Association among Adolescents' Weight Status, Parents' Perception on Their Children's Weight, Parenting Behaviors and Parenting Style: A Cross Sectional Study in Southern China

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ABSTRACT

Childhood obesity is becoming a challenging issue in China, and parents may play a key role in the development of adolescent obesity. However, the relationships between certain parent-related factors and the development of adolescent obesity are rarely reported in China. Therefore, this study aims to investigate the relationship among Chinese parents' perception of their children's weight, parenting behaviors, parenting style, and adolescents' weight status. Two studies were performed to achieve this purpose.

The first study (Chapter 3) examines the validity and reliability of the questionnaires for adolescents and parents; the questionnaires are intended to measure parenting behaviors, parents' perception of their children's weight, and parenting styles in the Chinese context. Several steps were performed. First, the questionnaires were selected based on their validity and reliability, as well as their applicability to the Chinese adolescent and parenting context. Second, the questionnaires were translated into Chinese using a cross-cultural translation technique. Third, five experts were invited to evaluate the content validity and feasibility of the questionnaires for application in the Chinese population. Fourth, 15 pairs of adolescents and their parents were invited to attend a short interview after completing the experimental version of the questionnaires. They were asked to share comments on the readability and cultural relevance of the questionnaire. The questionnaires were then revised according to their feedback. Fifth, 127 pairs of adolescents (10–15 years old) and their parents (Ganzhou: 62 pairs, Shantou: 65 pairs) were recruited to examine the retest reliability and internal consistency of the questionnaires. Sixth, the data collected in the main

survey were used to examine construct validity. The result showed that 10 items were excluded because of poor content validity or low intraclass correlation coefficient (<0.7). The internal consistencies of the subscales (ranging from 0.61 to 0.81) were found to be acceptable (Cronbach's α >0.6). The goodness-of-fit statistics (RMSEA, CFI, and NNFI) also indicated acceptable fit for the theory models. The results suggest that the validity and reliability of the questionnaires are acceptable, and the questionnaires are applicable to Chinese adolescents and parents in Southern China.

The second study (Chapters 4, 5, 6) determines the relationships among parenting behaviors, parents' perception of their children's weight, parenting style, and adolescent weight status. A total of 2,143 adolescents and 1,869 parents were recruited from secondary schools in Ganzhou and Shantou in China. The adolescents' weights and heights were measured by trained testers. The dietary habits and physical activity level of the adolescents, as well as parenting behaviors, parenting styles, parents' perception of their children's weight, and demographic information were collected through questionnaires issued to the adolescents and parents validated in Study 1. Several parenting behaviors, including "pressure to eat" and "diet and PA monitoring," were found to be significantly related to adolescents' age and gender-specific BMI Z score (Z-BMI), although the correlation coefficients were low (r ranged from -0.23 to 0.09, $p<0.01$). The results of the hierarchical multiple regression revealed that "pressure to eat" and "diet and PA monitoring" were the predictors of adolescent Z-BMI. The results of Kappa statistics showed that only a slight agreement exists between parental perception of their children's weights and the adolescents' actual weights (Kappa=0.221, $p<0.01$). A significant difference in parenting behaviors was found between parents with correct and incorrect perceptions

of their children's weight. Compared with the reference authoritative parenting style, the odds of acquiring unhealthy dietary habits were significantly higher for children with authoritarian (Father: OR=1.67, 95%CI: 1.29–2.16; Mother: OR=1.72, 95%CI: 1.31–2.26) and neglectful (Father: OR=2.17, 95%CI: 1.66–2.82; Mother: OR=2.29, 95%CI: 1.76–3.00) parents. The odds of being physically inactive for children with neglectful parents were almost twice than that for children with authoritative parents (Father: OR=2.05, 95%CI: 1.37–3.06; Mother: OR=1.77, 95%CI: 1.18–2.67). Significant differences were found in the parenting behaviors of parents with four different parenting styles. However, no association was found between parenting style and adolescent weight. The data of this study suggest that parenting behaviors are weakly but significantly associated with the development of adolescent obesity. Misclassifications of children's weight status were prevalent among Chinese parents. Parental perceptions of their children's weights were associated with some parenting behaviors related to children's weight development. The adolescents' dietary habits, physical activity, and some parenting behaviors were associated with parenting style. However, there was no direct association between parenting style and adolescent weight.

Key words: adolescent obesity, parenting behaviors, parenting styles

摘要

近年來，中國正面臨青少年的肥胖問題的嚴峻挑戰。研究顯示，父母可能在青少年肥胖的發展中發揮著重要的作用。然而，在中國，關于一些父母相關的因素與青少年體重水平之間的關系的研究報道還不夠深入和全面。因此本研究之目的在於探討中國父母對於孩子體重水平的認知、父母教養行爲、父母教養方式與青少年肥胖的關係。爲達到此研究目的，進行了兩項研究。

研究一(第 3 章)的目的在於驗證父母教養行爲，父母對於孩子體重水平的認知以及父母教養方式問卷的效度和信度。研究可分爲以下幾個步驟：第一，在前人研究的問卷中挑選一系列信度效度較好且適用於中國青少年和父母的問卷；第二，遵循跨文化翻譯的基本步驟，將英文問卷翻譯成中文；第三，邀請五名專家評估問卷的內容效度和問卷在中國人群中應用的可行性；第四，邀請十五名青少年及其父母在試用問卷後進行簡短訪談，考察問卷的可讀性和文化相關問題，並根據他們的意見進行修改；第五，招募 127 對青少年（10-15 歲）及其父母（贛州：62 對；汕頭：65 對）進行問卷重測信度和內部一致性測試。第六，利用研究二的調查資料問卷的結構效度測試。10 個問卷題目因爲內容效度不高或組內相關系數(ICC)低於 0.7 而被刪除。亞量表的內部一致性均高於 0.6(範圍：0.61-0.81)，處於可以接受範圍。結構效度測試中的模型擬合指數也顯示問卷結構符合父母教養行爲和父母教養方式的理論模型。因此本次研究的結果表明，這套問卷是可靠而有效的，可以應用於中國南方地區青少年及其父母。

研究二（第 4、5、6 章）旨在研究父母教養行爲、父母對於孩子體重水平的認知、父母教養方式與青少年肥胖發展的關系。研究對像是中國贛州市和汕頭市的 2,143 名青少年和 1,869 名他們的父母。青少年的身高和體重由培訓過的測量員量度。青少年的飲食習慣、體力活動水準、父母教養行爲、父母教養方式、父母對於孩子體重水平的認知以及其他資訊通過研究一驗證的問卷收集。結果顯示，幾種父母教養行爲，包括“強迫孩子吃東西”和“飲食和運動監控”，與青少年的 BMI Z 分的相關系數不高但具有統計學意義（範圍：-0.23-0.09, p<0.01）。分層多變量回歸的結果顯示，兩種父母教養行爲（包括“強迫孩子吃東西”和“飲食和運動監控”）可以預測青少年的 BMI Z 分。根據計算 Kappa 系數的結果，父母對於孩子體重水平的認知與青少年實際體重水平的一致性較差 (Kappa=0.221, p<0.01)。而且，對於孩子體重水平的認知正確與錯誤的兩類父母在父母教養行爲上的有差異，且差異具有顯著性。本次研究還發現，與民主型父母的孩子相比，專制型父母和忽視型父母的孩子出現不健康飲食習慣的優勢必（odds ratio， OR）顯著更高 (專制型父親: OR = 1.67, 95%CI: 1.29 - 2.16; 專制型母親: OR = 1.72, 95%CI: 1.31 - 2.26；忽視型父親 OR = 2.17, 95%CI: 1.66 - 2.82；忽視型母親 OR = 2.29, 95%CI: 1.76 - 3.00)。而忽視型父母的孩子出現體力活動不足情況的優勢必幾乎是民主型父母孩子的兩倍 (父親: OR = 2.05, 95%CI: 1.37-3.06; 母親: OR = 1.77, 95%CI: 1.18-2.67)。此外，不同教養方式類型的父母在教養行爲上的差異也具有顯著性。但是，沒有數據證明父母教養方式與青少年體重水平直接相關。本次研究的數據表明：父母教養行爲與青少年肥胖的發展相關微弱但具有統計學意義。許多父母對于孩子體重水平的認知不準確。父母教養行爲可能與父母對於孩子體重水平的認知有關。青少年的飲食習慣、體力活動水

準以及部分父母教養行爲與父母教養方式有關，但未發現父母教養方式與青少年體重水平直接相關。

關鍵字：青少年肥胖、父母教養行爲、父母教養方式

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PUBLICATIONS

The findings presented in this thesis have been reported, in part, in the following publication and presentations.

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ABBREVIATIONS

AEE	**Energy expenditure in physical activity**
BMI	**Body mass index**
CFA	**Confirmatory factor analysis**
CFI	**Comparative fit index**
CI	**Confidence interval**
CVD	**Cardiovascular disease**
EE	**Energy expenditure**
NNFI	**Non-normed fit index**
PA	**Physical activity**
REE	**Resting energy expenditure**
RMSEA	**Root mean square error of approximation**
SES	**Socioeconomic status**
TEE	**Total energy expenditure**
TEF	**Thermic effect of food**
Z-BMI	**Age and gender specific body mass index Z score**

CHAPTER 1

INTRODUCTION

1.1 Background

During the past decades, childhood obesity became one of the worldwide public health problems. It is estimated that one out of ten school-aged children in the world were overweight (Lobstein, Baur, & Uauy, 2004). In Hong Kong , the prevalence of childhood obesity had increased closed to 70% from 1994 to 2007 (Yeung & Hui, 2007). From 1989 to 1997, the prevalence of obesity in urban area of China increased from 1.5 to 12.6%, and the prevalence of overweight increased from 14.6 to 28.6% (Luo & Hu, 2002).

As the prevalence of obesity is still growing and pediatric obesity increases the risk for adult obesity and numerous associated diseases (Choudhary, Donnelly, Racadio, & Strife, 2007; Gunnell, Frankel, Nanchahal, Peters, & Davey Smith, 1998), thousands of studies were done to find out the causes and appropriate treatments for the childhood obesity. Among these studies, two interesting phenomenon were discovered. First, children of obese parents seems to have higher risk for developing obesity (Treuth, Butte, & Sorkin, 2003). Second, parental involvement is related to weight loss in children (McLean, Griffin, Toney, & Hardeman, 2003). These studies indicated that parents may play important roles in the etiology and prevention of childhood obesity.

Obesity is the result of a long-term positive energy balance, which could be caused by multiple reasons (Barlow & the Expert Committee, 2007). Several possible risk factors

for childhood obesity had been found, including lack of physical activity (Rennie, et al., 2005), long television viewing time (Danner, 2008), a high consumption of fast foods (Bowman, Gortmaker, Ebbeling, Pereira, & Ludwig, 2004) and so on. Obviously, parents could be associated with most of these factors and can potentially mediate or buffer the impact of many of these factors. Parents were found to not only play key roles in children's behaviors formation but also have an effect on the development of children's food preference and dietary habits (Rhee, 2008). Furthermore, it was found that parents' feeding strategies (Faith, Berkowitz, et al., 2004) and parents' own food intake (Fisher, Mitchell, Wright, & Birch, 2002) could influence children's food intake. In addition, parental support (Prochaska, Rodgers, & James, 2002) and parents' own physical activity (Yang, Telama, & Laakso, 1996) were also found to be associated with their children's weight status. These studies suggested that parents could influence child's weight status through parenting behaviors.

As parenting behaviors is found to be influential in determining childhood obesity, the first question is what could motivate parents to choose or modify their parenting behaviors? Parents' readiness and willingness to modify their parenting behaviors may be one of the important steps in preventing childhood obesity. Recent study suggested that parental perception of children's weights could be associated with the parents' readiness to help their children lose weight (Rhee, De Lago, Arscott-Mills, Mehta, & Davis, 2005). Unfortunately, high percentages of parental misconception of their children's weight were reported in recent studies (Eckstein, et al., 2006; Etelson, Brand, Patrick, & Shirali, 2003; Ward, 2008). However, whether the parents' misconception of their children weight is

associated with their parenting behaviors and the development of childhood obesity was not well reported.

Parenting behaviors is regarded as what parents do, while parenting style means how parents do it. Parenting style provides the emotional background how parenting behaviors are expressed and understood by children (Rhee, 2008). Parenting style was also found to be associated with childhood obesity. For example, parental neglect during childhood was found to predict a great risk of obesity in young adulthood, independent of age, gender, BMI in childhood, and social background (Lissau & Sørensen, 1994). Another study showed that, compared to the children with authoritative mothers, children raised by authoritarian mothers had an higher risk of being overweight (Rhee, Lumeng, Appugliese, Kaciroti, & Bradley, 2006). Therefore, childhood obesity intervention programs that include both parenting behaviors and parenting style may be more effective in weight loss and weight control than the traditional programs only focusing on behaviors (Rhee, et al., 2006).

Parenting behaviors and parenting style could be influenced by cultural difference. In China, tradition Chinese education is dominated by Confucianism for more than 2000 years. In traditional Chinese family, there is a strong bond between parents and children, and parent always play an extremely important role in determining their child's lifestyle. Even today, although Chinese society has been influenced by the West, many Chinese parents' beliefs and behaviors are still greatly influenced by Confucianism (Holroyd, 2003; P. Wu, et al., 2002; Xu, et al., 2005). Chinese parenting was characterized by

"restrictive", "controlling" and "authoritarian" (Lin & Fu, 1990; Steinberg, Dornbusch, & Brown, 1992). Research indicated that, Americans emphasize "nurturing innate ability" but Chinese attached great importance to high self-discipline, obedience to parents, which is one of the important parts in Chinese culture (Chao, 1994; F. M. Chen & Luster, 2002). However, only several studies had investigated the association between the parenting behaviors, parenting style and their children's weight status in China. For example, a study based on 163 Chinese children and their mothers in Taiwan and United States showed that democratic parenting style is one of the factors that related to Chinese children's weight status (J. L. Chen & Kennedy, 2004). Another study in Hong Kong found that parents may influence overweight children's attraction to physical activity(Lau, Lee, & Ransdell, 2007).

Although several studies had been done on the influence of parenting behaviors and parenting styles on children's weight status in China, there are still many research questions that are not well answered. For instance, during the past 3 decades, the implementation of the single-child family planning program in the 1970s in mainland China not only caused a drastic decline in the natural growth rate of population in China (Jing, 1994), but could also influence millions of Chinese's parenting behaviors and parenting style. Many Chinese children are treated like a little emperor or empress at home by their parents, which could be significantly different from tradition Chinese parenting style. In addition, for hundreds years, the roles of mothers and fathers in China is quite different (Berndt, Cheung, Lau, Hau, & Lew, 1993), which indicated that, in China, the parenting behaviors and parenting style could also be different in mothers and

fathers. However, little is known whether this gender difference in parenting is associated with children's weight status or not. Therefore, more studies are still needed to investigate the relationship among parenting behaviors, parents' perception of their children' weight, parenting styles and adolescents' weight status in China.

Furthermore, although a number of questionnaire and scales were developed to measure parenting behaviors and parenting styles (Birch, et al., 2001; Golan & Weizman, 1998; Hughes, Power, Fisher, Mueller, & Nicklas, 2003), most research regarding parenting behaviors and childhood obesity had been narrowly concentrated on a single aspect : parental control (Hughes, O'Connor, & Power, 2008). For example, Child Feeding Questionnaire (CFQ) is a frequently used instrument to measure parents' feeding beliefs, attitudes and behaviors. However, the confirmatory factor analysis showed that four out of seven factors in CFQ are focused on parental control practices (Birch, et al., 2001). In addition, because of the cultural difference, the questionnaire developed in western courntries could not be directly applied in Chinese population without validity and reliability test.

In general, there are several research problems remained unsolved. First, few questionnaires were available to measure Chinese parents' parenting behaviors, parenting style and parents' perception of their children's weight. Second, the relationship among parenting behaviors, parenting style and parents' perception of their children's weight and children's weight status were still not clear. Third, limited data was reported on Chinese parenting behaviors, parenting style and parents' perception of their children's weight.

Therefore, research questions were proposed for the current study. First, is parenting behaviors associated with the development of adolescent obesity in China? Which parenting behaviors were associated with adolescent obesity? Second, how many Chinese parents misclassify their children's weight status? Is parents' perception of their children's weight associated with their parenting behaviors? Third, is parenting style related to adolescent obesity? Is there any difference in parenting behaviors for the parents with different types of parenting style?

1.2 Purposes

Given the lack of questionnaires and studies on the association among Chinese parents' perception of their children's weight, parenting behaviors, parenting styles and adolescents' weight status, the purposes of this study were: 1) to examine the validity and reliability of questionnaires to measure Chinese's parenting behaviors, parents' perception of their children's weight and parenting styles; 2) to determine the relationship among adolescent weight status, parents' perception of their children's weight, parenting behaviors and parenting styles in China.

1.3 Significance

The significance of this study were summarized as follows. 1) The validated questionnaire in this study would be a valuable tool for practitioners and researchers for future evaluation and investigation; 2) Benefits parents with regards to effective parental style and behavior for combating obesity of their child; 3) Provide important information for designing effective strategies with regards to controlling childhood obesity; 4)

Meaningful implications for policy makers for designing national health policy

1.4 Hypotheses

The null hypotheses are set as:

I. The test-retest reliability, internal consistency and construct validity of the questionnaires for adolescents and parents would not be satisfactory.

II. There is no agreement between the parents' perception of their children' weight status and the adolescents' actual weight status.

III. There is no association between parenting behaviors and adolescents' weight status.

IV. There is no association between parenting styles and their adolescents' weight status.

1.5 Operational definitions

1.5.1 Parents' perception of their children's weight status

In the present study, parents' perception of their children is defined as the self-reported parents' recognition and discrimination of their children's heaviness (Warschburger & Kroller, 2009).

1.5.2 Parenting behavior

In the present study, parenting behavior is defined as the parents' actions or reactions, which may influence their children's weight status, including parents' feeding strategies,

parents' actions towards children's physical activity and sedentary behaviors (Rhee, 2008).

1.5.3 Parenting style

In the present study, parenting style is defined as the general mode of parenting reported by their children, which provides the emotional background how parenting behaviors are expressed and interpreted by adolescents (Darling & Steinberg, 1993).

1.5.4 Adolescent obesity

In this study, adolescent obesity is defined as body mass index (BMI) higher than the age and gender specific cutoff points based on the international growth standards for school-aged children and adolescents (Butte, Garza, & de Onis, 2007; De Onis, et al., 2007).

1.6 Limitations

First of all, as it is a cross-sectional study to determine the association between parenting behaviors, parenting styles and childhood obesity among Chinese, no information on causality relationship can be provided. Secondly, part of data in this study would be based on self-reported. However, sometimes self-reported data may reflect participants' idealizations of themselves rather than actual realities. And sometimes participants would like to give the responses which are more socially acceptable.

1.7 Delimitations

Firstly, due to vast territory in China and much higher prevalence of childhood obesityin unban regions as compared with in rural regions in China, the participants in this study would only be recruited in two cities in southern China. In addition, only the grade 1 and grade 2 students in secondary schools would be recruited in this study. Therefore, the findings of the study should be cautiously generalized to other age groups of children and parents as well as the children and parents in other locations.

Secondly, BMI rather than percent body fat would be used to determine adolescents' and their parents' weight status, although BMI is not a direct indicator of body composition.

Thirdly, children and parents recruited for reliability study will be ignorant of arrangement in repeated completion of the same questionnaire when they firstly introduced to the study.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

As obesity in children may lead to adult obesity and may increase the risk of chronic disease in adults, intervention programs for childhood obesity are urgently needed in order to control the development of obesity in the adult population (Magarey, Daniels, Boulton, & Cockington, 2003; Must & Strauss, 1999). However, most treatments for childhood obesity are characterized by patient non-attendance, high drop-out rate, and failure in weight maintenance (Stewart, Chapple, Hughes, Poustie, & Reilly, 2008). Therefore, some new intervention programs resulting in long-term, sustained involvement in obesity prevention are still needed.

Recommendations from expert committee on childhood obesity had pointed out the importance of parents' involvement in intervention (Barlow & the Expert Committee, 2007). Some experts suggested the programs for childhood obesity should be family based with the participation of at least one parent, or it may lead to failure in treatment (Dietz & Robinson, 2005; Robinson, 1999). Therefore, family based intervention, especially parents focused intervention could be an ideal long-lasting program for childhood obesity. One of the strong evidences of parents participation in obesity prevention is the study done of Epstein et al., in which ten years effectiveness of a combined parent-child intervention program was demonstrated (Epstein, Valoski, Wing, & McCurley, 1990).

Parents not only play key roles in treatment of childhood obesity but also in the etiology of childhood obesity. Parental obesity is a strong predictor for a childhood obesity persisting into adulthood, especially for young children (Whitaker, Wright, Pepe, Seidel, & Dietz, 1997). Parents provide foods or make food choices for their children. In addition, parents can serve as role models and authority figures who not only help mold and shape dietary and physical activity habits in children but also influence children's attitudes and beliefs towards eating practices and sports participation (Rhee, 2008).

Several literature reviews had demonstrated the association between parental perceptions, parenting behaviors, parenting style and other parent related factors and childhood obesity (Faith, Scanlon, Birch, Francis, & Sherry, 2004; Howard, 2007; Lindsay, Sussner, Kim, & Gortmaker, 2006; Rhee, 2008). However, although parental influence on childhood obesity is multi-factorial, majority of these studies only reviewed one or two factors. In addition, few Chinese studies were included in these reviews. Therefore, in order to better understand the relationship between parents and childhood obesity, this review attempts to summarize the studies in recent years on the association between childhood obesity and some parents related factors, which include heredity, parental perception, belief and knowledge, parenting behaviors, parenting style, home environment, and some other factors.

2.2 Heredity and childhood obesity

The dramatic increase in the prevalence of childhood obesity in the past a few years is

always reported to be associated with the changes in the environment (Franzini, et al., 2009; Strauss & Knight, 1999). However, not all children are influenced equally by unhealthy lifestyles. Some children remain lean even in a strongly obesogenic environment. There are really only two basic explanations for how these children keep lean (O'Rahilly & Farooqi, 2008). One is that the parents of these children always made right decision on their children's diet and exercise. Another reason is heredity. These lean children maybe somehow biologically different and keep their weight status largely through unascertained mechanisms.

