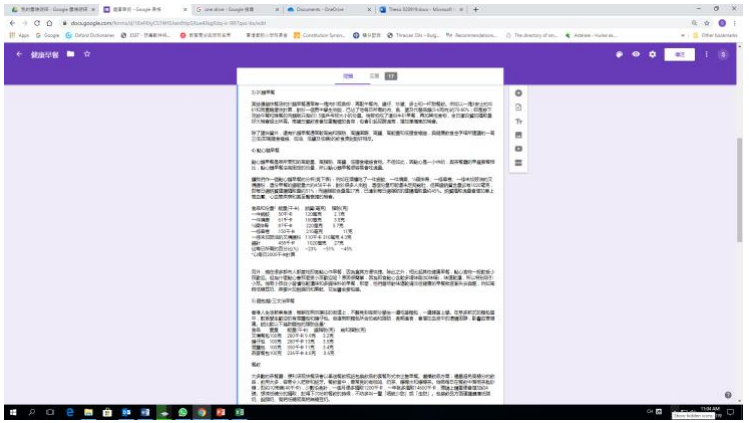
6. Design a healthy recipe

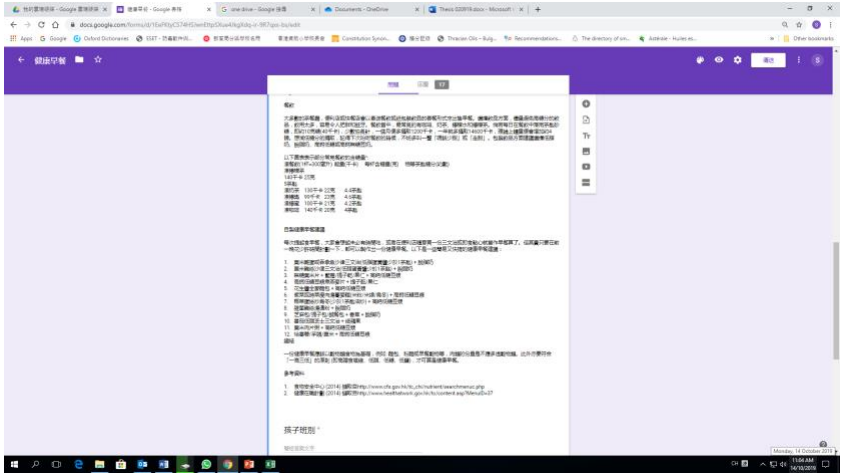





Remark: P= the Problem Scale; C= the Confidence Scale

7. Healthy Breakfast

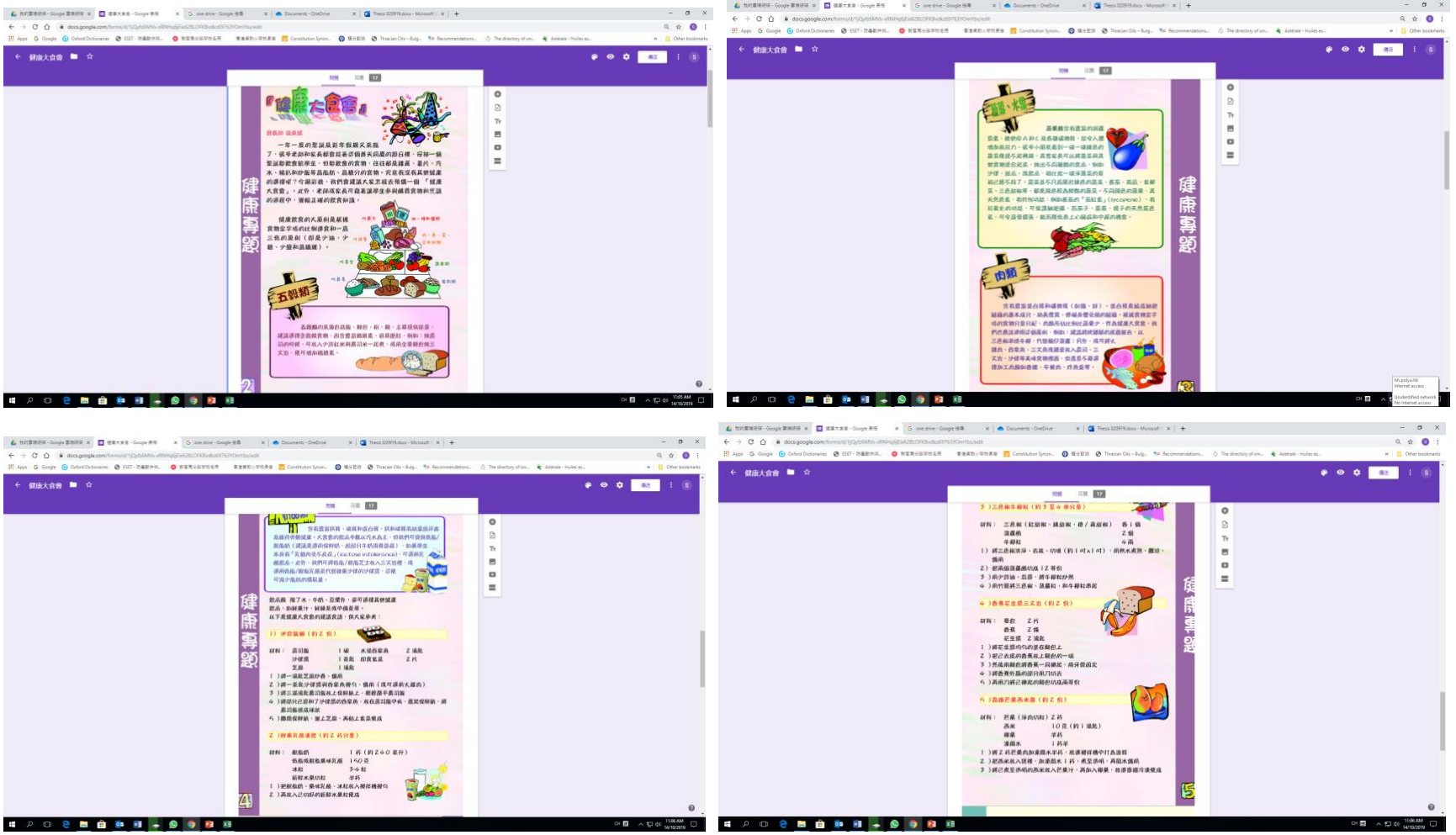






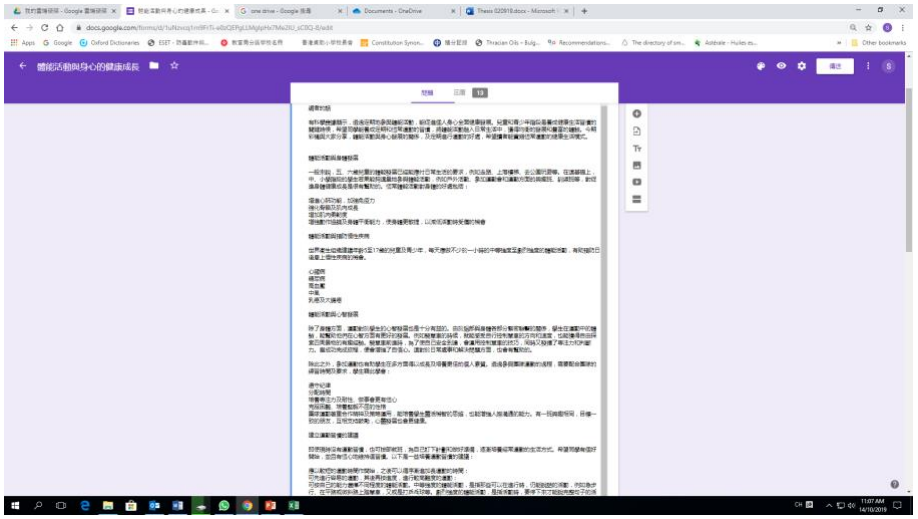