2.2.1 Genetic influence on childhood obesity

2.2.1.1 Parent–offspring design studies

A recent study (Toschke, von Kries, Beyerlein, & Ruckinger, 2008) based on the data of 4,884 children proved that maternal overweight could influence the entire BMI-distribution with an accentuation on upper quantiles to higher BMI values. However, some other factors including parental education, formula feeding and high TV consumption could only leaded to a shift of upper quantiles. The data of another study suggested that, parents' weight status, birth BMI were independent predictors of children's BMI ($r = 0.42$, $P < 0.001$) (Schaefer-Graf, et al., 2005). Another longitudinal study revealed that fathers' total or percentage body fat could predict their girls' long-term changes in total fat mass and percentage body fat (Figueroa-Colon, Arani, Goran, & Weinsier, 2000). In addition, the data of another study showed parents'standardized weight change was significantly associated with child's standardized weight change for the 0- to 6-month ($P<.001$) and 0- to 24-month ($P <.009$) time points

(Wrotniak, Epstein, Paluch, & Roemmich, 2004). This study indicated that children could get benefit from their parents who successfully lose weight in family-based intervention.

Similar results were also reported in China. A cross sectional survey based on 9,325 children aged 6-8 in China showed that the prevalence of obesity in the children of normal weight parents was 11.1%. The prevalence of obesity in the children of obese parents was as high as 33.6% (Y. Yu, Li, Xia, Tong, & Sun, 2002). 2002 China National Nutrition and Health Survey which included 6,826 Chinese children aged 7-17 years suggested that the heavier the parental body weight, the higher risk for overweight in their children (Y. Li, et al., 2007). Another survey which investigated 11,454 children aged 0-6 years in Shenzhen, showed that 13 factors associated with childhood obesity, including parental overweight, father's low education, birth weight no less than 4 kg and some other factors (B. Chen, et al., 2008). These large sample investigations successfully demonstrated a significant association between childhood obesity and parental weight status in Chinese population.

It has been suggested that increasing body fat in young women lead to intrauterine environments that, stimulate increased obesity among their children, generating an intergenerational acceleration of obesity levels (Levin, 2000). If this mechanism is true, the correlation coefficient between maternal BMI and offspring BMI should be stronger than the correlation coefficient between father's BMI and their children's BMI. However, no significant difference was found between maternal–offspring and paternal–offspring BMI in 4,654 families (Smith, Steer, Leary, & Ness, 2007). Further studies are needed to

determine whether children's weight status would be influenced by intrauterine environment.

2.2.1.2 Twin design studies

The classical twin design is one of the most efficient measures in determining the contribution of shared genes and shared environment to familial traits. The advantage of this design is providing a unique method for differentiating nature and nurture through the fact that monozygotic (MZ) twins share all of their genes, whereas dizygotic (DZ) twins share only half of their genes (Hopper, Bishop, & Easton, 2005). According to the data of over 25,000 twin pairs and 50,000 biological and adoptive family members in published twin and adoption studies, it was summarized that the weighted mean correlations were 0.74 for MZ twins, 0.32 for DZ twins, 0.25 for siblings, 0.19 for parent–offspring pairs, .06 for adoptive relatives, and .12 for spouses (Maes, Neale, & Eaves, 1997). Another studies measured the total and regional fat distribution of twins by DEXA (Dual energy X-ray absorptiometry) (Malis, et al., 2005). The results also showed that the intraclass correlations were higher for all fat percentages among MZ twins as compared with DZ twins. These studies suggested that genetic factors play an important role in variation of body fatness.

For the percentage of the fat mass that could be explained by gene, most studies had reached similar conclusion, in which the heritability estimated in adults is about 55% to 86% (Fabsitz, Sholinsky, & Carmelli, 1994; Faith, et al., 1999). For instance, a bivariate twin modeling was used to determine the contribution of the genetic factors to obesity, in

which substantial heritability for obesity was found to be 0.86 (95% CI, 0.77-0.94) (Bulik, Sullivan, & Kendler, 2003). A recent study based on the data of BMI and waist circumference (WC) of more than five thousands twin pairs in United Kingdom confirmed that the substantial heritability for BMI and WC were both 77% (Wardle, Carnell, Haworth, & Plomin, 2008). These studies support the importance of genes to the development of obesity.

2.2.1.3 Limitations

One of the limitations in the parent–offspring or twin design studies is parent-offspring and sibling correlations do not separate the genetic and environmental transmission. Heritability could be overestimated in parent–offspring and twin studies as the twins shared not only genetic but also the shared environmental factors. One solution for the shared environment problems in the parent–offspring or twin design studies is to choose the adoption study design. The logic of the adoption method is that resemblance in the trait between the adoptee and the biological family members could be explained by shared genes. However, resemblance between the adoptee and the adoptive family members should be shared family environment. For instance, based on 540 adult adoptees, some researchers had investigated the contributions of genetic factors and the family environment to percent body fat (Stunkard, et al., 1986), in which, a high correlation was found between the weight status of the adoptees and their biologic parents. However, no relation was found between the weight status of the adoptees and their adoptive parents.

Another limitation for parents-offspring design study is the heritability could be

underestimated because children and parents are measured at different ages. If different genetic and/or environmental factors account for the variation in BMI at different ages, parent-offspring and sibling correlations would be reduced and heritability could be underestimated. In addition, variability in heritability estimate is very large due to different study design (twin, family, and adoption studies), small sample and large variation in ages of participants (Beunen, et al., 1998). Although there are several limitations in these studies, parent–offspring and twin design studies are still effective and widely applied in genetic epidemiology. These studies had also successfully demonstrated that genetic factors are one of the most important factors in the etiology of childhood obesity.

2.2.2 Genetic influence on energy expenditure

An imbalance of energy intake relative to energy expenditure (EE) could lead to obesity. Possible mechanisms for the etiology of obesity, which is proved to be associated with genes, may include low energy expenditure and/ or high energy intake (Figueroa-Colon, et al., 2000).

2.2.2.1 Resting energy expenditure

50% to 75% of total energy expenditure of a person is spent as resting energy expenditure (REE) (Ravussin & Bogardus, 1989). Interindividual difference in REE could be one of the causes for obesity. Some early studies showed that children of obese parents had low REE (Griffiths & Payne, 1976; Griffiths, Payne, Stunkard, Rivers, & Cox, 1990), which could contribute to childhood obesity. It was reported that 11% of the variance in the REE

may be explained by family membership (Bogardus, et al., 1986). The intraclass correlation coefficient for familial influence on energy expenditure, independent of percent body fat, age and gender was 0.26 (Ravussin & Bogardus, 1989). Recent studies on REE and obesity showed that heritability of REE was 0.30 after body size were controlled (X. Wu, et al., 2004), and heritability was 0.29 ± 0.08 for REE after thyroid hormones and metabolic risk were adjusted (Bosy-Westphal, et al., 2008).

However, the data of some studies did not support for the theory that the children of obese parents have low REE and therefore have higher odds for overweight. For example, prepubertal girls with either lean or obese parents were found to have similar EE during rest, sleep, some types of physical activity and over a 24-h period (Treuth, Butte, & Wong, 2000). The results of another study showed that, compared with the children of nonobese parents, the adjusted mean REE was 50 kcal/day lower in children when only the mother was obese or only the father was obese, but not when both parents were obese (Goran, et al., 1995). Some researchers pointed out that one reason for the undiscovered relation between low metabolic rate and overweight could be that obesity-related metabolic risk factors mask the problem of low metabolic rate which may initially lead to overweight (Bosy-Westphal, et al., 2008).

2.2.2.2 Thermic effects of food

The thermic effect of food (TEF) is the increase in energy expenditure after food intake. TEF was investigated for decades. However, it is still not clear whether TEF contribute to the development of obesity and the heritability of TEF was reported by only a couple of

studies. The data of a study showed that at least 40% to 50% of the variation of TEF could be explained by genes. The correlations for TEF in DZ, MZ and parent-spring pairs were 0.35, 0.52 and 0.30 respectively (Bouchard, et al., 1989). In another study, TEF during exercise, was found to be significantly higher for the normal men when compared with obese men in submaximal intensities exercise (Segal, Presta, & Gutin, 1984). These studies suggested that the children of obese parents are more likely to have a low TEF.

2.2.2.3 Activity related energy expenditure and total energy expenditure

Energy expenditure in physical activity (AEE) is an key component of the total energy expenditure (TEE). Several studies suggested that the interindividual differences in AEE and TEE could be partly explained by heredity. For instance, it was found out that reduced energy expenditure, particularly on physical activity, play a key role in the rapid weight gain in infants born to overweight mothers (Roberts, Savage, Coward, Chew, & Lucas, 1988). Another study investigated the weight status and the energy expenditure of 196 nonobese girls, in which the data of REE and TEE were measure by indirect calorimetry and doubly labeled water method respectively. The data showed that TEE was found to be higher among girls with at least an overweight parent (Bandini, Must, Spadano, & Dietz, 2002). However, another study based on a large sample of healthy infants showed no aspect of infant energy expenditure was associated with parents' weight status (Davies, Wells, Fieldhouse, Day, & Lucas, 1995).

2.2.3 Genetic influence on energy intake and food preference

When energy intake is greater than energy expenditure, even at modest daily energy

surpluses, could cause the problem of childhood obesity (Goran, 2001). The result of an animal studies suggested that the macronutrients consumption in the diet seems to be partly heritable (Reed, Bachmanov, Beauchamp, Tordoff, & Price, 1997). Similar results were also found in the research on the development of child's dietary habits and food preference. It was found out that children were predisposed to reject unfamiliar foods and to learn the relation between foods' flavors and the post-ingestive consequences of eating (Birch & Fisher, 1998). In addition, this study also showed that children could respond to the energy density of the diet, which indicated that children's energy intake and food selection may be influenced by their genes.

On the other hand, several twin studies were undertaken to determine the influence of heredity in energy intake and food preference. A study investigated 3-d dietary record in 1597 subjects living in 375 families of French descent (Perusse, et al., 1988). However, the results showed no significant genetic effect on any tested nutrient intake (heritability $\leq 11\%$), which indicated that the genetic factor may not be the most important in children's food selection and that nongenetic effects maybe the major predictors of food intake. There are still some other studies indicated the presence of familial influence on energy intake and food preferences. For example, a study found that similarity among MZ twins exceeded that among DZ twins for intake of several types of food, which suggested that genes influence people's foods preferences (Heitmann, Harris, Lissner, & Pedersen, 1999). Another classic twin design study based on 396 twin pairs also showed an evidence of genetic influences on children's food intake (Faith, Rhea, Corley, & Hewitt, 2008).

In general, the results reviewed here suggested the association between food intake and genes. Although the heritability level may be not very high, there is increasing evidence that genes play an important role in energy intake and food preference, which has the potential to increase the risk for obesity.

2.3 Parental perception, belief and knowledge of childhood obesity

Heredity is one of the factors influencing childhood obesity but maybe not a major factor in determining the development of childhood obesity (Harrell, Bomar, McMurray, Bradley, & Deng, 2001). Studies showed that besides biological and developmental factors, a series of psychological, social, cultural, and environmental factors also influenced children's food consumption and physical activity (Sallis, et al., 1992). For the parents who want to actively engage in obesity prevention, parental perception of children's weight status, health belief toward childhood obesity as well as their knowledge on nutrition and exercise could be very important in childhood obesity treatment.

2.3.1 Parental perception of children's weight status

Some studies had proved that adolescents typically underestimate their weight status (Skinner, Weinberger, Mulvaney, Schlundt, & Rothman, 2008). Furthermore, it was found that the obese and overweight adolescents who had an accurate perception of weight were more likely to participate in weight-related behavior modification (Bittner Fagan,

Diamond, Myers, & Gill, 2008). A Portuguese study found incorrect perceptions of the need to diet, poorer self-perceived health status in the children with overweight (Fonseca & Gaspar de Matos, 2005). However, one problem is whether parents could correctly classify the weight status of their children. Another problem is whether parents of overweight adolescents who recognize their children's weight problem are more likely to help their children control weight.

Unfortunately, most studies showed that parents always regarded their children' weight as less severe than it actually was (Skinner, et al., 2008). It was reported that nearly one third of mothers misperceive their overweight children as being lower than their actual weight status (Maynard, Galuska, Blanck, & Serdula, 2003). A qualitative study revealed parents had a distorted view of clinically defined overweight preschoolers, and many of them did not regard overweight and obesity as health problems (Suzanne Goodell, Pierce, Bravo, & Ferris, 2008).It is also found that nearly all of the obese mothers classify themselves as overweight, but most of these mothers did not regard their overweight children as overweight. The study also revealed that mothers with less education were more likely to have misperception on their children's weight status (Baughcum, Chamberlin, Deeks, Powers, & Whitaker, 2000). Another study also suggested that few parents of overweight or "at risk of overweight" children classified their child as overweight or were worried about their child's overweight problem (Eckstein, et al., 2006).

Therefore, the development of obesity prevention strategies and weight management

programs may need to consider the issue of parental misperception of child's weight status. Moreover, some studies had suggested that the parents and children, who underestimated the children 's weight, were more likely to have poorer diet behaviors and more obstacles for the adoption of healthy diet and physical activity behaviors (Skinner, et al., 2008). A study had examined the psychological effects feedback to parents. During this study, the height and weight of children aged 6–11 years in London schools were tested, and parents were informed their child's weight status. Health behavior modification information was collected 6 weeks before and 4 weeks after the feedback which showed that feedback did not influence feeding behaviors in parents of healthy-weight children, but the application of food restriction strategies was increased among parents of overweight girls (Grimmett, Croker, Carnell, & Wardle, 2008). However, another cross sectional study showed that accurate perception of child weight status may not lead to helpful behaviors but may cause unhealthy behaviors such as pressure to diet (Neumark-Sztainer, Wall, Story, & van den Berg, 2008). One of the possible reasons for these conflicting results in different studies could be the different research designs, especially in the intervention design. Additional randomized, controlled intervention studies were still needed to determine whether in kind of interventions were effective or not in children's weight management.

2.3.2 Parental belief and knowledge of nutrition and exercise

Four categories of factors were found to influence food consumption: consumer's income, food prices and prices of other products and service, consumer's tastes & preference, and consumer's beliefs and knowledge of health and nutrition (Variyam & Blaylock, 1998).

Therefore, it was believed that the parents with good nutrition knowledge were more likely to choose healthy food for their children. A survey from England showed that the subjects in the highest quintile for knowledge were almost 25 times more likely to meet the diet recommendations than those in the lowest quintile (Wardle, Parmenter, & Waller, 2000). In another study, mothers' nutritional knowledge and health- and diet-related beliefs were found to be an important predictors of children's fruit intake (Gibson, Wardle, & Watts, 1998), fiber intakes and lower fat intakes (Variyam, Blaylock, Lin, Ralston, & Smallwood, 1999). In addition, mothers' awareness of diet and health relationships were also found to be associated with their teen children's dairy consumption, although mothers' health awareness did not influence preschool children and primary school children's dairy product consumption (Kim & Douthitt, 2003). The inconsistent results found in these findings suggested that nutrition knowledge may play a small but important role in the adoption of healthy dietary habits (Worsley, 2002).

Increasing children and adolescents sports and physical activity participation is one of the main objectives of childhood obesity prevention. Some studies had proved that exercise knowledge was one of the predictors for physical activity in both adults (Hagger, Chatzisarantis, & Biddle, 2002) and children (Trost, et al., 1997). For instance, the results of a longitudinal study suggested that prior knowledge predicted subsequent exercise behavior (Rimal, 2001). Another study also found that physical activity level could be associated with the knowledge of appropriate exercise intensity to keep health, the belief exercise adherence (Fitgerald, Singleton, Neale, Prasad, & Hess, 1994). Therefore, parents' beliefs and knowledge on exercise could be indirect predictors of their children's

physical activity. For example, it was found that parents who paid great attention to their children's physical activity were more likely to give their backing to their children's physical activity by, for instance, transporting them to sporting events et al. (Trost, et al., 2003). However, there was still study indicated that children's perceptions of their parents' beliefs were not associated with children's physical activity level (Kimiecik, Horn, & Shurin, 1996). Another study also indicated that knowledge and attitudinal factors had far low correlation to obesity than activity-related behavioral factors (Gordon-Larsen, 2001). Nevertheless, the results of most studies support including knowledge and beliefs in nutrition and exercise as one of the components for parents in childhood obesity prevention.

2.3.3 Chinese tradition and parental perceptional, beliefs and knowledge

Parental perceptional, beliefs and knowledge could be associated with cultural values. There are research evidences of ethnic and cultural difference in levels of body weight dissatisfaction and dieting behaviors (Altabe, 1998; Gluck & Geliebter, 2002). In China, some Chinese traditional ideas on obesity and poor knowledge on nutrition and physical activity maybe associated with the increase prevalence of childhood obesity. For example, in Chinese tradition culture, obese children are always regarded as healthy children, and good appetite is always associated with health (Y. N. Li, 2008). A study based on 140 obese children showed that 36% fathers and 28% mothers did not realized that their children were obese, and some parents even regard obesity as a characteristic of good health (Xiao, Yang, & He, 2001). A survey on Chinese parents' knowledge on obesity showed that the parents of obese children got lower scores in the obesity knowledge test,

when compared with the parents of normal weight children (J. G. Wang, Cui, Su, & Wang, 2007). Another intervention study was conducted to improve parental perception and knowledge on obesity. The data of questionnaire survey before and after intervention showed that parental knowledge on diet could be improved by intervention (Lv & Tian, 2007). One limitation for these studies was the sources or the procedure of questionnaire development was not clearly introduced. The reliability and validity of the questionnaires were not provided as well. Nevertheless, these studies still suggested that parental perception, belief and knowledge on obesity could be associated with childhood obesity in Chinese.

China is famous for her refined art of the cooking skills in Chinese food preparation. However, in China, most people care about the color, fragrance, flavor and shape of food, but relatively less attention is paid to the nutrient component of food. Therefore, in Chinese family, it always the flavor of food rather than the nutrition or contained calories concerns parents (Y. N. Li, 2008). In addition, many Chinese adults had an unforgettable poverty experience in their childhood, which increase their motivation to feed their children with abundant food. In a qualitative study, some Chinese reported that they experienced extreme hunger and destitution, and this miserable experience made them to always worry that their children may not have enough food intake, and tend to provide young children with excessive food (Jiang, et al., 2007)

In Chinese tradition, children's academic performance at school is always a primary concern for Chinese parents. It is also noteworthy that education is one of the most

important ways of personal advancement in mainland China (Xiang, Lee, & Solmon, 1997). Therefore, any activities (including physical activities or sports activities) that may negatively influence children's academic performance, maybe not supported by their parents. For instance, a study investigated the students and their parents in middle school track and field teams. The results showed that, although most parents believed exercise was good for children's health, most parents still did not support their children to participate in school team training, because the training would take up a lot of children's time and may adverse affect children's academic performance (C. L. Li & Li, 2005). Another study in Hong Kong also suggested that concepts associated with the intersection of Confucianism and postcolonialism will help to interpret the relatively subordinate place of physical activity in the lives of Hong Kong families (Ha, Macdonald, & Pang, accepted).

In summary, only a few studies investigated the parental perception, beliefs and knowledge on obesity, diet and exercise in Chinese. The results of these studies suggested that parental perception, beliefs and knowledge on obesity, diet and exercise could be related to Chinese tradition culture.

2. 4 Parenting behavior

2.4.1 Parenting behavior and children's food intake

2.4.1.1 Parental feeding behavior and children's food intake

Children's diet, which is one of the most important environmental factors in the etiology of childhood obesity (Birch & Fisher, 1998), could be influenced by parents, friends,

school, the media and their own taste and preference (Golan & Crow, 2004a; Lindsay, et al., 2006). A prominent parental influence on children's eating may be parents' feeding behaviors, which include restriction of food, pressure to eat, using food as a reward and other behaviors. Parental feeding behavior may influence the development of children's eating habits and food preference, their ability to regulate energy intake, and ultimately their weight status (Nguyen, Larson, Johnson, & Goran, 1996). A comprehensive literature review examined 22 studies on the association between parental feeding strategies, child's energy intake and weight status (Faith, Scanlon, et al., 2004). The results showed that, although study methodologies and results could be different, nineteen studies (86%) reported at least one significant association between parental feeding behaviors and child's weight status.

Restricting Access to Food

One of the frequently used parental feeding behaviors toward childhood obesity is restriction of portion sizes or unhealthy food eaten. Parents who use this type of feeding behaviors may believe what they are doing is good for their child's health. However, this assumption was not approved by the data found in recent research. A observational study was taken to determine the effects of restricting access to a palatable food on children's food choice. It was found that compared with a similar snack food that was not restricted, children showed more interest to a restricted snack food after a 5-week period of restriction (Fisher & Birch, 1999b). The results based on a longitudinal study also showed that the girls' dietary habit of eating snack foods in the absence of hunger could be predicted by parents' reports of restricting their daughter's access to foods (Fisher &

Birch, 2002). Another longitudinal study also demonstrated that parents' restriction feeding strategies at age 5 predicted higher BMI at age 7, even when BMI at age 3 was adjusted for (Faith, Berkowitz, et al., 2004).

Possible mechanisms were proposed by several researchers to explain the association between parents' restriction feeding strategy and children's weight status. Restricting access may focus children's attention on restricted foods, while increasing their desire to get and eat those foods (Fisher & Birch, 1999b). Therefore, parents' restriction feeding strategy may decrease the intake of unhealthy food and total calories of a meal. However, children may try to obtain and consume the restricted food when they are out of parental control. An observational study supported this hypothesis (Klesges, Stein, Eck, Isbell, & Klesges, 1991). It was found that, when children were allowed to freely select foods from dozens of foods, they chose a large amount of unhealthy food of which nearly 25% of all kilocalories are in the form of added sugar. However, when they were informed that parent would be monitoring the meal they chose, children modified their food choices by decreasing their food selection or by selecting fewer unhealthy foods.