Remark: P= the Problem Scale; C= the Confidence Scale

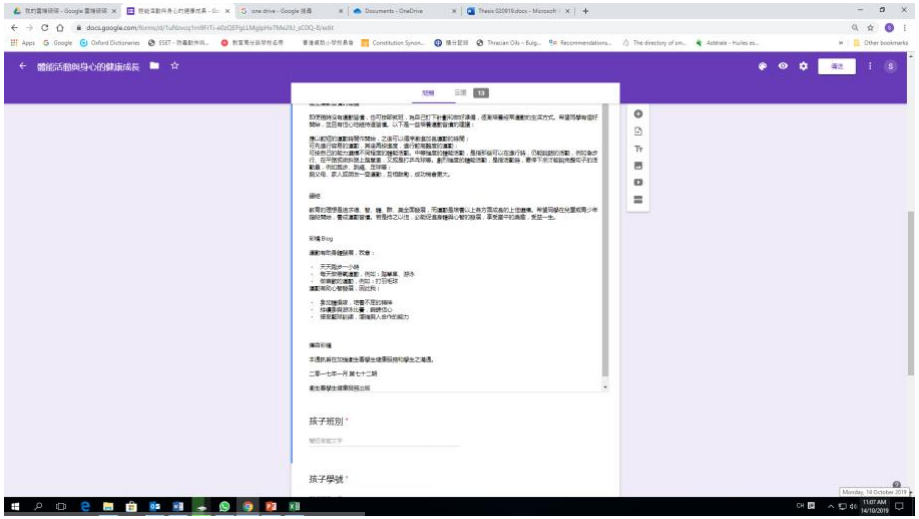
8. Healthy party



Remark: P= the Problem Scale; C= the Confidence Scale

9. Physical activity and development of physical and psychosocial health





Remark: P= the Problem Scale; C= the Confidence Scale