As considerable evidences for negative effects of restriction feeding strategy were provided, this feeding behavior should not be recommended for parents. Recent research recommended that information and guidance on feeding strategies and skills should be given to parents, particularly for the ones who cared about their child's weight (Clark, Goyder, Bissell, Blank, & Peters, 2007).

Pressure to eat

Another feeding behavior parents usually use is pressure to eat (prompting to eat or encouragement to eat), which means encourage children finish all the foods on their plate or force them to eat healthy food. Some studies had showed that this kind of feeding strategy may increase children's fruit and vegetable intake (Bourcier, Bowen, Meischke, & Moinpour, 2003). However, a study indicated that parents' "pressure to eat" strategy could be negatively related to children's total fat mass (Spruijt-Metz, Lindquist, Birch, Fisher, & Goran, 2002). Another study based the college students' memory showed that "pressure to eat" feeding strategy could lead to children's long-lasting negative feeling towards to that food (Batsell, Brown, Ansfield, & Paschall, 2002).

Further examination of the child's response to the feeding behavior of pressure to eat, may help us further understand the influence of "pressure to eat" on child weight status. It was found out that, young children of obese mothers were found to be more likely to use the strategy of "pressure to eat", especially for novel food, while children of nonobese mothers were not (Lumeng & Burke, 2006). Interestingly, the study also revealed that in the same study obese mothers also prompted their child more often when the food was novel than when it was familiar.

In general, the variability in these studies suggested that the relationship between "pressue to eat" and child's BMI may be more complicated than it appears. Encouraging or forcing children to eat some kind of food may increase this kind of food intake. However, in the long run, this strategy may lead to children's long-lasting negative

feelings toward this food.

Use food as rewards

Using food to shape children's behaviors is also a common applied parental feeding behavior. An survey on the child-feeding practices of low-income mothers showed that, besides using food to provide energy and nutrient to their children, food was also frequently applied to promote good behaviors (Baughcum, Burklow, Deeks, Powers, & Whitaker, 1998). It was believed that, this kind of feeding behavior to promote good behaviors unassociated with hunger could disarrange children's ability to perceive their normal hunger and satiety cues. An experimental study indicated that presenting food as reward enhanced preference for that food (Birch, Zimmerman, & Hind, 1980). This sort of parenting behavior, if applied continuously, may cause long term adverse effects on a child's ability to self-regulate energy intake and lead to an increased reliance on external cues to determine how much to eat (Rhee, 2008).

There are several issues should be noticed in the studies on parenting behaviors and children's dietary habits. Firstly, several studies had revealed that the relationship between parental feeding behaviors and child's weight status is likely to be bi-directional, but cross-sectional studies could not determine the cause and effects relationship (Clark, et al., 2007; Faith, Berkowitz, et al., 2004). For instance, parents may use restrict child access to unhealthy food, if the child are overweight. However, parents may not use this restriction strategy if their child is lean. It could be one of the possible reasons why association between parental feeding styles and children's weight status can not be found

in some cross-sectional studies (Baughcum, et al., 1998; Saelens, Ernst, & Epstein, 2000).

Another factor that may influence the parental feeding behavior is socioeconomic status. In a qualitative study, some feeding beliefs and behaviors that may be associated with childhood obesity were found in some mothers with low SES (Baughcum, et al., 1998). For instance, they were found to be more likely to use food to shape their children's behaviors. Another study also showed that mothers with low education levels were more likely to use "pressure to eat" strategy (Lumeng & Burke, 2006). Therefore, the results of these studies indicated that more studies are needed to identify interventions that are effective across different socioeconomic groups or design different programs for different groups.

In summary, various parental feeding behaviors were found to be involved in the etiology of childhood obesity. It was recommended that parent should let children to grow in the nature way, in which parents are responsible for the what, when and where of feeding, while children are responsible for the how much and whether of eating (Satter, 2004).

2.4.1.2 Parental modeling and children's food intake

Another parenting behavior to promote healthy dietary habits in children is through role modeling or observational learning. A recent study in a laboratory setting indicated that children had higher odds to eat new food if others were eating the same kind of food than when others were only present or eating another kind of food (Addessi, Galloway, Visalberghi, & Birch, 2005). Therefore, it was hypothesized that, by eating and drinking

healthy foods and showing their child that they enjoy it, parents may influence their children's dietary intake (Golan & Crow, 2004a; Lindsay, et al., 2006). Some studies proved this hypothesis. A statistically significant but modest correlation coefficient ($r < 0.50$) was found between parents' and children's intakes of many types of foods (Oliveria, et al., 1992). The frequency with which parents model healthful dietary behaviors were also found to have long-term influence on development of childhood eating habits (Tibbs, et al., 2001). In addition, another study demonstrated that parents' own fruit and vegetable intake may promote their daughters' fruit and vegetable intake, leading to higher micronutrient intakes and lower dietary fat intakes (Fisher, et al., 2002). When adolescents get older, they may also get increasingly support from their friends. However, it was found that families still play a continued key role in providing support to adolescents in the African-American families (Wilson & Ampey-Thornhill, 2001).Through these studies, it is clear that parents can indirectly mold their child behaviors through role modeling. Therefore, adoption of healthy behaviors is strongly recommended for parents in children obesity prevention.

2.4.2 Parenting behavior and children's physical activity level

Current guideline for children recommended at least 60 minutes of physical activity on most, preferably all, days of the week, however, currently most of the children can not meet the recommendation for 60 minutes of daily physical activity (Nicklas, Hayes, & American Dietetic Association, 2008). Sport or physical activity participation is a very complex behavior which could be influenced by many factors. Schools have been regarded to play a central role in the promoting physical activity in children and

adolescents (Pate, et al., 2006). However, it is parent determined whether or not children could walk to school, how far they were allowed to cycle, and facilitated attendance at out-of-school activities such as dancing and swimming. Therefore, parents also play key roles in children's physical activity participation (Mulvihill, Rivers, & Aggleton, 2000).

Parent could support their children to do physical activity in many forms. It could be in the form of payment of sportswear or sports shoes, driving children to playground, encouraging children to do physical activity or frequently doing exercise as a model (Prochaska, et al., 2002). Research on parental influences helps determine several dimensions of parenting behaviors that could be important: acceptance and social support; role modeling; expressing expectations; reinforcing behavior by rewarding and punishing; controlling behavior and giving detailed instructions (Woolger & Power, 1993).

2.4.2.1 Modeling

One of the most important parental behaviors influencing children's physical activity level could be role modeling. The data from Framingham Children's Study showed that children of active parents had significant higher odds ratio for being physically active when compared with the children of inactive parents. Moreover, when both parents were active, the children were 5.8 times as likely to be active as children of two inactive parents (Moore, et al., 1991). A survey in Norway also showed that adolescents' sport participation is influenced by their family members' and peers' sport participation, and part of the explanation for participation was based on the adolescent's relationship with physically active family members (Skille, 2005). These studies suggested that the one of

the possible reasons for the association between parents' and child's physical activity levels could be parental role modeling. A recent qualitative study also suggested that parental role modeling was one of the most important factors to consider in designing programs for physical activity promotion among adolescents (Wright, Wilson, Griffin, & Evans, 2008). In general, these studies had clearly demonstrated that child's physical activity level could be influenced through parental modeling.

2.4.2.2 Parent support

Several reviews had summarized the studies on parental support and child's physical activity (Sallis, Prochaska, & Taylor, 2000; van der Horst, Paw, Twisk, & Van Mechelen, 2007). Unfortunately, the findings are still inconclusive. For example, some research had found that the children with more parental support for sports participation were more active (O'Loughlin, Paradis, Kishchuk, Barnett, & Renaud, 1999). Adolescents who received parental encouragement to exercise had significantly more physically active days in a week than did their counterparts (King, Tergerson, & Wilson, 2008). However, it was also found that parent support was not a significantly associated with objectively measured physical activity level (Sallis, Taylor, Dowda, Freedson, & Pate, 2002). It was reported that parent's reported support maybe related to girl's physical activity, although the correlation was not statistically significant ($r = 0.26$, $p < 0.06$). However, it was found that the girl's reported of their parent's support for physical activity was not associated with girl's activity levels (Adkins, Sherwood, Story, & Davis, 2004). Another study based on self-reported and accelerometer measured adolescents' physical activity level showed that parent support significantly correlated with adolescent self-reported physical

activities. But the researchers failed to find significant association between parent support and adolescent's physical activity level measured by accelerometers (Prochaska, et al., 2002).

In summary, there are considerable inconsistent results in the studies on the association between parent support and children's physical activity level. Some possible explanations for this inconsistency could be the difference in the methods measuring physical activity, sample characteristics and statistical analysis (van der Horst, Paw, et al., 2007). For example, physical activity level was determined by different questionnaires and objective measures (such as accelerometer or pedometer). Some studies recruited the children with overweight or at risk of overweight, whereas populations of normal weight children were included in other studies. Therefore, additional studies are still needed to determine the relationship between parent support and children's physical activity level.

2.4.3 Parenting behaviors and childhood obesity in China

The research from western countries had proved the association between parenting behaviors and childhood obesity. Given that the social structure and tradition culture in China is different from western countries, it is plausible that the parenting behaviors in Chinese parents such as feeding behaviors and parental support to children's physical activity may be different.

"Pressure to eat" was reported to be one of the most common feeding strategies used by parents from western countries (Bourcier, et al., 2003; Spruijt-Metz, et al., 2002). The

research indicated that this kind of feeding strategy was also frequently applied in Chinese parents. However, most Chinese parents just choose to remind rather than force their children to eat food. It was reported that 56.0% parents often reminded their children to eat some food they regarded as healthy food, and 7.7% parents often forced their children to eat these food (W. J. Ma, Du, Lin, Ren, & Ma, 2001). One parenting behavior that rarely reported in American or European parents but very common in China could be "criticize children at dinner". It was found that 14.8% and 27.5% of parents often or sometimes criticized their children at dinner, respectively, which could cause 5.9% children could not eat anything during the dinner (W. J. Ma, et al., 2001). A cross sectional study based on 930 families with 2- to 6-year-old children in Beijing also revealed a strong relation between parents' and children's dietary habits, TV watching and physical activity (Jiang, et al., 2006).

Research in China also showed that parents may influence children's physical activity through role modeling and providing financial or emotional support (C. Sun, Zhang, Niu, & Ma, 2008). For example, a cross sectional study on 1,614 middle school students in Hefei showed that the children of active parents were more likely to be physically active (Y. H. Sun, Be, & Ni, 1994). Another study from 104 parents of overweight children in Hong Kong had showed that parental influence, especially father's role modeling, was significantly related to overweight Chinese children's physical activity participation (Lau, et al., 2007).

Although some meaningful studies has been taken to investigate the influence of

parenting behaviors on childhood obesity in China, there are still several limitations in these studies that needed to be acknowledged. For example, as parenting behaviors may be influenced by cultural factors, Chinese parents could have some unique parenting behaviors with Chinese characteristics. For instance, parents always like to add some dishes to their children to express their love to children. This feeding strategy could influence children's own capability to regulate calories intake. However, the relationship between these traditional Chinese parenting behaviors and children's weight status was not well reported. No significant differences were found in the parenting behaviors in Chinese parents and western parents. Nevertheless, these Chinese studies still successfully demonstrated that the parenting behaviors could be associated with Chinese children's weight status.

2.5 Parenting style

Parenting behaviors or practices is regarded as what parents do, while parenting style is thought of how parents do it. Parenting style is defined as "the general pattern of parenting that provides the emotional background in which parent behaviors are expressed and interpreted by the child" (Rhee, 2008). Therefore, parenting style may not only influence parents' feeding strategies and behaviors towards children's physical activity, but may also influence children's daily activities, eating habits, emotional functioning, and ultimately the risk for overweight. Intervention that attaches importance to both parenting style and parenting behaviors could be more effective in childhood obesity prevention than present treatments only concentrated on parenting behaviors (Rhee, et al., 2006).

2.5.1 The construct of parenting style

The most widely used typology was originally established by Baumrind, in which parenting styles were conceptualized based on the amount and quality of two underlying dimensions: demandingness and responsiveness (Baumrind, 1971). According to these two dimensions, parenting could be categorized into four main styles: (1) the authoritative style (high demandingness/high responsiveness) (2) the authoritarian style (high demandingness/low responsiveness); (3) the indulgent/permissive style (low demandingness/high responsiveness) and (4) the uninvolved/neglectful style (low demandingness/low responsiveness) (Darling & Steinberg, 1993).

2.5.2 The influence of parenting style on children

The authoritative parenting style is considered to be the best parenting style and was reported to be associated with improved child outcomes. In contrast, the other three parenting style do not satisfy child's developmental needs, and therefore has been associated with poorer outcomes among children. For example, it was reported that parenting styles may influence adolescents' academic achievement and performance (Aunola, Stattin, & Nurmi, 2000). It was also found that authoritative parents were found to be successful in keeping their children from problem drug use (Baumrind, 1991).

Some studies had also reported the association between the parenting style and child's weight status. Data based on 4,983 4- to 5-year-old children in the first wave of the

nationally representative Longitudinal Study of Australian Children showed that, children of fathers with permissive and uninvolved parents had higher odds of being in a higher BMI category when compared with the children of authoritative fathers (Wake, Nicholson, Hardy, & Smith, 2007). Another study found that, compared with children of authoritative mothers, children raised by authoritarian, permissive and neglectful mothers had an significant increased odds of being overweight (Rhee, et al., 2006). A survey from Latino parents and their children suggested the association between children's healthy eating & physical activity and parental use of positive reinforcement & monitoring. It was also found out that appropriate disciplining styles application in parents was associated with healthy diet, while parental use of control styles was related to unhealthy diet (Arredondo, et al., 2006).

2.5.3 Chinese parenting style and childhood obesity

As the theories and models for parenting were developed based on the sample of White Europeans and Americans, an important research question "is the influence of parenting style different in different culture contexts?" was raised by several researchers. Chao believed that the concepts of authoritative and authoritarian were a little bit ethnocentric and do not capture the important characteristics of Chinese parenting style. He also the first researcher to use the Chinese term "guan" which probably as "training" , "to govern" , "to care for" in a international parenting literature (Chao, 1994). In China, Confucianism was the most important part in traditional Chinese education during the past 2,000 years. Although, during the past 3 decades, Chinese society has been greatly influenced by the culture from western countries, many Chinese's beliefs, behaviors and

parenting style were still influenced by both Confucianism (Holroyd, 2003; P. Wu, et al., 2002; Xu, et al., 2005). Chinese parenting was often considered as "restrictive", "controlling" and "authoritarian" (Lin & Fu, 1990; Steinberg, et al., 1992). In fact, Confucian tradition accords family relationships with special significance. In a traditional Chinese family, sons or daughters should be loyal to and respect to their parents (Bond & Hwang, 1986). Research indicated that, Americans value "nurturing innate ability", but Chinese attach importance to high self-discipline, obedience to parents, high parental involvement and sacrifice, which are deeply rooted in the Chinese traditional culture (Chao, 1994; F. M. Chen & Luster, 2002).

Chinese parenting style influenced by Confucianism had been reported to be associated with children's social and school performance (X. Y. Chen, Dong, & Zhou, 1997; Nelson, et al., 2006) as well as child temperament (Porter, et al., 2005). However, only a few studies investigated the association between the Chinese parenting behaviors, parenting style and their children's weight status. For example, A cross-sectional study based on 163 Chinese children (aged 8 to 10 years) and their mothers indicated a positive relationship between democratic parenting and the children's BMI (J. L. Chen & Kennedy, 2004). Another study in Hong Kong found that parental influence, especially father's role modeling, could significantly influence overweight Chinese children's attraction to physical activity (Lau, et al., 2007).

On the other hand, the implementation of the single-child family planning program in the 1970s in mainland China may not only leaded to a great decrease in Chinese's natural

growth rate of population (Jing, 1994), but could also modify millions of Chinese's parenting behaviors and parenting style. During the past 3 decades, as there is only one child in most Chinese family, many children could be spoiled by their parents and other family members. On the other hand, Chinese had also been exposed and influenced by western culture during the past 30 years, Therefore, Chinese parenting style rooted in traditional Chinese culture could be different now. In addition, in Chinese culture, mothers and fathers could play different roles and may have different parenting styles. Chinese mothers are always described as "Ci" (kind), while Chinese fathers are always regarded as "Yan" (strict) (Berndt, et al., 1993). However, little is known whether the influence of maternal parenting style and paternal parenting style on children's weight status is different and further studies are still needed to explore the relationship between Chinese parenting style and childhood obesity.

In general, during the past 3 decades, Chinese parenting style were influenced by tradition Chinese culture as well as the western culture. Although the differences between parenting styles in China and United States were reported, the theory of Chinese parenting style is still not well established. In addition, the theory of parenting established based on American parents (Baumrind, 1971) was still widely applied in the studies on Chinese parents' parenting (X. Y. Chen, et al., 1997; Pong, Johnston, & Chen, 2009; Porter, et al., 2005), which indicated that the theory still could be used to solve many research problems in Chinese parents.

2.6 Home environment

2.6.1 Food availability and accessibility

Parents may also influence children's weight by changing home environment. An animal experimental study showed that the rats provided with five bottles of food and one bottle of water became fatter than the rats given five bottles of water and one of food, which indicated that the changes in food availability rather than physiological mechanisms maybe responsible for the unhealthy food intake and weight problem (Tordoff, 2002). Therefore, it also suggested that the issue of food availability at home should be included in childhood obesity interventions.

Recent studies indicated that availability and accessibility as one of the most important determinants for fruit and vegetables consumption in children (Blanchette & Brug, 2005). For example, several cross sectional studies had shown that home availability of fruits and vegetables could predict fruit and vegetable consumption in school aged children and adolescents (Cullen, et al., 2003; Neumark-Sztainer, Wall, Perry, & Story, 2003). On the other hand, lack of nutritionally adequate and safe foods may increase risk for obesity and health problems (Adams, Grummer-Strawn, & Chavez, 2003). Another longitudinal study also suggested that home availability of fruits and vegetables was a very important predictor of fruit and vegetable intake (Larson, et al., 2007). In addition, not only food availability but also food accessibility is important for children's food consumption. For instance, it was found out that children were more likely to eat carrots if they were cut up into small pieces and placed in the place within children's reach (Hearn, et al., 1998). Therefore, to promote children's healthy food consumption, parents are advised to make

healthy foods available and accessible in the home.

As it had proved that fast food availability may contribute to increasing obesity prevalence (Jeffery & French, 1998), besides providing access to healthy foods, parents may also need to control their children's unhealthy foods intake through limiting the availability of such foods at home. Although it was reported that restricting access may arouse children's attention on restricted foods, and increase children's desire to eat those foods (Fisher & Birch, 1999b), most successful behavioral programs to weight loss still include stimulus control techniques that involve limiting the availability of unhealthy foods at home (Young, Northern, Lister, Drummond, & O'Brien, 2007). Therefore, in spite of the negative effects, unhealthy food control is still suggested for parents (Hughes, et al., 2008).

2.6.2 Home and neighborhood environment for physical activity

2.6.2.1 Exercise equipment accessibility

Parents could promote children's physical activity in various ways. Research showed that adolescents' exercise equipment availability at home were positively associated with their physical activity level (Dunton, Jamner, & Cooper, 2003). It was also found that the physical activity participation among adolescent girls could be promoted by their perception of equipment that is accessible at home (Motl, Dishman, Saunders, Dowda, & Pate, 2007). However, the data of another study showed that girls' access to sporting equipment at home was not significantly correlated to objectively measured moderate intensity physical activity (Trost, Pate, Ward, Saunders, & Riner, 1999). It also reported

that equipment accessibility showed a statistically significant cross-sectional, but not longitudinal, direct influence on physical activity (Motl, et al., 2005). In general, although exercise equipment accessibility may not be a major determinant for childhood obesity prevention, it was suggested that the exercise equipment accessibility should be considered in the development of interventions to prevent childhood obesity.

2.6.2.2. Home and neighborhood environment for physical activity

Research on the influence of the physical environment on obesity suggested that residents from communities with higher density, greater connectivity, and more land use mix were more likely to be physical active (walking/cycling) than the residents in low-density, poorly connected, and single land communities (Saelens, Sallis, Black, & Chen, 2003). In addition, proximity to play space or recreational facilities, sidewalk availability, fast-food proximity and number of food stores et al. had also been thought to the determinants of the development of obesity (Papas, et al., 2007). However, most of these studies were based on adults. In the recent 10 years, the effects of built environment on childhood obesity also received some attention. For instance, playgrounds were reported to promote children's moderate to vigorous physical activity especially for girls (Zask, van Beurden, Barnett, Brooks, & Dietrich, 2001). It was also found that residents of low walkability neighborhoods had higher BMI and were more likely to have overweight problems than the residents of high-walkability neighborhoods (Saelens, et al., 2003). In addition, research on Chinese showed that adolescents living in neighborhoods without sidewalks had significant higher odds to be physically inactive (M. Li, Dibley, Sibbritt, & Yan, 2006). However, the data another study showed that overweight was not related to

proximity to sports fields and fast food restaurants or the neighborhood crime level (Burdette & Whitaker, 2004).

Neighborhood safety is another important factor that may influence parents' decision on children's physical activity. Many children complained that, because of the safety issue (crossing busy roads etc.), they were not allowed by parents to cycle or play out far from their home (Mulvihill, et al., 2000). One study had examined the determinants considered in parents' decisions about the selection of play spaces for their children (Sallis, McKenzie, Elder, Broyles, & Nader, 1997). The results showed that safety is one of the most important factors that parents would consider. However, in a cross-sectional survey in 20 large US cities, mothers' perception of neighborhood safety was related to their children's screen time but not be associated with their children's time spent in outdoor play or risk for obesity (Burdette & Whitaker, 2005). Another study also revealed that perceived neighborhood safety was not direct or indirect associated with self-reported physical activity (Motl, et al., 2007).

In general, although there were several studies indicated that physical environment maybe not significantly associated with physical activity, most research findings supported the importance of the home and neighborhood environments for children's physical activity promotion (Franzini, et al., 2009).

2.7 Other related factors

2.7.1 Child's age and sensitive periods

As sensitive periods for development of childhood obesity may provide windows of opportunities prevention and treatment of obesity, it is very important to find the sensitive periods for influence of parents on childhood obesity. It was believed that the stage of cognitive development in children could be the most effective period for the behavior modification in childhood obesity prevention. Several potential critical or sensitive periods for development of childhood obesity was determined (Dietz, 1994).

Mother's pregnancy could be one of the sensitive periods for intervention. It was found that infants exposed to acute malnutrition in early pregnancy are more likely to have overweight problem in later life (Strauss, 1997). The research based on animal model also suggested that the control of energy utilization during early post-weaning period could be determined by the nutrient availability during the first 2 wk of intrauterine life (Anguita, Sigulem, & Sawaya, 1993). In addition, maternal smoking during pregnancy might be a risk factor for childhood obesity (Toschke, Montgomery, Pfeiffer, & von Kries, 2003; Von Kries, Toschke, Koletzko, & Slikker, 2002). Maternal diabetes during pregnancy was also found to be associated with childhood obesity (Dabelea, et al., 2008). Therefore, one of the key strategies for mother in childhood obesity prevention is to quit smoking and prevent diabetes during pregnancy. Although intrauterine factors may not make an important contribution to the children's BMI (Smith, et al., 2007), pregnancy still a sensitive period for the development of childhood obesity.

Infancy, when children are establishing the foundation for eating habits and nutritional adequacy for a life time (Westenhoefer, 2002), is another sensitive period that parents need to pay attention to childhood obesity development. In this period, most research concentrated on whether breastfeeding is related to childhood obesity. For instance, it was indicated that breastfeeding may protect against obesity if maintained for ≥6 month (Toschke, et al., 2007). A cross-sectional study in German also found breastfeeding as a significant protective factor against the development of obesity (Von Kries, et al., 1999). One possible mechanism for protective effects of breastfeeding is that the breastfeeding helps infants learn how to regulate their energy intake than bottle-feeding does (Lindsay, et al., 2006). However, a longitudinal study based on 1958 "British Birth Cohort" (n = 12,857) found no relationship between breast feeding and BMI in childhood (Parsons, Power, & Manor, 2003). This study also showed that breastfeeding was protective against increased BMI in adults, but this influence disappear and no longer significant after confounding factors (parental weight status, socioeconomic status etc.) were controlled. In addition, a recent study did not support the association between breastfeeding promotion intervention and reduced childhood obesity as well (Kramer, et al., 2008). Although inconsistent results were found on the influence of breastfeeding on childhood obesity, it is still recommended that exclusive breastfeeding (breast milk only, with no water, other fluids, or solids) for six months, with supplemental breast feeding continuing for at least two years (Hoddinott, Tappin, & Wright, 2008).

Early childhood, when the physical activity and dietary patterns become more like adults' and dietary and physical activity habits are gradually established, could also be one of the important sensitive periods for the influence of parents on childhood obesity. Although

the early learning is influenced by children's genetic predispositions (Birch & Fisher, 1998), subsequent learning could be more important in the development of children's food choice (Westenhoefer, 2002). Therefore, parents could play a key role in their children's learning process (the influence of parents' belief, knowledge, behavior and parenting style on childhood obesity was reviewed above). However, the influence of parents on childhood obesity may decrease when children grow up. For instance, it was reported that parental obesity significantly increased the risk of adult obesity among both obese and nonobese children under 10 years of age. But among older children, weight status in childhood becomes an increasingly important predictor of adult obesity, no matter the parents are obese or not (Whitaker, et al., 1997). Another study also suggested that obese 3-9 years olds children with obese parents may be ideal candidates for treatment, because the parents still have the chance to mold and shape their children's behaviors in their early childhood (Epstein, et al., 1990). However, after 10 years of age, parental influence has a significantly less influence on a child's risk of future weight problem.

2.7.2 Socioeconomic status

Family socioeconomic status (SES), which is normally determined by children's parents' income, education and occupations, could be another factor modifying the influence of parents on childhood obesity. It was also not hard to imagine that parents with low SES were less likely to buy fresh fruits and vegetable, exercise equipments & sports wear with good quality, and less likely to provide safe and high-walkability neighborhood for their children. In fact, it is widely accepted that, SES is one of the factors influencing

childhood obesity, although the relationship between obesity and SES could be different in developed and developing countries. For instance, in the United States, it was reported that adolescents in the high SES group had lower odds to be obesity and overweight. In contrast, adolescents in low SES groups in China were found to have a lower odds to be obesity and overweight (Y. Wang, 2001). The present studies suggested that, in developed countries, low-SES groups were more likely to be obese than their high-SES counterparts, whereas low-SES groups had lower risk than high-SES groups in developing countries (McLaren, 2007; Y. Wang, 2001). In addition, the relation between SES and childhood obesity also differed by race/ethnicity (Whitaker & Orzol, 2006). Recent findings indicated that the reverse association (high-SES groups had low odds for overweight than are their low-SES counterparts) only existed in white children, not in black children and adolescents (Y. Wang & Zhang, 2006). However, most studies on SES were cross-sectional, and may not be able to demonstrate the long term relationship between SES and obesity risk. Several longitudinal studies of SES and weight change over time were reported only among adults in developed societies (Ball & Crawford, 2005b). More longitudinal studies among children especially in developing countries were still needed. In general, it seems that childhood obesity may influenced by SES, but the relationship between SES and obesity varies across countries and ethnicity.

However, few of studies investigated the mechanisms that may explain the relations.The mechanisms by which SES are associated with obesity are still not clear. A number of potential mechanisms were suggested by several studies. For instance, the low prevalence of obesity in lower SES groups in developing societies was believed to be due to food

insufficiency, perhaps together with high energy expenditure during manual work. In developing countries, a greater prevalence of obesity in individuals of higher SES could be due to their adequate food supplies, and maybe coupled with different cultural belief toward body shapes (Sobal & Stunkard, 1989). For developed countries, some researchers attempted to explain the effects of SES on obesity by investigating the role of behaviors. The summarized potential mediators may include low SES parents' poorer knowledge on physical activity and nutrition, poorer behavioral skills, differing social norms related to obesity and poorer access to healthy foods among lower SES areas et al. (Ball & Crawford, 2005b). For example, it was found significant differences in nutrition knowledge between socio-demographic groups, and knowledge was found to decline with lower educational level and socio-economic status (Parmenter, Waller, & Wardle, 2000). Another study showed that SES was inversely associated with calories intake; and positively related to weight concern and perceived social support for healthy diet and physical activity (Jeffery & French, 1996). A theoretical model was proposed to explain socio-cultural variations in food intake, exercise, and ultimately weight status (Ball & Crawford, 2005a). However, research also indicated that SES differences in these behaviors may not adequately explain SES differences in BMI (Ball, Mishra, & Crawford, 2003). It appears that additional studies are still needed to elucidate the possible mechanism for the association between SES and childhood obesity.

2.8. Intervention

Many studies had demonstrated the importance of parents' involvement in weight loss programs, and therefore, parents' participation and support were highlighted in childhood

obesity prevention (Barlow & the Expert Committee, 2007). Some experts even pointed out that if one or both parents are not involved in the intervention, the treatment is not likely to success (Dietz & Robinson, 2005).

School-based, family based, and community based intervention are the most common programs for childhood obesity. In many of studies, intervention through parents was only a part of a more comprehensive program (Lindsay, et al., 2006). Most of these multi-component interventions can be effective in childhood obesity treatment (Foster, et al., 2008; Robertson, et al., 2008). A ten years longitudinal study showed that, the intervention in which children were treated together with their parents were more effective than the intervention only concentrated on children (Epstein, et al., 1990). A systematic review also indicated that the more behavior modification skills taught to both parents and children, the higher probability that the weight loss program is successful (McLean, et al., 2003). However, as these intervention programs were comprehensive programs mixed with various interventions targeted children, teachers, classmates, parents or other family members, it is impossible to figure out the effectiveness of intervention toward parents.

Recently, a special intervention integrating behavioral, social learning, and family system approaches toward childhood obesity was proposed, in which change was taken place in parents (instead of the obese child) addressing a healthy lifestyle rather than weight reduction (Golan & Weizman, 2001). One of the advantages of this parents focused intervention is preventing the adverse psychological effects in conventional treatments.

For instance, intervention toward obesity maybe sometimes not only related to food intake and physical activity but also associated with issues of shame and social isolation (Sjoberg, Nilsson, & Leppert, 2005). While this problem could be avoided if parents focused program is applied.

On the other hand, the results application of this parents focused programs showed that this approach that targeted solely parents leaded to greater weight loss in obese children when compared with conventional intervention at treatment termination and at 1-, 2-, and 7-year follow-up visits (Golan & Crow, 2004b). The feasibility of changing parental behaviors through multidimensional education in parents focused program had also been demonstrated (McGarvey, et al., 2004). In addition, some other studies using similar ideas resulted in great success as well. For instance, a recent study showed that overweight and obese mothers who modified their food choices and eating habits made comparable changes for their child (Klohe-Lehman, et al., 2007). Another study reported that obese child z-BMI change in a family based intervention program could be predicted by parent Z-BMI change (Wrotniak, et al., 2004).

However, there are still several limitations for the conceptual model for the parents focused intervention (Golan & Weizman, 2001). Firstly, most interventions were focused on nutrition issues. Physical activity had not been valued as it should be. In addition, parents showed strong influences, mainly on the children no more than 12 years old. When children grow up, they become more independent, and their friends' influence becomes increasing important (Golan & Weizman, 2001). Therefore, parents focused

intervention provided a framework to guide future interventions and evaluations on childhood obesity, but improvements and adjustments are still needed.

2.9. Summary

The role of parents in the development and prevention of childhood obesity is multifaceted and complex. Current studies regarding the influence of parents on childhood obesity showed that parents played a critical role in the etiology of childhood obesity. Parents could influence children's weight status through the heredity, parents' perception, parenting behaviors, parenting styles, home environment et al. Given the considerable evidence for the association between parents and childhood obesity, it is suggested that influence parents should receive more attention in childhood obesity prevention.

CHAPTER 3

EXAMINATION OF VALIDITY AND RELIABILITY OF QUESTIONNAIRES FOR CHINESE ADOLESCENTS AND PARENTS TO MEASURE PARENTS' PERCEPTION OF THEIR CHILDREN'S WEIGHT, PARENTING BEHAVIORS AND PARENTING STYLE

3.1 Introduction

As childhood obesity was found to be one of the key predictors of adult obesity (Whitaker, et al., 1997) and could be associated with some chronic diseases (Gunnell, et al., 1998), children's weight problem has been regarded as an increasing important public health issue. The studies in the past two decades highlighted the importance of parents. It was found that parent may play a very important role in etiology, prevention and treatment of childhood obesity through their parenting behaviors and parenting styles (Epstein, et al., 1990; Lindsay, et al., 2006).

Several studies had been done to investigate the association between parents' perception of their children's weight, parenting behaviors, parenting styles and childhood obesity in Chinese and some interesting results were found (J. L. Chen & Kennedy, 2004; G. S. Ma, 2005; W. J. Ma, et al., 2001). For example, it was reported that democratic parenting style, poor communication and poor behavior control could be contributed to children's weight problem (J. L. Chen & Kennedy, 2004). However, one of the limitations for the Chinese studies on this field is few valid and reliable questionnaires in Chinese were developed to measure Chinese parents' parenting behaviors and parenting style. Moreover, in many of these studies, only one or two parenting behaviors rather than a broader range of

parenting behaviors were measured.

Although a number of valid and reliable questionnaire and scales, such as Child Feeding Questionnaire (CFQ), Family Eating and Activity Habits Questionnaire, and Caregiver's Feeding Styles Questionnaire, were well developed in western countries (Birch, et al., 2001; Golan & Weizman, 1998; Hughes, et al., 2003), these questionnaires could not be directly applied in Chinese population without reliability and validity test

Therefore, the purpose of this study is to examine the validity and reliability of questionnaires to measure parenting behaviors, patents' perception of their children's weight and parenting styles for Chinese.

3.2 Methods

3.2.1 Questionnaire selection

Relevant studies and questionnaire were reviewed to determine the theory framework as well as the advantages and shortcomings of the existing instruments (Golan & Weizman, 2001; Hughes, et al., 2008; Lindsay, et al., 2006; Rhee, 2008; Trost, et al., 2003). As there were dozens of possible questionnaires that could be applied to measure parents' perception of their children's weight, parenting behaviors and parenting styles, the questionnaires was selected based on the following 3 rules: 1) the questionnaire was proven to have at least acceptable validity and reliability; 2) the items are appropriate for adolescents aged 10-15; 3) there is no cultural conflict in the items.

Adolescents' perception of weight

Figure drawings incorporating boys, girls, men and women figures were applied to measure adolescents' perception of their and their parents' weight status (Collins, 1991). Each set of drawings consists of a set of seven figures, in which the adolescent (or adult) is from very thin to very obese. Adolescents were asked to report their current body weight and the weight status they would like to be. The drawings could be applied in children over 10 years old (Parkinson, Tovée, & Cohen-Tovée, 1998). The test-retest reliability of this item based on Grade 1-3 children with 3 days internal was 0.71 (Collins, 1991).

Parents' perception of their children's weights

To assess the parents' perceptions of their children's weights, an item applied in a previous study in China (Shi, Liena, Nirmal Kumara, & Holmboe-Ottesen, 2007) was selected in the current study. parents were asked to report their children's weights subjectively by giving any one of the five possible answers: "very underweight", "slightly underweight", "normal", "slightly overweight", and "overweight".

Parenting behaviors

Items applied to measure parent-reported parenting behaviors were modified based on the questionnaires used in previous studies (Arredondo, et al., 2006; O'Connor, et al., 2010), was used to assess the parenting behaviors. The scale had the followings subscales: "Diet and physical activity (PA) Monitoring", "Use food or sedentary behaviors as rewards", "Pressure to eat", "Restricting access to unhealthy food and sedentary behaviors", and

"Reinforcement" regarding adolescents' eating and PA. Five Likert-scale responses were provided for these questions (response options: never, rarely, sometimes, frequently, always or strongly disagree, disagree, neutral, agree, strongly agree).

Perceived parenting style

As parenting style would provide the expected effects only when they are actually perceived by the adolescents (Choquet, Hassler, Morin, Falissard, & Chau, 2008). The items used to measure adolescents' perceived parenting styles in Authoritative Parenting Index (API) was used in the current study. The Authoritative Parenting Index was reported to be had a factor structure consistent with a theoretical model of the construct and had good reliability (Jackson, Henriksen, & Foshee, 1998). API could be applied in fourth grade (9-10 years old) to tenth grade (15-16 years old) children (Jackson, et al., 1998). There are nine items in the responsiveness subscale and seven items in the demandingness subscale.

3.2.2 Translation and Back-translation

The procedure of the translation and back translation, based on steps introduced in cross-cultural translation technique (Banville, Desrosiers, & Ganet-Volet, 2000) was performed for the items derived from questionnaire in English. The items were translated into simplified Chinese by two bilingual graduate students. Their two translation versions would be compared after the translation is completed. Differences between the two versions would be discussed, and finally reach an agreement. After that, another two bilingual graduate students would back-translate the instrument into English, and neither

of them would be given the original version beforehand. The same strategy in translation was also applied in the back-translation. The back translations were compared to the original version to ensure the accuracy of translation for instruction, each item and response option.

3.2.3 Content validity

Based on the conceptual framework of parenting behaviors and parenting styles, a pool of items were prepared. Five experts in family studies, nutrition, sports science, physical education and medicine were invited to evaluate the content validity of questionnaire. The experts were informed about the objectives of the questionnaires. They were required to complete an evaluation form for the questionnaire on an individual basis. They rated the effectiveness of each item, add some important factors that were omitted in the questionnaire, and evaluated the feasibility of the questionnaire application in Chinese adolescents and parents. The items with less than 80% agreement (four out of five experts agreed to keep the item) were dropped. The questionnaire was modified according to the reviewers.

3.2.4 Pretest of the experimental version

15 pairs of adolescents and their parents at Ganzhou and Shantou (7 pairs in Ganzhou and 8 pairs in Shantou) were invited to complete the experimental version of questionnaire followed by a short interview. At first, according to the procedure recommended by Banville et al. (2000), the adolescents and parents were invited to complete the experimental version of questionnaire. They were invited to indicate the questionnaire

words they do not understand or feel uncomfortable. They were also invited to talk about their (or their parents') parenting behaviors and styles, and whether the items catch their parenting behaviors and styles. According to their feedbacks, the content and language of some items were modified so as to make the questionnaire culturally relevant.

3.2.5 Test-retest reliability and internal consistency

As it was reported that reasonable precision for estimates of reliability needs about 50 study participants (Hopkins, 2000), 127 pairs of adolescents and their parents (Ganzhou: 62 pairs, Shantou: 65 pairs) were recruited. During the pilot study, adolescents and their parents were required to complete the questionnaires twice with two weeks apart, so that the test-retest reliability, internal reliability could be determined.

3.2.6 Construct validity

2,162 pairs of adolescents and parents in Ganzhou and Shantou were invited to participate in a survey using the questionnaire. 1,000 data extracted randomly from the survey was analyzed for construct validity.

3.2.7 Data analysis

The test-retest reliability of each item was determined by intraclass correlation coefficient (ICC). ICC was regarded as acceptable if ICC was greater than 0.7. Cronbach's alpha was performed to determine internal reliability of the scaled responses to multiple items. Internal consistency was deemed acceptable if Cronbach's alpha is greater than 0.6 (Sim & Wright, 2000). Confirmatory Factor Analysis (CFA) using Lisrel 8.51 software was

conducted to determine the construct validity. Non-Normed Fit Index (NNFI) (>0.90 indicates good fit), Comparative Fit Index (CFI) (>0.90 indicates good fit) and Root Mean Square Error of Approximation (RMSEA) (<0.08 indicates acceptable fit) were used for determining model fit (Hooper, Coughlan, & Mullen, 2008).

3.3 Results

3.3.1 Content validity

A total of 46 items and 41 items were proposed for questionnaire for adolescents and their parent respectively. 6 items in adolescent questionnaire and 3 items in parent questionnaire, which were lower than 80% agreement in content validity test, were dropped. Therefore, after content validity test, 40 items and 38 items were retained for questionnaire for adolescents and their parent respectively.

3.3.2 Test-retest reliability and internal consistency

The demographic information of the participants in the reliability test were summarized in the Table 3.1. Of the 127 adolescents, 65 (51.2%) were boys and 60 (48.8%) were girls. The age of the adolescents ranged from 10 to 15 years old. 80 out of the 127 parents (63%) recruited in the reliability study were mothers.

As it was showed in the Table 3.2, the two weeks test-retest reliability of the items on adolescents' and parents' perception of adolescents' weight were excellent, which ranged from 0.83 to 0.92. The results indicated that the items on adolescents' and parents' perception of adolescents' weight were reliable.

Table 3.1 Demographic data (N=127)

Child sex, %	
Boy	51.2
Girl	48.8
Child age, mean ±SD, y	13.1±0.8
Height, cm	162.2±6.7
Weight, kg	50.2±7.6
BMI	19.1±2.4
Overweight, %	18.1
Parent sex, %	
Male	37.0
Female	63.0

Table 3.2 The test retest reliability of the items related to adolescents' and their parents' perception of weight

Items	ICC	95%CI	N	P	Report Status
Which picture looks the most like how you look?	0.92	0.89-0.95	123	.000	A
Which picture looks the most like the way you want to look?	0.86	0.80-0.90	123	.000	A
Which picture looks the most like your father?	0.91	0.87-0.94	123	.000	A
Which picture looks the most like your mother?	0.91	0.87-0.94	123	.000	A
Which picture looks shows the way you want to look when you grow up.	0.83	0.76-0.88	123	.000	A
Please report the weight status of your child	0.88	0.82-0.92	126	.000	P

Note: A: adolescent-reported; P: parent-reported

For the test-retest reliability of items on parenting behaviors, only one item was found to be less than 0.7 and were dropped (Table 3.3). The results showed that the test-retest reliability of other items ranged from 0.71 to 0.83, and the internal consistencies of subscales ranged from 0.69 to 0.79. The results suggested that the questionnaire was

reliable and internal consistent.

The results of test-retest reliability and internal consistencies in the items of parenting style were also found to be acceptable. As it was showed in Table 3.4 and Table 3.5, the test-retest reliability of 16 items ranged from 0.70 to 0.84 for mothers and 0.70 to 0.85 for fathers. The internal consistencies of responsiveness and demandingness for parents ranged from 0.70 to 0.75, demonstrating that the questionnaire was reliable and internal consistent.

After the reliability test, one item in parents questionnaire was dropped, and a total of 40 items and 38 items were left in the questionnaires for adolescents and parents respectively.

3.3.3 Construct validity

As it was showed in Table 3.6, the results of CFA showed that the factor loadings of the items on parenting behaviors ranged from 0.60 to 0.76. The model exhibited acceptable fit indicated by the goodness-of-fit statistics (RMSEA=0.052, NNFI=0.91, CFI=0.92). The results of CFA on parenting style items were summarized in Table 3.7. The factors loadings estimated based on the data of father and mothers were quite similar (ranged from 0.55 to 0.76 for fathers and ranged from 0.59 to 0.74 for mothers). The RMSEA, CFI and NNFI for the parenting style model also indicated acceptable fit.

Table 3.3 The test retest reliability and internal consistency of the items on parenting behaviors

Items	ICC	95%CI	N	P	Cronbach's α
Diet and physical activity (PA) monitoring					0.76
1. How much do you keep track of sweets (candy, ice cream, cake) that your child eats?	0.74	0.61-0.82	125	.000	
2. How much do you keep track of the high-fat foods that your child eats?	0.71	0.57-0.80	125	.000	
3. How much do you keep track of servings of fruits and vegetables your child is eating?	0.80	0.70-0.86	125	.000	
4. How often must your child ask permission before getting a snack?	0.71	0.56-0.80	125	.000	
5. How much do you keep track of the amount of TV or videos your child is watching?	0.72	0.59-0.81	125	.000	
6. How much do you keep track of exercise your child is getting?	0.73	0.60-0.81	125	.000	
Reinforcement					0.79
7. How often do you praise your child for eating a healthy snack?	0.83	0.75-0.89	123	.000	
8. How often do you praise your child for being physically active?	0.71	0.57-0.81	122	.000	
Use food or sedentary behaviors as rewards					0.69
9. I offer sweets (candy, ice cream, cake) to my child as a reward for good behavior	0.77	0.66-0.84	125	.000	
10. I offer TV, or video game to my child as a reward for good behavior	0.72	0.60-0.81	125	.000	
Pressure to eat					0.74
11. My child should always eat all the food on his/her plate	0.55	0.34-0.70	126	.000	D
12. I have to be especially careful to make sure my child eats enough	0.76	0.65-0.84	126	.000	
13. If my child says "I am not hungry" I try to get him/her to eat anyway	0.78	0.67-0.85	124	.000	
14. If I don't regulate or guide my child's eating, he/she would eat much less than he/she would eat much less than he/she should	0.71	0.56-0.80	124	.000	
Restricting access to unhealthy food and sedentary behaviors					0.74
15. I limit the amount of soda my child drinks	0.71	0.57-0.81	124	.000	
16. I limit the number of snacks my child eats	0.71	0.57-0.80	124	.000	
17. I limit the amount of time my child watches TV or videos during week (Mon-Fri)	0.81	0.73-0.87	124	.000	
18. I limit the amount of time my child watches TV or videos during weekend (Sat/Sun)	0.83	0.75-0.89	124	.000	

Table 3.4. The test retest reliability and internal consistency of the items on adolescent-reported fathers' parenting style

Items	ICC	95%CI	N	P	Cronbach's α:
Responsiveness (fathers)					0.70
1. He is always telling me what to do	0.72	0.60-0.80	123	.000	
2. He makes rules without asking what I think.	0.75	0.64-0.82	123	.000	
3. He makes me feel better when I am upset.	0.71	0.59-0.80	123	.000	
4. He is too busy to talk to me.	0.75	0.64-0.82	123	.000	
5. He listens to what I have to say.	0.73	0.62-0.81	123	.000	
6. He likes me just the way I am.	0.71	0.57-0.79	123	.000	
7. He tells me when I do a good job on things.	0.78	0.69-0.85	123	.000	
8. He wants to hear about my problems.	0.76	0.65-0.83	123	.000	
9. He is pleased with how I behave.	0.82	0.74-0.87	123	.000	
Demandingness (fathers)					0.75
10. He has rules that I must follow.	0.72	0.60-0.81	123	.000	
11. He tells me times when I must come home.	0.72	0.60-0.81	123	.000	
12. He makes sure I tell her where I am going.	0.71	0.59-0.80	123	.000	
13. He makes sure I go to bed on time.	0.75	0.64-0.82	123	.000	
14. He asks me what I do with friends.	0.70	0.57-0.79	123	.000	
15. He knows where I am after school.	0.85	0.78-0.89	123	.000	
16. He checks to see if I do my homework.	0.75	0.64-0.83	123	.000	

Note: D: The item was deleted , Cronbach's α was calculated based on the items with test-retest reliability higher than 0.70

Table 3.5. The test retest reliability and internal consistency of the items on adolescent-reported mothers' parenting style

Items	ICC	95%CI	N	P	Cronbach's α:
Responsiveness (mothers)					0.71
1. She is always telling me what to do	0.74	0.62-0.82	122	.000	
2. She makes rules without asking what I think.	0.75	0.65-0.83	123	.000	
3. She makes me feel better when I am upset.	0.72	0.59-0.80	123	.000	
4. She is too busy to talk to me.	0.70	0.58-0.79	123	.000	
5. She listens to what I have to say.	0.73	0.61-0.81	123	.000	
6. She likes me just the way I am.	0.70	0.57-0.79	123	.000	
7. She tells me when I do a good job on things.	0.84	0.76-0.89	123	.000	
8. She wants to hear about my problems.	0.76	0.65-0.83	123	.000	
9. She is pleased with how I behave.	0.73	0.61-0.81	122	.000	
Demandingness (mothers)					0.71
10. She has rules that I must follow.	0.74	0.63-0.82	123	.000	
11. She tells me times when I must come home.	0.70	0.56-0.79	123	.000	
12. She makes sure I tell her where I am going.	0.74	0.63-0.82	123	.000	
13. She makes sure I go to bed on time.	0.72	0.59-0.80	123	.000	
14. She asks me what I do with friends.	0.75	0.64-0.82	123	.000	
15. She knows where I am after school.	0.74	0.62-0.82	123	.000	
16. She checks to see if I do my homework.	0.70	0.58-0.79	123	.000	

Note: D: The item was deleted , Cronbach's α was calculated based on the items with test-retest reliability higher than 0.70

Table 3.6 Factor loadings of confirmatory factor analysis on parenting behaviors items

Items	Factor loading [a]
Diet and physical activity (PA) monitoring	
1. How much do you keep track of sweets (candy, ice cream, cake) that your child eats?	0.67
2. How much do you keep track of the high-fat foods that your child eats?	0.68
3. How much do you keep track of servings of fruits and vegetables your child is eating?	0.66
4. How often must your child ask permission before getting a snack?	0.72
5. How much do you keep track of the amount of TV or videos your child is watching?	0.69
6. How much do you keep track of exercise your child is getting?	0.74
Reinforcement	
7. How often do you praise your child for eating a healthy snack?	0.65
8. How often do you praise your child for being physically active?	0.70
Use food or sedentary behaviors as rewards	
9. I offer sweets (candy, ice cream, cake) to my child as a reward for good behavior	0.76
10. I offer TV, or video game to my child as a reward for good behavior	0.65
Pressure to eat	
11. I have to be especially careful to make sure my child eats enough	0.71
12. If my child says "I am not hungry" I try to get him/her to eat anyway	0.70
13. If I don't regulate or guide my child's eating, he/she would eat much less than he/she would eat much less than he/she should	0.68
Restricting access to unhealthy food and sedentary behaviors	
14. I limit the amount of soda my child drinks	0.60
15. I limit the number of snacks my child eats	0.74
16. I limit the amount of time my child watches TV or videos during week (Mon-Fri)	0.74
17. I limit the amount of time my child watches TV or videos during weekend (Sat/Sun)	0.71

[a] The goodness-of-fit statistics of CFA: RMSEA=0.052, NNFI=0.91, CFI=0.92

Table 3.7 Factor loadings of confirmatory factor analysis on parenting style items

Item	Factor loading	
	Father	Mother
Responsiveness		
1. He/She is always telling me what to do	0.64	0.65
2. He/She makes rules without asking what I think.	0.64	0.66
3. He/She makes me feel better when I am upset.	0.69	0.67
4. He/She is too busy to talk to me.	0.62	0.61
5. He/She listens to what I have to say.	0.68	0.66
6. He/She likes me just the way I am.	0.65	0.69
7. He/She tells me when I do a good job on things.	0.62	0.61
8. He/She wants to hear about my problems.	0.55	0.59
9. He/She is pleased with how I behave.	0.63	0.63
Demandingness		
10. He/She has rules that I must follow.	0.70	0.69
11. He/She tells me times when I must come home.	0.62	0.66
12. He/She makes sure I tell her where I am going.	0.72	0.73
13. He/She makes sure I go to bed on time.	0.66	0.64
14. He/She asks me what I do with friends.	0.76	0.74
15. He/She knows where I am after school.	0.68	0.68
16. He/She checks to see if I do my homework.	0.65	0.67

The goodness-of-fit statistics of CFA: RMSEA=0.056, NNFI=0.92, CFI=0.93 (based on fathers); RMSEA=0.055, NNFI=0.93, CFI=0.94 (based on mothers)

3.4 Discussion and conclusion

The purpose of this study was to determine the validity and reliability of the questionnaires for Chinese adolescents and parents to measure parents' perception of their children's weight, parenting behaviors and parenting style. The content validity, construct validity, 2 weeks test retest reliability and internal consistency of the questionnaires were determined in the present study. The results of the data indicated that the validity and reliability instruments were acceptable and could be applied in

Chinese adolescents and their parents.

Some parent related behaviors, which could be associated with childhood obesity, were identified based on previous studies. For instance, recent studies emphasized the influence of parental feeding behavior on the child's and infant's food intakes (Koletzko, et al., 2009; Kroller & Warschburger, 2009). Based on conceptual framework and the questionnaires used in previous studies (Arredondo, et al., 2006; O'Connor, et al., 2010), the 17 items questionnaire was developed to measure parenting behaviors in Chinese parents. "Diet and PA monitoring", "reinforcement", "use food as rewards", "pressure to eat" and "restricting access to unhealthy food and sedentary behaviors", which were found to be the important parenting behaviors contributed to the development of childhood obesity (Clark, et al., 2007; Faith, Scanlon, et al., 2004; Rhee, 2008), were included as the factors in the this parenting behavior questionnaire. The goodness-of-fit statistics of CFA indicated that the model provided acceptable fit to the data in current study. Moreover, content validity, two weeks test retest reliability and internal consistency were also found to be acceptable.

In the current study, the items for parenting style measurement, was developed based on Authoritative Parenting Index (API). Evidences were provided in support of the validity and reliability of the API (Jackson, et al., 1998). The results of CFA indicated that the structure of the questionnaire was consistent with the theory model of parenting style, in which parenting styles were conceptualized based on two underlying dimensions: demandingness and responsiveness (Baumrind, 1971). The results of content validity test and reliability test also proved that the questionnaire was valid in content and reliable. However, the cultural difference between China and

western countries should be considered for parenting style. For instance, it was reported that Americans and Europeans attached importance to "nurturing innate ability". However, Chinese emphasized the importance of high self-discipline, obedience to parents, high parental involvement and sacrifice, which are rooted the Confucian education philosophy (Chao, 1994; F. M. Chen & Luster, 2002). Therefore, a Chinese researcher pointed out that the concepts of authoritative and authoritarian may not capture the important characteristics of Chinese parenting styles (Chao, 1994). In addition, there is no standard cutoff point for the questionnaires to measure parenting style, the four parenting styles were categorized based on a relative criterion rather than an absolute one, in which a cross-classification of high and low scores based on median splits on the responsiveness and demandingness subscale identified the four categorical parenting styles (Darling & Steinberg, 1993). This means that considering the difference in parenting style of Chinese and American parents (P. Wu, et al., 2002), a neglectful mother in a Chinese study could be regarded as an authoritative mother if her data were included in a study in the United States. Additional studies were needed for the measurement of parenting style.

Several limitations in this study should be acknowledged when interpreted the data. First of all, as no specific theory on Chinese parenting was well established and could be applied in the present study, the questionnaires were still based on the theory established in western countries, although several steps were applied in the current study to make the questionnaire culturally relevant. Therefore, the questionnaire may not catch all the characteristics of Chinese parenting behaviors and parenting styles. Nevertheless, the theory of parenting established based on American parents (Baumrind, 1971) was still widely applied in the studies on Chinese parents' parenting

(X. Y. Chen, et al., 1997; Pong, et al., 2009; Porter, et al., 2005), which indicated that the theory still could be used to solve many research problems in Chinese parents. The questionnaires were still meaningful for the studies on the Chinese parenting. Secondly, memory problem is very hard to avoid in the test retest situations, although there was two weeks' time between the two reliability tests. The adolescents and parents may still remember some of their choices in the first test, and reproduce answers in the second test, which may lead to overestimation of the test retest reliability. Thirdly, although the parent, who was invited to complete the questionnaire in the second reliability test, was required to be the same parent in the first reliability test, it was still possible that several participants may not comply with the rules. In this case the test retest reliability could be underestimated. In addition, the participants recruited in this study were 10-15 years old adolescents and their parents in Ganzhou and Shantou. Therefore, the questionnaires developed in the current study may not be appropriate to be used in the children under ten years old or in other areas of China.

Evidences were provided in the current study for the content validity, construct validity, test retest reliability and internal consistency. Despite of the limitations of the study, it was still demonstrated that the questionnaires for both adolescents and parents were valid, reliable and could be applied in Chinese adolescents and their parents in southern China to measure parents' perception of their children's weight, parenting behaviors and parenting styles.

CHAPTER 4

PARENTING BEHAVIORS AND ADOLESCENT OBESITY

4.1 Introduction

Although malnutrition among children remained prevalent in developing countries, it was reported that prevalence of overweight in young women is higher than the prevalence of underweight in many developing countries, especially in the countries with high economic growth (Mendez, Monteiro, & Popkin, 2005). Recent research showed that Chinese children is experiencing large increase in mean BMI at the 95th percentile (Popkin, 2010), which indicated that, just like the trend in the United States, the childhood obesity is becoming an increasing important problem in China.

Balanced diet, increased physical activity and social support to alter modern diets and lifestyle were suggested to solve the obesity epidemic (Heber, 2010), the importance of parents' participation in weight control programs were also highlighted (Barlow & the Expert Committee, 2007). It was suggested that treatments should be a family based program with the participation of at least one parent (Dietz & Robinson, 2005; Robinson, 1999). Recent evidence in both qualitative and quantitative studies also confirmed the importance of parent involvement in the childhood obesity treatment (Heinberg, et al., 2009; Stewart, et al., 2008).

Parents not only influence their children's diet and physical activity through the food & home environment they provide, their feeding behaviors (restriction assess to some food, pressure to eat, using food as rewards etc.), financial and emotional support for their children's sports participation, but also influence the development of children's dietary and exercise habits through role modeling. For instance, a longitudinal study demonstrated that parental

restriction of food intake at age 5 could predict higher BMI at age 7, after BMI at age 3 was adjusted for (Faith, Berkowitz, et al., 2004). It could be explained that the children's attention and appetite for the restricted food was increased by their parents' restricting feeding strategy (Fisher & Birch, 1999b). The data from Framingham Children's Study showed that children of active parents had significantly higher odds to be to be physically active than the children of inactive mothers (Moore, et al., 1991).

However, inconsistent results were still found in several studies. For example, a study showed that adolescents who received parental reinforcement participated in significantly more days of physical activity in a week than did their counterparts (King, et al., 2008). However, the data of another study showed that girl's perception of parent's support for physical activity was not associated with girl's activity levels (Adkins, et al., 2004). Therefore, further studies were still needed to clarify the parenting behaviors that associated with children's diet and physical activity, which could be very important in the prevention and treatment of childhood obesity.

The association between Chinese parenting behaviors and childhood obesity were also reported by some Chinese studies. For instance, a cross sectional study based on 930 families with 2- to 6-year-old children in Beijing revealed a strong association between parents' and children's dietary habits, TV watching and physical activity (Jiang, et al., 2006). Another study from 104 parents of overweight children in Hong Kong had showed that parental influence, especially father's role modeling, significantly influenced overweight Chinese children's physical activity participation (Lau, et al., 2007). However, most of these studies concentrated on one or two parenting behaviors rather than a broad range of parenting behaviors. In addition, the difference in cultural orientation toward parenting behaviors

should be acknowledged. For example, in Chinese culture, Chinese mothers are always described as "Ci" (kind), while Chinese fathers are always regarded as "Yan" (strict) (Berndt, et al., 1993). Therefore, mothers and fathers could play different roles in family and may have different parenting behaviors. However, few studies in China compared diet and physical activity related parenting behaviors in fathers and mothers.

Therefore, the purposes of this study are 1) to determine the association between adolescents' dietary habits, physical activity, weight status and parenting behaviors; 2) to compared diet and physical activity related parenting behaviors in Chinese fathers and mothers.

4.2 Methods

Study population and procedure

The study population of present study was the adolescents and their parents in urban areas (city or town) of southern China, due to much higher prevalence of obesity in the urban areas as compared with rural areas (countryside) (Luo & Hu, 2002). As improved economic and social conditions was found to be an important factor that may lead to Chinese's increased nutrient-dense and energy-dense food intake, sedentary lifestyle and weight status (Y. Wang, Monteiro, & Popkin, 2002), it was decided to recruited our participants from a developed city and an underdeveloped city in southern China. Stratified random sampling was applied in the present study, in which a city (Shantou) in developed area and a city (Ganzhou) in underdeveloped area were chosen. Shantou, one of the original Special Economic Zones of China established in the 1980s, is one of the developed regions in southern China. The Gross Domestic Product (GDP) per capita in Shantou was 20,279 RMB (Shantou municipal bureau of statistics, 2010). Ganzhou, one of the old revolutionary base areas in China, is an underdeveloped inland city located in southern China. The GDP per capita in Ganzhou was

9,391 RMB (Ganzhou municipal bureau of statistics, 2010).Adolescents and their parents were randomly recruited from grade 1 and grade 2 of secondary schools in Ganzhou and Shantou respectively. For example, in Ganzhou, there are two districts. In the present study, a key secondary school and an ordinary secondary school was randomly chosen in each district. 4-6 classes in each school (2-3 classes in each grade) were randomly drawn in the investigation. The same sampling strategy was applied in Shantou. Exclusion criteria for adolescents was using medications that may influence weight gain or loss, and a diagnosis of physical or developmental disability or chronic illness.

From April to May 2009, 2,162 pairs of adolescents and parents participated in the present survey (Ganzhou: 1,179 pairs; Shantou: 1,106 pairs). There were 19 adolescents who had physical disability or received medications that influence their weight status were excluded from the analysis. 274 parents did not send the questionnaire back. Consequently, 2,143 adolescents and 1,869 their parents were finally included in the data analysis.

During the survey, adolescents in secondary school were invited to complete an anthropometric test for body weight and height, and were asked to fill out questionnaires inside a classroom with the assistance of investigators. The adolescents were also asked to take home the "questionnaires for parents" for either their mother or father to fill out, and to give the questionnaires back to the survey conductors. Souvenirs were given to the participants as compliments.

Other than the participants in the main survey, 127 pairs adolescents and parents (Ganzhou: 62 pairs, Shantou: 65 pairs) were invited to participate in a reliability study four weeks prior to the main survey. During the reliability study, adolescents and their parents were required to

complete the questionnaires twice with two weeks apart. The test-retest reliability of each item and internal consistency was determined by intraclass correlation coefficient (ICC) and Cronbach's alpha respectively.

Signed informed consent was obtained from all participants (including adolescents and parents) prior to the survey. The adolescents and their parents were briefly introduced that they need to provide some information about their child's health status and were highly encouraged to honestly report what they really think and what they did. In the instruction of the questionnaire, both adolescents and parents were clearly informed that there is no right or wrong answers for each item and the questionnaire is anonymous. Formal approval was granted from the Chinese University of Hong Kong Research Ethics Committee.

Main study measures

Adolescent weight status

An adolescent's body weight to the nearest 0.1 kg was measured with minimal clothing and without shoes using a measuring scale. An adolescent's body height to the nearest 0.5 cm was taken using a stadiometer. An adolescent's body mass index (BMI) was calculated as his or her weight in kilograms divided by the square of his height in meters. The BMI was further categorized either as underweight (thinness, BMI-for-age < -2 SD), normal, or overweight (BMI-for-age > 1SD) based on the international growth standards for school-aged children and adolescents updated by the World Health Organization (WHO) (Butte, et al., 2007; De Onis, et al., 2007). The age and gender specific BMI Z scores (Z-BMI) for each adolescent was calculated based on the international growth standard.

Parent weight status

The BMIs of parents were recorded based on their self-reported heights and weights, as it is not feasible to measure parents' height and weight in the present study. Validity of self-reported heights and weights of adults were well reported (Bolton-Smith, Woodward, Tunstall-Pedoe, & Morrison, 2000; Wada, et al., 2005). Pearson's r between self-reported BMI and measured BMI was 0.943 and 0.950 for men and women, respectively (Wada, et al., 2005). According to the BMI reference for screening overweight and obesity among Chinese adults, parental BMIs were categorized either as non-overweight ($BMI<24kg/m^2$) or overweight ($24\ kg/m^2 \leq BMI < 28\ kg/m^2$), or obese ($BMI \geq 28\ kg/m^2$) (Zhou & Cooperative Meta-Analysis Group of the Working Group on Obesity in China, 2002).

Adolescents' dietary habits

Adolescents' dietary habits were measured by a five-point Likert-scale including 12 items. During the survey, the adolescents were provided with responses ranging from "never," "rarely," "sometimes," "frequently," and "always" to indicate the frequency of their dietary behaviors during the past years. The sample questions were as follows: "I eat at least 3 servings of vegetables a day" and "I eat more during dinner if the food tastes good." The total score of the adolescents' dietary habits was calculated as the sum score of each item (several item were reversed coded). The validity and reliability of the scale were found to be acceptable (Sheu, 2003). The reliability test in the current study showed that the two weeks test-retest reliability of these items ranged from 0.70 to 0.79. The internal consistency for this scale was 0.71.

Adolescents' physical activity level

All adolescents were invited to complete a validated physical activity rating questionnaire for children and youth (PARCY) to assess their average weekly physical activity over the last

year. The PARCY is a 1-item activity rating modified from the Jackson Activity Coding (Baumgartner & Jackson, 1996; George, Stone, & Burkett, 1997) and the Godin-Shephard Activity Questionnaire modified for Adolescents (Aaron, et al., 1993; Godin & Shephard, 1985). The criterion validity and convergent validity of PARCY have been published in other sources (Hui, 2001; Hui, Chan, Wong, Ha, & Hong, 2001; Kong, et al., 2010). The scale is an 11-point scale (0 - 10) ranging from no exercise at all (rating of 0) to vigorous exercise almost everyday (rating of 10). The design of the rating took into consideration activity frequency, duration, and intensity. The physical activity levels of the subjects were further categorized into either "inactive" (PAR = 0 to 2), "slightly active" (PAR = 3 to 6), or "active" (PAR = 7 to 10) groups for analysis. The reliability test in the current study showed that the two weeks test-retest reliability of the item was 0.83.

Parent-reported parenting behaviors

An 17-item, five-point Likert-type scale, which was modified and translated based on the questionnaires used in previous studies (Arredondo, et al., 2006; O'Connor, et al., 2010), was used to assess the parenting behaviors. The scale had the followings subscales: "diet and physical activity (PA) Monitoring", "use food or sedentary behaviors as rewards", "pressure to eat", "restricting access to unhealthy food and sedentary behaviors", and "reinforcement" regarding adolescents' eating and PA. Five Likert-scale responses were provided for these questions (response options: never, rarely, sometimes, frequently, always or strongly disagree, disagree, neutral, agree, strongly agree). Another 1,000 data extracted randomly from the main survey was analyzed for constructed validity. Confirmatory factor analysis using LISREL 8.51 software was conducted. The description of the items as well as the results of construct validity test and reliability test were summarized in Table 3.3 and Table 3.6.

Adolescents' pubertal status

Although it was suggested that obesity could be associated with pubertal timing (Kaplowitz, Slora, Wasserman, Pedlow, & Herman-Giddens, 2001; Tremblay & Frigon, 2005), pubertal status was not well controlled in many studies on adolescent obesity (Tsiros, Sinn, Coates, Howe, & Buckley, 2008). In this study, a self-assessment questionnaire, which required the adolescents to report their pubic hair growth, breast development (for girls), and male genital development (for boys), was used to measure the children's pubertal status. The questionnaire enabled the reliable estimation of the sexual maturation status of Chinese children (Chan, et al., 2008). The two weeks test-retest reliability of these two items in this study is 0.80 and 0.82, respectively. The internal consistency was 0.71.

Social-demographic information

Adolescent gender and age were based on the adolescent's self-report. The background information supplied by the parents included parental education level, age, family income, and so on.

Statistical Analysis

The correlation coefficients were calculated among adolescents' BMI, Z-BMI, dietary habits, PA level, parenting behaviors, parenting style and other related variables based on the study sample in Shantou and Ganzhou respectively. As age, gender, socioeconomic status was reported to be associated with children's weight status, dietary habits and physical activity, these factors were included in the analysis as covariates (Y. Wang, et al., 2002; Y. Wang & Zhang, 2006). Hierarchical multiple regression analysis for parenting behaviors variables and social-demographic variables predicting adolescents' Z-BMI, dietary habits and physical activity level were conducted respectively. Social-demographics variables, which could be

associated with adolescents' weight status, dietary habits and physical activity level (such as gender, age, parents' education, family income et al.) were selected as the controlled variables in the first block in stepwise regression. Parent reported parenting behaviors variables and adolescents reported parenting behaviors variables were entered in the second block in stepwise regression respectively. Analysis of covariance (ANCOVA) was used to compare the scores in parenting behaviors between fathers and mothers, adjusting for adolescents' weight status, gender, and age.

4.3 Results

The social-demographic information is summarized in Table 4.1. The age of adolescents recruited in this study ranged from 10 to 15. It was found that 16.7% of the adolescents were overweight.

The correlation matrix among children's BMI, dietary habits, physical activity level, parenting behaviors, parenting styles, and parents' perception of their children's weight calculated based on the study sample in Shantou and Ganzhou were summarized in Table 4.2, adjusting for the age, gender, family income and parents' education. As it was showed in Table 4.2, the calculated correlation coefficients between adolescents' BMI and "diet and PA monitoring" were 0.10 and 0.12 in Shantou and Ganzhou respectively, both of which were statistically significant ($p<.01$). While, the correlation coefficients between adolescents' physical activity and "reinforcement" were 0.05 and 0.02 in Shantou and Ganzhou respectively, both of which was not statistically significant. Since very similar correlation coefficients were found in almost all the correlation among the variables in the study sample in Shantou and Ganzhou (Table 4.2), it was decided to combine the data in Shantou and Ganzhou together in the following data analysis.

Table 4.1 Demographic information (N=2,143)

Adolescent sex, %	
Boy	51.4
Girl	48.6
Adolescent age, mean ±SD, y	12.5±0.9
Adolescent weight status, %	
Underweight	2.4
Normal	80.9
Overweight	16.7
Adolescents' BMI, mean ±SD	18.6±2.8
Adolescent dietary habits, mean ±SD	39.3±5.3
Adolescent physical activity, mean ±SD	5.1±2.8
Parent sex, %	
Male	40.4
Female	59.6
Parent BMI, mean ±SD	22.2±3.0
Parenting behaviors, mean ±SD	
Diet and physical activity monitoring	19.8±4.3
Use food or sedentary behaviors as rewards	5.4±1.8
Pressure to eat	9.8±2.1
Restricting access to unhealthy food and sedentary behaviors	15.4±2.7
Reinforcement	7.0±2.1
Region, %	
Ganzhou	45.7
Shantou	54.3

The diet and physical activity related parenting behaviors in fathers and mothers were summarized in Table 4.3. No significant difference were found between paternal and maternal parenting behaviors in "use food or sedentary behaviors as rewards", "pressure to eat" and "reinforcement". Slight but statistical significant differences were found in "food and PA monitoring" and "use food or sedentary behaviors as rewards".

Table 4.2 Correlation matrix among Adolescents' BMI, Z-BMI, dietary habits, physical activity, parenting behaviors, parenting style and parents' perception of their child's weight in Ganzhou and Shantou

	BMI		Z-BMI		Dietary habits		Physical activity	
	Shantou	Ganzhou	Shantou	Ganzhou	Shantou	Ganzhou	Shantou	Ganzhou
Diet and PA monitoring	0.10*	0.12*	0.09*	0.10*	0.21*	0.23*	0.11*	0.15*
Reinforcement	0.01	0.05	0.00	0.03	0.10*	0.09*	0.05	0.02
Use food or sedentary behaviors as rewards	-0.02	0.01	-0.03	0.00	-0.04	-0.02	0.00	0.03
Pressure to eat	-0.22*	-0.18*	-0.23*	-0.22*	-0.06	-0.03	0.04	0.01
Restricting access to unhealthy food and sedentary behaviors	0.03	0.02	0.01	0.00	0.19*	0.23*	0.08*	0.11*
Adolescents' perception of their own weight	0.72*	0.68*	0.72*	0.69*	0.09*	0.10*	-0.02	0.01
Parents' perception of their child's weight	0.75*	0.65*	0.74*	0.65*	0.09*	0.07*	0.00	0.05
Paternal responsiveness	-0.01	0.05	-0.02	0.04	0.20*	0.16*	0.12*	0.08*
Maternal responsiveness	0.00	0.01	-0.01	0.01	0.18*	0.17*	0.10*	0.09*
Paternal demandingness	-0.03	0.02	-0.03	0.02	0.11*	0.08*	0.10*	0.08*
Maternal demandingness	-0.03	0.01	-0.03	0.01	0.10*	0.08*	0.10*	0.08*

Note: Age, gender, family income and parents' education were adjusted ; *: $p<0.01$

Table 4.3. Comparison of paternal and maternal parenting behaviors, adjusting for adolescents' weight status, gender, age, parents' weight status, education level and family income.

Parenting behaviors, mean (95%CI)	Mothers	Fathers	ANCOVA	
			F	P
Food and PA Monitoring	20.5(20.2-20.9)**	19.4 (19.0-19.9)**	14.11	<0.01
Use food or sedentary behaviors as rewards	5.5(5.3-5.7)*	5.3(5.1-5.4)*	4.01	<0.05
Pressure to eat	8.4(8.3-8.6)	8.3(8.2-8.5)	1.10	>0.05
Resticting access to unhealthy food and sedentary behaviors	15.6(15.4-15.8)	15.2(15.5)	3.45	>0.05
Reinforcement	7.2 (7.0-7.3)	7.1(6.8-7.3)	0.43	>0.05

**: P<0.01; *: P<0.05

The correlation among adolescents' weight status, dietary habits, physical activity, parenting behaviors were summarized in Table 4.4. Several parenting behaviors reported by adolescents and parents, including "pressure to eat" and "diet and PA monitoring", were found to be significantly related to adolescents' BMI and Z-BMI, although the correlations coefficients were not high. Moreover, it is noteworthy that the correlations coefficients between "pressure to eat" and adolescents' weight status were negative, which means that the higher adolescents' BMI, the less likely that parents would choose the feeding strategies of "pressure

to eat". Furthermore, positive associations were found among "diet and PA monitoring", "reinforcement", "restricting access to unhealthy food and sedentary behaviors" and adolescents' dietary habits. In addition, statistically significant but low correlations were found between "diet and PA monitoring", "restricting access to unhealthy food and sedentary behaviors" and adolescents' physical activity level.

Table 4.4 Correlation matrix among adolescents' weight status, dietary habits, physical activity and parenting behaviors (data in Ganzhou and Shantou combined)

	BMI	Z-BMI	DH	PA
Diet and PA monitoring	0.10**	0.09**	0.21**	0.11**
Reinforcement	0.01	0.00	0.10**	0.05
Use food or sedentary behaviors as rewards	-0.02	-0.03	-0.04	0.00
Pressure to eat	-0.22**	-0.23**	-0.06	0.04
Restricting access to unhealthy food and sedentary behaviors	0.03	0.01	0.19**	0.08*

Note: DH: Dietary habits; PA: Physical Activity
Age, gender, family income and parents' education were adjusted
*: $p<0.05$; **: $p<0.01$

Hierarchical regression models were used to predict adolescents' Z-BMI, dietary habits and physical activity respectively. As it was showed in Table 4.5, the regression model were adjusted for several social-demographic factors, including gender, age, pubertal status and parents' weight status in the first step, which explained about 9% of variance of adolescents' weight status. The data suggested that "pressure to eat" and "Diet and PA monitoring" could explain 4.2% and 1.1% of the variance of adolescents' weight status (Table 4.5). The full models using parenting behaviors could explain 14.2% of the variance of adolescents' Z-BMI.

Table 4.5 Hierarchical regression model to predict adolescents' Z-BMI with parenting behaviors and social-demographic information

Predictors	B	β	95%CI for B	Sig.	R^2(unique)
Step 1					0.089
Adolescent's gender	-0.425	-0.113	-0.677- -0.173	0.001	
Age	-0.293	-0.135	-0.453- -0.134	0.000	
Pubertal status	0.444	0.223	0.298-0.590	0.000	
Parent's weight status	0.487	0.142	0.261-0.712	0.000	
Step 2					0.042
Pressure to eat	-0.231	-0.274	-0.297- -0.165	0.000	
Step 3					0.011
Diet and PA monitoring	0.133	0.123	0.048-0.217	0.002	
Model R^2: 0.143; Final multiple R=0.378, P<0.01					

Note: Only variables with statistic significant in the model were presented.

The results of hierarchical regression for the adolescents' dietary habits predication were summarized in Table 4.6. In the first step, gender and age accounted for about 4% of the variability. For the parents reported parenting behaviors, "parents' diet and PA monitoring"and "resticting access to unhealthy food and sedentary behaviors" accounted for only 3.9% and 0.9% of variability respectively (Table 4.6). This model could only explain 9% of the variance of adolescents' dietary habits.

For the predication of adolescents' physical activity, several social-demographic variables including gender, father's education level and family income were found to be associated with adolescents' physical activity, explaining nearly 13% of the variability (Table 4.7). The results of regression revealed that "parents' diet and PA monitoring" may explain 1.3% of the variance of adolescents' PA. The percentage of the variance of adolescents' PA could be explained by the model was only 14.0%.

Table 4.6 Hierarchical regression model to predict adolescents' dietary habits with parenting behaviors and social-demographic information

Predictors	B	β	95%CI for B	Sig.	R^2(unique)
Step 1					0.046
Adolescent's gender	1.470	0.371	0.742-2.198	0.000	
Step 2					0.039
Diet and PA monitoring	0.181	0.147	0.083-0.279	0.000	
Step 3					0.009
Resticting access to unhealthy food and sedentary behaviors	0.225	0.117	0.076-0.374	0.003	
Model R^2: 0.090; Final multiple R=0.300, P<0.01					

Note: Only variables with statistic significant in the model were presented.

Table 4.7 Hierarchical regression model to predict adolescents' physical activity with parenting behaviors and social-demographic information

Predictors	B	β	95%CI for B	Sig.	R^2(unique)
Step 1					0.127
Adolescent's gender	-1.506	-0.301	-1.845- -1.167	0.000	
Father's education level	0.394	0.140	0.119-0.669	0.005	
Family income	0.375	0.086	0.077-0.699	0.014	
Step 2					0.013
Parents' diet and PA monitoring	0.069	0.020	0.029-0.109	0.001	
Model R^2: 0.140; Final multiple R=0.374, P<0.01					

Note: Only variables with statistic significant in the model were presented.

4.4 Discussion and conclusion

The present study is one of the few studies investigating the association between parenting behaviors and adolescent obesity in China. The data of this study revealed that several parenting behaviors were significantly correlated to adolescents' BMI, dietary habits and physical activity, although only low percentage of the variance of adolescents' weight status, dietary habits and PA could be explained by these parenting behaviors.

"Pressure to eat" is one of frequently used parents' feeding behaviors, which means encouraging or forcing child to eat. Previous studies suggested that this type of parenting behaviors may have long term effects on children's food intake and weight status (Clark, et al., 2007). For instance, "pressure to eat" was found to be associated with higher fruit and

vegetable intake (Bourcier, et al., 2003). A cross-sectional study showed that "pressure to eat" were negative related to children's weight status (Spruijt-Metz, et al., 2002). Another longitudinal study revealed that parents always choose their feeding strategy based on their children's weight status. It was found out that, towards thinner children, parents were found to be more likely to use the behaviors of "pressure to eat" but less likely to use "restriction" strategies (Lee, Mitchell, Smiciklas-Wright, & Birch, 2001). The result of this study also confirmed these findings. The data of this study showed that "pressure to eat" were negatively related to adolescents' BMI ($r=-0.22$, $p<0.01$) and Z-BMI ($r=-0.23$, $p<0.01$). In addition, the data of this study showed that the parenting behavior of "pressure to eat" could explain 4.2% the variance of adolescents' weight status. The results of another study showed that "pressure to eat" and parents' concern for their children' weight status were found to explain 15% of the variance of children's total fat mass (Spruijt-Metz, et al., 2002). As two kinds of parenting behaviors were included in the same block in Spruijt-Mets's regression model, it may not be able to compare the data in Spruijt-Mets's study and ours. However, both of the studies suggested that "pressure to eat" is significantly associated with child's weight status.

Several parents' feeding behaviors including food restriction and using food as rewards were found to be associated with children's food intake (Rhee, 2008). For instance, adverse effects of restricting access to food on children's food intake were reported. In turns, children's weight status may also influence parental restriction (Fisher & Birch, 1999a). The present study also found that parents' restriction feeding behaviors were positively correlated to adolescents' dietary habits. Moreover, the results of hierarchical regression also indicated that "resticting access to unhealthy food and sedentary behaviors" was one of the significant predictors for adolescents' dietary habits. In addition, the data also revealed the correlation

between "diet and PA monitoring" and adolescents' dietary intake, which was consistent to the findings from previous studies (Lindsay, et al., 2006; Rhee, 2008), although it was noteworthy that the percentage of variability of adolescents' dietary habits explained by other parenting behaviors was not high.

Sufficient physical activity has been regarded as one of the key components in weight control program (Jakicic & Otto, 2005). Research suggested that parenting behaviors may influence their children's physical activity level. For instance, it found that when compared with the children of physical inactive parents, the children of active parents had higher odds ratio of being active (Moore, et al., 1991). It was also reported that the children received more parental support for sports participation were more active (O'Loughlin, et al., 1999). However, inconsistent results were found in several studies. It was reported that girls' physical activity were related to parents reported support but not associated with girls' perception of parent's support for physical activity (Adkins, et al., 2004). Another study revealed that parent support significantly correlated with adolescent self-reported physical activities, but not related to the adolescents' physical activity measured by accelerometers (Prochaska, et al., 2002). The results of the present study showed that "PA monitoring" and "restricting access to sedentary behaviors" were significantly associated with adolescents' physical activity. However, hierarchical model showed that parenting behaviors could only explain very low percentage of the variance of adolescents' physical activity. The data of present study indicated that parenting behaviors could be weakly but statistically significant related to adolescents' physical activity.

In addition, we failed to find large difference between paternal and maternal parenting behaviors in this study, although slight but significant differences were found in several

parenting behaviors. For hundreds years, Chinese families were influenced by Confucian ideas, in which women had low status in the household (S. W. K. Yu & Chau, 1997). However, the patriarchy of Chinese family was challenged since the implementation of one-child policy in 1979. Recent study indicated that the one-child policy is undermining patrilineal norms in China and the positions of women are improved significantly (Deutsch, 2006). Therefore, the slight differences in parenting behaviors in Chinese fathers and mothers could be partly explained by the promotion of gender equality in family during the past 3 decades.

Since the single-child family planning program was implemented in the 1970s in mainland China, millions of Chinese's parenting behaviors and parenting style was modified (Jing, 1994). Many Chinese children were treated like a little emperor or empress at home by their parents, which could be significantly different from tradition Chinese parenting style. For instance, parents always like to add some dishes to their children to express their love to children. It was reported that 56.0% parents often reminded their children to eat some food they regarded as healthy food, and 7.7% parents often forced their children to eat these food (W. J. Ma, et al., 2001). The data of this study also indicated that "pressure to eat" was also frequently used Chinese parents, which seems not consistent with the tradition "authoritarian" and "controlling" parenting in China. As this feeding strategy could influence children's own capability to regulate calories intake, "pressure to eat" may contribute to energy over-consumption and childhood obesity. The findings suggest that not only parenting behaviors but also parents' belief should be considered in the intervention.

There are several limitations in the present study that need to be clarified. First of all, as the study design of present study is cross sectional study, the direction of cause and effect could

not be determined. Other limitations may include the self-report nature of the data and non-national representative sample. There were also several strengths in this study which include large sample size and well developed questionnaires with acceptable validity and reliability.

In conclusion, it was successfully demonstrated in the present study that adolescents' weight status, dietary habits and physical activity were statistically significant but weakly associated with some parenting behaviors, including "pressure to eat", "diet and physical activity monitoring", "restricting access to unhealthy food and sedentary behaviors" and some other parenting behaviors. However, we failed to find large differences in parenting behaviors between Chinese fathers and mothers.

CHAPTER 5

PARENTS' PERCEPTIONS OF THEIR CHILDREN'S WEIGHTS AND THEIR RELATION TO PARENTING BEHAVIORS

5.1 Introduction

Childhood obesity is a growing epidemic worldwide. The incidence of childhood obesity has increased in most developed and developing countries. In China, as the nutritional problems shift from malnutrition to overnutrition in children and adolescents (Y. Wang, et al., 2002), the prevalence of obese children aged 2 to 6 years increased from 1.5% to 12.6%, and the prevalence of overweight individuals increased from 14.6% to 28.6% in urban areas of China from 1989 to 1997 (Luo & Hu, 2002).

Modifications of some eating habits and physical activities were recommended to the children and the parents to help prevent excessive weight gain of the children (Barlow & the Expert Committee, 2007). Since parents play a key role in shaping their children's eating habits and inclination to do physical activities (Rhee, 2008), parents' readiness and willingness to modify their parenting behaviors or parenting styles may be important steps toward helping their children lose weight. The Health Belief Model suggested that one of the key factors that determine individuals' health-related behaviors is their perception of their susceptibility to a particular health problem (Elder, Ayala, & Harris, 1999; Janz & Becker, 1984; Rhee, 2008). Therefore, parents may not be too willing to change their behaviors until they recognize the weight problems of their children. Recent studies also proved the correlation between

parental perception of children's weights and the parents' readiness to help their children lose weight (Rhee, et al., 2005).

Unfortunately, recent European and American studies have reported high percentages of parental misconception of their children's weight (Eckstein, et al., 2006; Etelson, et al., 2003; Ward, 2008). For instance, a cross-sectional survey in the United States showed that 95% of obese mothers believed that their children were overweight. However, nearly 80% of the mothers failed to perceive their overweight children as overweight (Baughcum, et al., 2000). The results of a study in Germany revealed that only 40.3% of the mothers correctly recognized their children's weight (Warschburger & Kroller, 2009). The data of Chinese parents' perception of their child's weight was reported by several cross-sectional surveys in mainland China (Shi, et al., 2007; Xie, et al., 2006). It was found that about 22% of the parents regarded their children as underweight even if their children had normal weights. Meanwhile, of the overweight children, 23% were perceived by their parents as having normal weights (Shi, et al., 2007).

The factors that may influence parents' perceptions of their children's weights had been widely discussed in recent studies. Children's and parents' characteristics, including children's weights, children's ages, children's sex, parents' weights, parental education level, and family incomes had been reported to be associated with parental perceptions of their children's weights (Baughcum, et al., 2000; Campbell, Williams, Hampton, & Wake, 2006; Huang, et al., 2007; Warschburger & Kroller, 2009). However, few studies had investigated the direct relationship between parental perception of children's weights and parenting behaviors to promote healthy dietary

and physical activity habits (Hodges, 2003), even if some studies had already determined a correlation between parenting behaviors and the development of childhood obesity (Birch & Fisher, 1998; Faith, Scanlon, et al., 2004; Rhee, 2008). In addition, although Chinese adolescents' and parents' weight perceptions were reported by several studies (Shi, et al., 2007; Xie, et al., 2006; Xie, et al., 2003), the studies concentrated on adolescents' own weight perceptions and weight satisfaction. There have not been substantial reports on Chinese parents' perceptions of their children's weights. Therefore, the purpose of this study is to examine Chinese parents' perceptions of their adolescent children's weights and to explore the parenting behaviors associated with these perceptions.

5.2 Methods

Study population and procedure

The study population of present study was the adolescents and their parents in urban areas of southern China, due to much higher prevalence of obesity in the urban areas as compared with rural areas (Luo & Hu, 2002). As improved economic and social conditions was found to be an important factor that may lead to Chinese's increased nutrient-dense and energy-dense food intake, sedentary lifestyle and weight status (Y. Wang, et al., 2002), it was decided to recruited our participants from a developed city and an underdeveloped city in southern China. Stratified random sampling was applied in the present study, in which a city (Shantou) in developed area and a city (Ganzhou) in underdeveloped area were chosen. Shantou, one of the original Special Economic Zones of China established in the 1980s, is one of the developed regions in southern China. The Gross Domestic Product (GDP) per capita in Shantou was 20,279 RMB (Shantou municipal bureau of statistics, 2010). Ganzhou, one of the old

revolutionary base areas in China, is an underdeveloped inland city located in southern China. The GDP per capita in Ganzhou was 9,391 RMB (Ganzhou municipal bureau of statistics, 2010).Adolescents and their parents were randomly recruited from grade 1 and grade 2 of secondary schools in Ganzhou and Shantou respectively. For example, in Ganzhou, there are two districts. In the present study, a key secondary school and an ordinary secondary school was randomly chosen in each district. 4-6 classes in each school (2-3 classes in each grade) were randomly drawn in the investigation. The same sampling strategy was applied in Shantou. Exclusion criteria for adolescents was using medications that may influence weight gain or loss, and a diagnosis of physical or developmental disability or chronic illness. From April to May 2009, 2,162 pairs of adolescents and parents participated in the present survey (Ganzhou: 1,179 pairs; Shantou: 1,106 pairs). There were 19 adolescents who had physical disability or received medications that influence their weight status were excluded from the analysis. 274 parents did not send the questionnaire back. Consequently, 2,143 adolescents and 1,869 their parents were finally included in the data analysis.

During the survey, adolescents aged 10 to 15 years were invited to complete an anthropometric test for body weight and height, and were asked to fill out questionnaires inside a classroom with the assistance of an investigator. The adolescents were also asked to take home the "questionnaires for parents", to ask either their mothers or fathers to fill out the questionnaires, and to give these back to the survey conductors. Souvenirs were given to the participants as compliments.

Other than the participants in the main survey, 127 pairs (Ganzhou: 62 pairs, Shantou:

65 pairs) were invited to participate in a pilot study beforehand. During the pilot study, adolescents and their parents were required to complete the questionnaires twice with two weeks apart. The test-retest reliability of each item and internal consistency was determined by intraclass correlation coefficient (ICC) and Cronbach's alpha respectively.

Signed informed consent was obtained from all participants (including adolescents and parents) prior to the survey. The adolescents and their parents were briefly introduced that they need to provide some information about their child's health status and were highly encouraged to honestly report what they really think and what they did. In the instruction of the questionnaire, both adolescents and parents were clearly informed that there is no right or wrong answers for each item and the questionnaire is anonymous. Formal approval was granted from the Chinese University of Hong Kong Research Ethics Committee.

Main study measures

Adolescent weight status

An adolescent's body weight to the nearest 0.1 kg was measured with minimal clothing and without shoes using a measuring scale. An adolescent's body height to the nearest 0.5 cm was taken using a stadiometer. An adolescent's body mass index (BMI) was calculated as his weight in kilograms divided by the square of his height in meters, and was categorized either as underweight (thinness, BMI-for-age < -2 SD), normal or, overweight (BMI-for-age > 1SD) based on the international growth standards for school-aged children and adolescents updated by the World Health Organization (WHO) (Butte, et al., 2007; De Onis, et al., 2007).

Parent weight status

The BMIs of parents were recorded based on their self-reported heights and weights, as it is not feasible to measure parents' height and weight in the present study. Validity of self-reported heights and weights of adults were well reported (Bolton-Smith, et al., 2000; Wada, et al., 2005). Pearson's r between self-reported BMI and measured BMI was 0.943 and 0.950 for men and women, respectively (Wada, et al., 2005). According to the BMI reference for screening overweight and obesity among Chinese adults, parental BMIs were categorized either as non-overweight (BMI<24kg/m^2) or overweight (24 kg/m^2≤BMI<28 kg/m^2), or obese (BMI≥28 kg/m^2) (Zhou & Cooperative Meta-Analysis Group of the Working Group on Obesity in China, 2002).

Parental perceptions of their children's weights

To assess the parents' perceptions of their children's weights, parents were asked to report their children's weights subjectively by giving any one of the five possible answers: "very underweight", "slightly underweight", "normal", "slightly overweight", and "very overweight". To aid in the analysis, the perception levels of the subjects were further categorized into either "underweight" ("very underweight" or "slightly underweight"), "normal" ("normal"), or "overweight" ("slightly overweight" or "very overweight") group. The test-retest reliability of this item was 0.88.

Adolescents' perceptions of their own weights

Figure drawings developed by Collins were used to examine adolescents' perceptions of their weights (Collins, 1991). The drawings were consisted of seven figures, whose

descriptions ranged from very thin to very obese. In this study, adolescents were instructed to choose any one of the seven figures to answer the following question: "Which picture looks the most like how you look?" The test-retest reliability of this item based on Grade 1-3 children with 3 days internal was 0.71 (Collins, 1991). The results of reliability test in current study showed that the test-retest reliability was 0.92. To aid in the analysis, the perception levels of the subjects were further categorized into "underweight", "normal", or "overweight" groups according to the classification method used in a previous study (Warschburger & Kroller, 2009). The adolescents who selected the thinnest 2 figures were categorized as "underweight"; the ones selected the next 3 figures were categorized as "normal" and the ones selected the heaviest 2 figures were categorized as "overweight". The adolescent's/parents' weight perceptions, depending on consistency of these to the actual weights, were defined either as "correct" or "incorrect".

Parenting behaviors

An 17-item, five-point Likert-type scale, which was modified and translated based on the questionnaires used in previous studies (Arredondo, et al., 2006; O'Connor, et al., 2010), was used to assess the parenting behaviors. The scale had the followings subscales: "diet and physical activity (PA) Monitoring", "use food or sedentary behaviors as rewards", "pressure to eat", "restricting access to unhealthy food and sedentary behaviors", and "reinforcement" regarding adolescents' eating and PA. Five Likert-scale responses were provided for these questions (response options: never, rarely, sometimes, frequently, always or strongly disagree, disagree, neutral, agree, strongly agree). Another data from the main survey was analyzed for construct validity. Confirmatory factor analysis using LISREL 8.51 software was conducted.

The description of the items as well as the results of construct validity test and reliability test were summarized in Table 3.3 and Table 3.6.

Others

Adolescents' gender and age were recorded based on the adolescents' own reports. Background information supplied by the parents included parental education level, age, and family income, among others.

Data analysis

The agreement of the parents' (adolescents') weight perceptions with the adolescents' actual weights were tested using Kappa statistics. Multinomial logistic regression was used to predict the risk factors that influence the accuracy of the parents' perception of their adolescents' weights. Analysis of covariance (ANCOVA) was used to compare the scores in parenting behaviors among parents with accurate perceptions and those who have misconceptions of their children's weights. As age, gender, socioeconomic status was reported to be associated with children's weight status, these factors were included in the analysis as covariates (Y. Wang, et al., 2002; Y. Wang & Zhang, 2006).

5.3 Results

A total of 2,143 adolescents and 1,869 their parents were included in this study. The demographic information is summarized in Table 5.1. The data of this study showed about two out of five parents mistakenly identified their children's weight, while nearly three out of five adolescents did not correctly report their weights.

Table 5.1 Demographic information (N=2,143)

Adolescent sex, %	
Boy	51.4
Girl	48.6
Adolescent age, mean ±SD, y	12.5±0.9
Adolescent weight status, %	
Underweight	2.4
Normal	80.9
Overweight	16.7
Adolescents' BMI, mean ±SD	18.6±2.8
Adolescent dietary habits, mean ±SD	39.3±5.3
Adolescent physical activity, mean ±SD	5.1±2.8
Parent sex, %	
Male	40.4
Female	59.6
Parent BMI, mean ±SD	22.2±3.0
Parenting behaviors, mean ±SD	
Diet and physical activity monitoring	19.8±4.3
Use food or sedentary behaviors as rewards	5.4±1.8
Pressure to eat	9.8±2.1
Restricting access to unhealthy food and sedentary behaviors	15.4±2.7
Reinforcement	7.0±2.1
Region, %	
Ganzhou	45.7
Shantou	54.3

As shown in Table 5.2, there was only a minimal agreement between the adolescents' BMIs and their parents' perception of their children's weights (Kappa=0.221, $p<0.01$). About 40% of parents of overweight adolescents believed that their children had normal weights or were underweight. Of the parents, 42.2% regarded their normal-weight children as underweight. Poor agreement was also found between the adolescents' actual BMIs and their perceptions of their own weights (Kappa=0.167, $p<0.01$). Nearly 30% of the overweight adolescents classified themselves either as adolescents with normal weights or as underweight. Moreover, 55.0% of

normal-weight adolescents considered themselves "underweight".

Table 5.2 The agreement of the adolescents' BMI category with their parents' and the adolescents' weight perception

	Adolescents' BMI category (N, %)			kappa
	underweight	normal	overweight	
Parental perception				0.221
Underweight	44(91.7)	626(42.2)	6(1.9)	
normal	2(4.2)	802(54.1)	120(38.5)	
overweight	2(4.2)	55(3.7)	186(59.6)	
Adolescents' perception				0.167
Underweight	44(84.6)	949(55.0)	21(5.9)	
normal	8(15.4)	635(36.8)	90(25.3)	
overweight	0(0)	141(8.2)	245(68.8)	

Note: 10 adolescents and 26 parents were excluded from the analysis because of incomplete data about them

The data of this study showed that several factors could be associated with parental weight perception (Table 5.3). It was learned that Chinese parents were more likely to incorrectly identify a boy's weight than a girl's weight (OR=1.61, 95% CI 1.29-2.01). Compared with fathers, mothers were less likely to have wrong perceptions about their children's weight (OR=0.80, 95%CI: 0.64-1.00). The results of the logistic regression also suggested that there was a correlation between parental perception of their children's weights and the adolescents' own perception of their weights. Unlike the parents whose children failed to correctly perceive their own weights, the parents whose children correctly reported their weights had better ability to recognize their children's weights (OR=0.30, 95% CI: 0.24-0.38). For the other adolescents' and parental characteristics, no significant independent association was found.

Table 5.3. Odds ratio for parental ability to incorrectly (versus correctly) identify their children's weight according to selected variables

		Adjusted OR (95% CI)
Adolescents' Gender	Girl	Reference
	Boy	1.61(1.29-2.01)**
Adolescents' weight perception	Incorrect	Reference
	correct	0.30(0.24-0.38)**
Parents' gender	father	Reference
	Mother	0.80(0.64-1.00)*
Number of children in the family	1	Reference
	≥2	0.99(0.72-1.35)
Parents' weight status	Normal	Reference
	overweight	0.98(0.75-1.28)
	obesity	0.66(0.37-1.20)
Parents' education	Junior middle school or lower	Reference
	Senior high school	0.94(0.70-1.27)
	College or higher	0.70(0.53-1.10)
Family income	Low	Reference
	Middle	0.94(0.73-1.19)
	High	0.88(0.48-1.60)
Location	Ganzhou	Reference
	Shantou	1.18(0.86-1.62)

Adjusted for adolescents' age and weights.
*: P<.05; **:P<.01

Parenting behaviors, which could be associated with the development of childhood obesity, were compared between the parents who correctly and incorrectly perceived their children's weights, using ANCOVA test (adjusting for adolescents' weight status, gender, and age) (Table 5.4). The data of this study suggest that indeed, there are differences between the parents with correct perception of their children's weights and those with incorrect perception. Compared with the parents who have wrong perceptions of their children's weights, the parents who have correct perception of their children's weights got higher scores in monitoring their adolescents' dietary and physical activities (p<.01), and gave more positive reinforcement to their children for manifesting healthy behaviors (p<.05). Parents with incorrect perception of their children's weights were more likely to select the feeding strategy of "pressure to eat"

($p<.01$) compared to parents with correct perception. However, no significant difference were found in "use food or sedentary behaviors as rewards" and "restricting access to unhealthy food and sedentary behaviors" between parents with correct and incorrect perception.

Table 5.4 Comparison of Parenting Behaviors of Parents With Correct and Incorrect Perception of Their Children's Weight

	Score in parenting behaviors Mean (95%CI)		ANCOVA Test		
	Correct	Incorrect	F	p	Cohen's *d*
Food and PA monitoring	20.38 (20.05-20.71)	19.52 (19.15-19.89)	11.93	0.001	0.20
Use food or sedentary behaviors as rewards	5.62 (5.48-5.76)	5.52 (5.36-5.67)	0.58	0.447	0.06
Pressure to eat	9.69 (9.53-9.86)	10.12 (10.01-10.38)	20.26	0.000	0.21
Restricting access to unhealthy food and sedentary behaviors	15.56 (15.34-15.78)	15.35 (15.10-15.59)	1.62	0.204	0.08
Reinforcement	7.20 (7.04-7.36)	6.95 (6.77-7.13)	4.05	0.044	0.12

Note: adolescents' weight, gender and age were adjusted.

5.4 Discussion and conclusion

The results of this study show that 16.7% of the adolescents are overweight, and over a quarter of the parents are overweight or obese. Childhood obesity has become an emerging major public health problem in China (Ji & Working Group on Obesity in China, 2005) although its prevalence has not yet reached the levels seen in other developed countries. This study shows a slight agreement between parental perception of their children's weights and the adolescents' actual weights. A higher percentage of misconception of the children's weight in Chinese parents was found (Table 2) compared with data in 2002 (Shi, et al., 2007). This could be caused by time-varying difference and the difference in research methods (sampling design and measurement instruments). Data from the present survey revealed that only 56% of the parents correctly reported their children's weights. Similar results were reported by other

studies. The results of a study conducted in the US showed that only 60% of the respondent mothers accurately assessed the weights of their children (Boutelle, Fulkerson, Neumark-Sztainer, & Story, 2004). This study shows that Chinese parents are not better at identifying their children's weights although a race/ethnicity difference in the accuracy of parental perception of their children's weight was reported (Boutelle, et al., 2004). In addition, the WHO growth reference where the BMI values at +1 SD are 25.4 kg/m^2 for boys and 25.0 kg/m^2 for girls at 19 years old (De Onis, et al., 2007) was used in the present study. This standard is linked to the overweight cut-off points (25 kg/m^2), and higher than the overweight standard for Chinese (24 kg/m^2) (Zhou & Cooperative Meta-Analysis Group of the Working Group on Obesity in China, 2002). Therefore, the prevalence of parents' misclassification of their children's weight could be even higher if a lower standard for overweight is applied.

Parental assessment of the weights of their children was reported to be associated with the characteristics of the parents themselves, as well as their children (Huang, et al., 2007). The results of this study reveal that parental perceptions of their children's weights are associated with gender, and the latter's perceptions of their own weights. Overweight daughters are more likely to elicit maternal concern (Campbell, et al., 2006; Maynard, Galuska, Blanck, & Serdula, 2003) compared with overweight sons. Chinese parents are also more likely to mistakenly perceive their sons' weights than their daughters.' Mothers were also found to have better ability to discriminate their children's weights. The main reason for this gender difference could be related to social values (Campbell, et al., 2006). For instance, girls with slender and graceful stature are favorably perceived by society, while overweight boys are sometimes

regarded as strong and healthy rather than obese. Therefore, Chinese parents are more sensitive to weight issues concerning their daughters than their sons, similar to parents from the US and Australia (Campbell, et al., 2006; Maynard, et al., 2003).

The reasons for parents' misclassification of their children's' weights are still not determined. It may be caused by parents' weak recognition of their children's true weights, lack of understanding of the definition of the words "overweight" and "obesity," and emotional factors such as parents' unwillingness to admit that their children are overweight or obese (Maynard, et al., 2003). A qualitative study revealed that low income US mothers preferred to describe their overweight children as thick or solid rather than overweight or obese (Jain, et al., 2001). A recent study showed that socioeconomic status is not associated with maternal classification of their own child's weight but with the identification of overweight in unrelated children (Warschburger & Kroller, 2009). Therefore, mothers' perception of their own children may be more influenced by emotional factors than "cognitive" factors such as knowledge about obesity and body image, which could be related to educational level. The study shows that parental perceptions of their children's weights are associated with gender, but not associated with the parents' education level and family income. Similarly, it could be explained that the parents' perception of their children's weight may be mainly caused by emotional factors, which could be related to the parents' and adolescent gender, rather than factors like education level, family income, and number of children in the family. However, the present study could not confirm this assumption. Further studies are needed to investigate the reasons.

The Health Belief Model suggests that the primary motivation to behavior

modification in weight management is the level of perceived threat or risk of obesity (Daddario, 2007). Therefore, addressing misconceptions of children and their parents on the children's weights may be an important first step to weight management. Previous studies suggested that underestimating children's weights by their parents and by the children themselves were associated with poorer diet behaviors and increase in the perceived barriers to the observation of a healthy diet or desire to exercise (Skinner, Weinberger, Mulvaney, Schlundt, & Rothman, 2008). Moreover, feedback on children's and adolescent's risk for overweight problem is recommended to increase parents' risk awareness and willingness to modify their parenting behaviors (Warschburger & Kroller, 2009). A study examined the psychological impact of a school-based weight-screening intervention that gave feedback to parents. The results showed that feedback did not influence changes in child feeding among parents of healthy-weight children. However, parents of overweight girls imposed more dietary restrictions on their daughters (Grimmett, Croker, Carnell, & Wardle, 2008). Another cross-sectional study showed that accurate classification of an overweight child may not translate into helpful behaviors and may lead to unhealthy behaviors such as encouragement to diet (Neumark-Sztainer, Wall, Story, & van den Berg, 2008). Several parenting behaviors including "food and PA monitoring," "pressure to eat," and "reinforcement" were found to be associated with parental perceptions of their children's weight in the current study. These parenting behaviors have been proven to be associated with childhood obesity (Birch & Fisher, 1998; Rhee, 2008). For instance, some studies indicated that parents' "pressure to eat" strategy correlates with children's caloric intake (Drucker, Hammer, Agras, & Bryson, 1999) and total fat mass (Spruijt-Metz, Lindquist, Birch, Fisher, & Goran, 2002). The present study reveals that parents with correct perception of their children's weight are

associated with lower frequency of using the strategy of "pressure to eat," compared with the parents with incorrect perception. Although only a small effect is found in the current study, the differences should not be ignored (Pedersen, 2003). The results still indicate that accurate classification of children's weights may be related to positive parenting behaviors, which could benefit childhood obesity prevention.

The results of this study also show the correlation between adolescents' perceptions of their own weights and their parents' perception. Another study based on 718 children and their parents also indicated that parents' judgment of adolescents' weights may affect their children's perceptions of their own weights (Huang, Donohue, Becerra, & Xu, 2009). The results of these studies suggest that parental perception of their children's weight is associated with parenting behaviors as well as adolescents' perception of their own weight, both of which may contribute to the development of adolescent obesity.

Several limitations need to be acknowledged and addressed regarding the present study. One is that the BMI rather than body fat was used to classify adolescents' weights. Although using BMI-for-age percentiles for screening overweight and obese children was effective (Ji & Working Group on Obesity in China, 2005; Mei, et al., 2002), there might have been mistakes in the weight classifications in this study because the BMI is not a direct measurement of body fat. Second, Collins' drawings, which were used to classify adolescents' perception of their own weight, are not based on individuals of a specific BMI range. The format and style of Collins'drawings are similar to the ones developed by Warschburger and Kroller based on specific preschool-aged children's BMI percentile (2009). The classification method used in

Warschburger and Kroller's study was then applied, although it is a limitation that needs to be acknowledged. The results could also not be applied to all Chinese in the world because the sample was drawn only from limited urban areas in Southern China. Other limitations that should be considered in interpreting the results include the "self-report" nature of certain data and the cross-sectional study design.

The survey, in spite of its limitations, still successfully demonstrates that misconceptions about children's weights are prevalent among Chinese parents. The accuracy of parental perception of children's weights could be associated with gender, and the adolescents' perceptions of their own weights. The association between parents' perception of their children's weight and parenting behaviors suggests that the accurate classification of children's weights could help prevent childhood obesity.

CHAPTER 6

ASSOCIATION BETWEEN PARENTING STYLE AND ADOLESCENT OBESITY

6.1. Introduction

Childhood obesity is a public health issue that is becoming an increasingly important problem in developed countries (Lehingue, 1999; Ogden, Flegal, Carroll, & Johnson, 2002). In the past 10 years, the obesity epidemic among children and adolescents has also been growing rapidly in China (Ji & Working Group on Obesity in China, 2005). Parents could play key roles in the development and prevention of childhood obesity. It was reported that childhood obesity could be associated with parental weight (Wrotniak, et al., 2004), parental perception of children's weight (Maynard, et al., 2003), parental belief and knowledge on health and nutrition (Wardle, et al., 2000), parental socioeconomic status (Whitaker & Orzol, 2006), and parenting behaviors (Clark, et al., 2007). Furthermore, recent research revealed that children's weight problem may also influenced by their parents' parenting style (Rhee, et al., 2006).

Parenting style is defined as "a constellation of attitudes toward the child, which are communicated to him or her, and which, taken together, create an emotional climate in which the parent's behaviors are expressed" (Darling & Steinberg, 1993). Parenting style could be very important in childhood obesity prevention because it provides the environmental and emotional context for children's growth, as well as the context in which specific parenting behaviors are expressed (Rhee, 2008). The most widely used typology was originally established by Baumrind, in which parenting styles were conceptualized based on the amount and quality of two underlying dimensions: demandingness and responsiveness (Baumrind, 1971). According to these two

dimensions, parenting could be categorized into four main styles: (1) the authoritative style (high demandingness/high responsiveness) (2) the authoritarian style (high demandingness/low responsiveness); (3) the indulgent/permissive style (low demandingness/high responsiveness) and (4) the uninvolved/neglectful style (low demandingness/low responsiveness) (Darling & Steinberg, 1993). Compared with the other three parenting styles, the authoritative parenting style is regarded as the desirable and has been related to better child outcomes. It was reported that parenting styles may influence adolescents' academic achievement and performance (Aunola, et al., 2000). It was also found that authoritative parents were evidently successful in preventing their adolescents from problem drug use and in developing competence (Baumrind, 1991).

Inconsistent results were reported by several studies on the relationship between parenting style and obesity. For instance, it was found that children of authoritarian, permissive, and neglectful mothers had an increased risk of being overweight (Rhee, et al., 2006). However, the results of a longitudinal study in Australia indicated that fathers', but not mothers' parenting styles may increase the risk for childhood obesity (Wake, et al., 2007). Another study revealed that parenting style may not be an independent risk factor for childhood obesity (Agras, Hammer, McNicholas, & Kraemer, 2004). In addition, few studies had investigated whether the concordance of mother and father parenting styles would influence their children's weight status. For example, does a child grow up in a family with two authoritative parents have low risk for obesity than the child in a family with no or only one authoritative parent? Therefore, the relationship between parenting style and obesity in children and adolescents is still not clear.

Furthermore, in China, Confucianism dominated the content of traditional Chinese culture for centuries. In traditional Chinese family, there is a strong bond between parents and children, and parenting always has influence in determining a child's lifestyle during his or her growth. Even today, although Chinese society has been influenced by the West, many Chinese's beliefs and behaviors including parenting are still greatly influenced by Confucianism (Holroyd, 2003; P. Wu, et al., 2002; Xu, et al., 2005). Chinese parenting was always described as "authoritarian", "restrictive" and "controlling" (Lin & Fu, 1990; Steinberg, et al., 1992). Research indicated that, Americans value "nurturing innate ability" but Chinese attach importance to high self-discipline, obedience to parents, high parental involvement and sacrifice, which are deeply rooted in the Confucianism (Chao, 1994). This specific Chinese parenting style influenced by Chinese culture had been reported to be associated with children's social and school performance (Nelson, et al., 2006) as well as child temperament (Porter, et al., 2005).

However, few studies had investigated the association between the Chinese parenting style and their children's weight status and existing studies have focused almost exclusively on the parenting style of European or American parents. A cross-sectional study based on 163 Chinese children (aged 8 to 10 years) and their mothers indicated a positive relationship between democratic parenting and the children's BMI (J. L. Chen & Kennedy, 2004). However, one of the limitations for this study is the small sample size. Furthermore, only two categorical parenting styles (authoritarian and democratic) rather than the commonly used four categorical parenting styles were applied in the study. In addition, some studies revealed that parenting style could be

associated with children's health-related behaviors (Lohaus, Vierhaus, & Ball, 2009; Reitz, Dekovic, Meijer, & Engels, 2006), which could be the factors contributing to the development childhood obesity.

Therefore, the objectives of this study are: 1) to determine whether adolescents' weight is related to parenting style; 2) to examine the relationship between parenting style and the factors related to adolescent obesity (e.g., adolescents' dietary habits, level of physical activity, and parenting behaviors).

6.2 Methods

Study population and procedure

The study population of present study was the adolescents and their parents in urban areas of southern China, due to much higher prevalence of obesity in the urban areas as compared with rural areas (Luo & Hu, 2002). As improved economic and social conditions was found to be an important factor that may lead to Chinese's increased nutrient-dense and energy-dense food intake, sedentary lifestyle and weight status (Y. Wang, et al., 2002), it was decided to recruited our participants from a developed city and an underdeveloped city in southern China. Stratified random sampling was applied in the present study, in which a city (Shantou) in developed area and a city (Ganzhou) in underdeveloped area were chosen. Shantou, one of the original Special Economic Zones of China established in the 1980s, is one of the developed regions in southern China. The Gross Domestic Product (GDP) per capita in Shantou was 20,279 RMB (Shantou municipal bureau of statistics, 2010). Ganzhou, one of the old revolutionary base areas in China, is an underdeveloped inland city located in southern China. The GDP per capita in Ganzhou was 9,391 RMB (Ganzhou municipal

bureau of statistics, 2010).Adolescents and their parents were randomly recruited from grade 1 and grade 2 of secondary schools in Ganzhou and Shantou respectively. For example, in Ganzhou, there are two districts. In the present study, a key secondary school and an ordinary secondary school was randomly chosen in each district. 4-6 classes in each school (2-3 classes in each grade) were randomly drawn in the investigation. The same sampling strategy was applied in Shantou. Exclusion criteria for adolescents was using medications that may influence weight gain or loss, and a diagnosis of physical or developmental disability or chronic illness.

From April to May 2009, 2,162 pairs of adolescents and parents participated in the present survey (Ganzhou: 1,179 pairs; Shantou: 1,106 pairs). There were 19 adolescents who had physical disability or received medications that influence their weight status were excluded from the analysis. 274 parents did not send the questionnaire back. Consequently, 2,143 adolescents and 1,869 their parents were finally included in the data analysis.

During the survey, adolescents in the grade 1 and grade 2 students in secondary school were invited to complete an anthropometric test for body weight and height, and were asked to fill out questionnaires inside a classroom with the assistance of an investigator. The adolescents were also asked to take home the "questionnaires for parents" for either their mother or father to fill out, and to give the questionnaires back to the survey conductors. Souvenirs were given to the participants as compliments.

Other than the participants in the main survey, 127 pairs adolescents and parents

(Ganzhou: 62 pairs, Shantou: 65 pairs) were invited to participate in a reliability study four weeks prior to the main survey. During the reliability study, adolescents and their parents were required to complete the questionnaires twice with two weeks apart. The test-retest reliability of each item and internal consistency was determined by intraclass correlation coefficient (ICC) and Cronbach's alpha respectively

Signed informed consent was obtained from all participants (including adolescents and parents) prior to the survey. The adolescents and their parents were briefly introduced that they need to provide some information about their child's health status and were highly encouraged to honestly report what they really think and what they did. In the instruction of the questionnaire, both adolescents and parents were clearly informed that there is no right or wrong answers for each item and the questionnaire is anonymous. Formal approval was granted from the Chinese University of Hong Kong Research Ethics Committee.

Main study measures

Adolescent weight status

An adolescent's body weight to the nearest 0.1 kg was measured with minimal clothing and without shoes using a measuring scale. An adolescent's body height to the nearest 0.5 cm was taken using a stadiometer. An adolescent's body mass index (BMI) was calculated as his or her weight in kilograms divided by the square of his height in meters, and was categorized either as underweight (thinness, BMI-for-age < -2 SD), normal, or overweight (BMI-for-age > 1SD) based on the international growth standards for school-aged children and adolescents updated by the World Health Organization (WHO) (Butte, et al., 2007; De Onis, et al., 2007).

Parent weight status

The BMIs of parents were recorded based on their self-reported heights and weights, as it is not feasible to measure parents' height and weight in the present study. Validity of self-reported heights and weights of adults were well reported (Bolton-Smith, et al., 2000; Wada, et al., 2005). Pearson's r between self-reported BMI and measured BMI was 0.943 and 0.950 for men and women, respectively (Wada, et al., 2005). According to the BMI reference for screening overweight and obesity among Chinese adults, parental BMIs were categorized either as non-overweight (BMI<24kg/m^2) or overweight (24 kg/m^2≤BMI<28 kg/m^2), or obese (BMI≥28 kg/m^2) (Zhou & Cooperative Meta-Analysis Group of the Working Group on Obesity in China, 2002).

Adolescents' dietary habits

Adolescents' dietary habits were measured by a five-point Likert-scale including 12 items. During the survey, the adolescents were provided with responses ranging from "never," "rarely," "sometimes," "frequently," and "always" to indicate the frequency of their dietary behaviors during the past years. The sample questions were as follows: "I eat at least 3 servings of vegetables a day" and "I eat more during dinner if the food tastes good." The total score of the adolescents' dietary habits was calculated as the sum score of each item. The validity and reliability of the scale were found to be acceptable (Sheu, 2003). The two weeks test-retest reliability of these items ranged from 0.70 to 0.79. The internal consistency for this scale was 0.71. The scores of dietary habits were dichotomized and further categorized as "healthy diets" (upper part) and "unhealthy diets" (lower part).

Adolescents' physical activity level

All adolescents were invited to complete a validated physical activity rating questionnaire for children and youth (PARCY) to assess their average weekly physical activity over the last year. The PARCY is a 1-item activity rating modified from the Jackson Activity Coding (Baumgartner & Jackson, 1999; George, et al., 1997) and the Godin-Shephard Activity Questionnaire modified for Adolescents (Aaron, et al., 1993; Godin & Shephard, 1985). The criterion validity and convergent validity of PARCY have been published in other sources (Hui, 2001; Hui, et al., 2001). The scale is an 11-point scale (0 - 10) ranging from no exercise at all (rating of 0) to doing vigorous exercise almost everyday (rating of 10). The design of the rating took into consideration activity frequency, duration, and intensity. The physical activity levels of the subjects were further categorized into either "inactive" (PAR = 0 to 2), "slightly active" (PAR = 3 to 6), or "active" (PAR = 7 to 10) groups for analysis. Our pilot study showed that the two weeks test-retest reliability of the item was 0.83.

Parenting behaviors

An 17-item, five-point Likert-type scale, which was modified and translated based on the questionnaires used in previous studies (Arredondo, et al., 2006; O'Connor, et al., 2010), was used to assess the parenting behaviors. The scale had the followings subscales: "diet and physical activity (PA) Monitoring", "use food or sedentary behaviors as rewards", "pressure to eat", "restricting access to unhealthy food and sedentary behaviors", and "reinforcement" regarding adolescents' eating and PA. Five Likert-scale responses were provided for these questions (response options: never, rarely, sometimes, frequently, always or strongly disagree, disagree, neutral, agree, strongly agree). Another 1,000 data extracted randomly from the main survey was

analyzed for construct validity. Confirmatory factor analysis using LISREL 8.51 software was conducted. The description of the items as well as the results of construct validity test and reliability test were summarized in Table 3.3 and Table 3.6.

Perceived Parenting style

Adolescents were required to report both their father's and mother's parenting style via Authoritative Parenting Index (API), which was reported to have a factor structure consistent with a theoretical model of the construct and had good reliability (Jackson, et al., 1998). There were nine items in the responsiveness subscale and seven items in the demandingness subscale. API was translated into Chinese and then back-translated into English to ensure the instrument's internal validity. The two weeks test-retest reliability of these items ranged from 0.70 to 0.85. The internal consistencies for the two subscales were 0.70 and 0.75, respectively. The description of the items as well as the results of construct validity test and reliability test were summarized in Table 3.4, Table 3.5 and Table 3.7. A cross-classification of high and low scores based on median splits on the responsiveness and demandingness subscale identified the four categorical parenting styles (Darling & Steinberg, 1993).

Adolescents' pubertal status

Although it was suggested that obesity could be associated with pubertal timing (Kaplowitz, et al., 2001; Tremblay & Frigon, 2005), pubertal status was not well controlled in many studies on adolescent obesity (Tsiros, et al., 2008). In this study, a self-assessment questionnaire, which required the adolescents to report their pubic hair growth, breast development (for girls), and male genital development (for boys), was used to measure the children's pubertal status. The questionnaire enabled the

reliable estimation of the sexual maturation status of Chinese children (Chan, et al., 2008). The two weeks test-retest reliability of these two items in this study is 0.80 and 0.82, respectively. The internal consistency was 0.71.

Demographic information

Adolescent gender and age were based on the adolescent's self-report. The background information supplied by the parents included parental education level, age, family income, and so on.

Statistical Analysis

Logistic regression was applied to predict the odds ratios of being overweight for the children of authoritarian, permissive, and neglectful parents, using the children of authoritative parents as reference. The same strategy was also applied to determine the odds of being physically inactive and having unhealthy dietary habits. Analysis of covariance (ANCOVA) was used to compare obesity-related parenting behaviors in the four parenting style groups. As age, gender, socioeconomic status was reported to be associated with children's weight status, dietary habits and physical activity, these factors were included in the analysis as covariates (Y. Wang, et al., 2002; Y. Wang & Zhang, 2006).

6.3 Results

2,143 adolescents and 1,869 their parents were included in this study. The demographic information is summarized in Table 6.1. The age of adolescents recruited in this study ranged from 10 to 15. The data of this study showed that 16.7% of the adolescents were overweight. The authoritative parenting style was found in 30.3% of

fathers and 25.2% of mothers (Table 6.2).

Table 6.1 Demographic information (N=2,143)

Adolescent sex, %	
Boy	51.4
Girl	48.6
Adolescent age, mean ±SD, y	12.5±0.9
Adolescent weight status, %	
Underweight	2.4
Normal	80.9
Overweight	16.7
Adolescents' BMI, mean ±SD	18.6±2.8
Adolescent dietary habits, mean ±SD	39.3±5.3
Adolescent physical activity, mean ±SD	5.1±2.8
Parent sex, %	
Male	40.4
Female	59.6
Parent BMI, mean ±SD	22.2±3.0
Parenting behaviors, mean ±SD	
Diet and physical activity monitoring	19.8±4.3
Use food or sedentary behaviors as rewards	5.4±1.8
Pressure to eat	9.8±2.1
Restricting access to unhealthy food and sedentary behaviors	15.4±2.7
Reinforcement	7.0±2.1
Region, %	
Ganzhou	45.7
Shantou	54.3

Table 6.2 Percentage of parents in each type of parenting style

	Parenting Style Types			
	Authoritative	Authoritarian	Permissive	Neglectful
Fathers (N=2,096), %	30.3	26.0	16.7	27.1
Mothers (N=2,104), %	25.2	24.7	17.6	32.5

The results of logistic regression are summarized in Tables 6.3 and 6.4. No significant association was found between the adolescents' weight and the fathers' or mothers' responsiveness and demandingness (Table 6.3). However, the children of parents with

low responsiveness (Father: OR = 1.70, 95%CI: 1.40 - 2.06; Mother: OR = 1.71, 95%CI: 1.41 - 2.09) or low demandingness (Father: OR=1.39, 95%CI: 1.15 - 1.69; Mother: OR = 1.45, 95%CI: 1.20 - 1.76) had a significant increase in the odds of having unhealthy dietary habits compared with the children of parents with high responsiveness and demandingness. The children of parents with low responsiveness were more likely to be physically inactive compared with the children of parents with high responsiveness (Father: OR = 1.80, 95%CI: 1.34 - 2.43; Mother: OR = 1.38, 95%CI: 1.02 - 1.86).

In addition, the data of this study revealed the significant association between adolescents' dietary habits, physical activity level and parenting styles (Table 6.4). It was found that as compared to the reference authoritative parenting style, the odds of having unhealthy dietary habits were significantly higher in the children of parents with authoritarian (Father: OR = 1.67, 95%CI: 1.29 - 2.16; Mother: OR = 1.72 95%CI: 1.31 - 2.26) and neglectful parenting style (Father: OR = 2.17 95%CI: 1.66 - 2.82; Mother: OR = 2.29, 95%CI: 1.76 - 3.00). The odds for being physically inactive in the children of neglectful parents were almost twice of those for children with authoritative parents (Father: OR = 2.05, 95%CI: 1.37 - 3.06; Mother: OR = 1.77, 95%CI: 1.18 - 2.67). Moreover, the result also showed that compared to the children grew up in the family with two authoritative parents, the children lived in the family with no authoritative parent had significant higher risk for having unhealthy diet (OR = 1.95, 95%CI: 1.51 – 2.51) and being physical inactive (OR = 1.65, 95%CI: 1.09 - 2.49). However, no significant association was found between parenting style and the adolescents' weight status.

Table 6.3 Adjusted odds ratio of being overweight, physical inactive and having unhealthy dietary habits in children of parents with low responsiveness/ demandingness as compared with high responsiveness/ demandingness.

	Overweight vs. Not Overweight[#]	Unhealthy Diet vs. Healthy Diet ^	Inactive vs. Active^
Father's Responsiveness			
High	Reference	Reference	Reference
Low	1.08(0.82-1.42)	1.70(1.40-2.06)**	1.80(1.34-2.43)**
Mother's Responsiveness			
High	Reference	Reference	Reference
Low	0.89(0.68-1.18)	1.71(1.41-2.09)**	1.38(1.02-1.86)*
Father's Demandingness			
High	Reference	Reference	Reference
Low	1.00(0.75-1.32)	1.39(1.15-1.69)**	1.23(0.92-1.65)
Mother's Demandingness			
High	Reference	Reference	Reference
Low	0.89(0.75-1.29)	1.45(1.20-1.76)**	1.35(1.01-1.80)*

Note: [#] Adolescents' age, gender, pubertal status, parents' weight status, education level and family income were adjusted.
^ Age, gender, weight status, parents' education level and family income were adjusted.
*:P<.05, **:P<.01

Table 6.4 Adjusted odds ratio of being overweight, physical inactive and having unhealthy dietary habits in children of authoritative parents as compared with the children of parents with other parenting styles

	Overweight vs. Not Overweight[#]	Unhealthy Diet vs. Healthy Diet ^	Inactive vs. Active^
Father's parenting style			
Authoritative	Reference	Reference	Reference
Authoritarian	1.15(0.80-1.65)	1.67(1.29-2.16)**	1.65(1.11-2.45)*
Permissive	0.99(0.65-1.50)	1.32(0.99-1.77)	1.04(0.65-1.64)
Neglectful	1.15(0.77-1.71)	2.17(1.66-2.82)**	2.05(1.37-3.06)**
Mother's parenting style			
Authoritative	Reference	Reference	Reference
Authoritarian	1.22(0.84-1.77)	1.72(1.31-2.26)**	1.23(0.81-1.87)
Permissive	1.35(0.91-2.02)	1.44(1.07-1.95)*	1.19(0.75-1.89)
Neglectful	0.89(0.60-1.33)	2.29(1.76-3.00)**	1.77(1.18-2.67)**
The number of authoritative parents			
2	Reference	Reference	Reference
1	1.02(0.64-1.61)	1.22(0.88-1.70)	1.30(0.75-2.25)
None	1.10(0.77-1.58)	1.95(1.51-2.51)**	1.65(1.09-2.49)*

Note: [#] Adolescents' age, gender, pubertal status, parents' weight status, education level and family income were adjusted.
^ Adolescents' age, gender, weight status, parents' education level and family income were adjusted.
*:P<.05, **:P<.01

Parenting behaviors, which could be associated with the development of childhood obesity, were compared among the parents with different parenting styles using

ANCOVA test (adjusting for the adolescents' weight, gender, age, parents' weight, education level, and family income) (Table 6.5 and Table 6.6). The data of this study suggested that indeed, there were differences in the parenting behaviors of parents with different parenting styles. Compared with authoritarian, permissive and neglectful parents, authoritative parents obtained higher scores in monitoring their adolescents' dietary and physical activities ($P < 0.01$). Moreover, authoritative parents were found to give more positive reinforcement to their children for manifesting healthy behaviors compared with authoritarian and neglectful parents ($P < 0.01$). In addition, the data revealed that compared with permissive and neglectful parents, authoritative parents were more likely to restrict their children from unhealthy food and sedentary behaviors ($P < 0.01$). However, no significant difference was found in the feeding strategy of "Pressure to eat" in both fathers and mothers with different parenting styles.

Furthermore, as it was showed in Table 6.7, compared with the parenting behaviors in the family with one or no authoritative parent, some parenting behaviors (food & PA monitoring, food and sedentary behaviors restriction and reinforcement) could be different in the family, in which both father and mother are authoritative. However, no significant difference was found in other parenting behaviors, such as "Using food or sedentary behaviors as rewards" and "Pressure to eat".

Table 6.5 Comparison of the parenting behaviors in fathers with different parenting styles, adjusting for adolescents' weight status, gender, age, parents' weight status, education level and family income.

	Authoritative	Authoritarian	Permissive	Neglectful	F	ANCOVA
Food and PA Monitoring	20.7(20.3-21.1) [abc]	20.0(19.5-20.4) [ae]	19.7 (19.2-20.2) [b]	19.2(18.8-19.6) [ce]	7.83	P <.01
Use food or sedentary behaviors as rewards	5.5(5.3-5.7)	5.5(5.3-5.7)	5.2(5.0-5.4)	5.3 (5.2-5.5)	0.51	P >.05
Pressure to eat	9.7 (9.5-9.9)	10.0(9.8-10.2)	9.5(9.3-9.8)	9.9(9.7-10.1)	1.85	P >.05
food and sedentary behaviors restriction	15.9(15.6-16.1) [bc]	15.6(15.3-15.9) [de]	14.8(14.5-15.2) [bd]	15.2(14.9-15.5) [ce]	11.27	P <.01
Reinforcement	7.4(7.3-7.6) [abc]	6.8(6.6-7.0) [a]	7.0(6.8-7.3) [bf]	6.6(6.4-6.8) [cf]	8.32	P <.01

[a]: difference between authoritative and authoritarian parenting style group is significant, p<.05; [b]: difference between authoritative and permissive parenting style group is significant, p<.05; [c]: difference between authoritative and neglectful parenting style group is significant, p<.05; [d]: difference between authoritarian and permissive parenting style group is significant, p<.05; [e]: difference between authoritarian and neglectful parenting style group is significant, p<.05; [f]: difference between permissive and neglectful parenting style group is significant, p<.05

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Table 6.6. Comparison of the parenting behaviors in mothers with different parenting styles, adjusting for adolescents' weight status, gender, age, parents' weight status, education level and family income.

	Authoritative	Authoritarian	Permissive	Neglectful	F	ANCOVA
Food and PA Monitoring	20.9(20.4-21.3) [abc]	20.2(19.8-20.6) [ae]	20.0(19.5-20.5) [bf]	19.0(18.6-19.4) [cef]	15.30	P <.01
Use food or sedentary behaviors as rewards	5.5(5.3-5.7)	5.4(5.2-5.6)	5.2(5.0-5.4)	5.3(5.2-5.5)	1.75	P >.05
Pressure to eat	9.7(9.5-9.9)	10.0(9.8-10.2)	9.6(9.4-10.9)	9.8(9.6-10.0)	1.74	P >.05
food and sedentary behaviors restriction	15.9(15.6-16.2) [bc]	15.6(15.3-15.9) [de]	15.1(14.8-15.4) [bd]	15.2(14.9-15.4) [ce]	6.34	P <.01
Reinforcement	7.6(7.3-7.8) [ac]	6.7(6.5-6.9) [ad]	7.2(7.0-7.5) [df]	6.6(6.4-6.8) [cf]	16.77	P <.01

[a]: difference between authoritative and authoritarian parenting style group is significant, p<.05; [b]: difference between authoritative and permissive parenting style group is significant, p<.05; [c]: difference between authoritative and neglectful parenting style group is significant, p<.05; [d]: difference between authoritarian and permissive parenting style group is significant, p<.05; [e]: difference between authoritarian and neglectful parenting style group is significant, p<.05; [f]: difference between permissive and neglectful parenting style group is significant, p<.05

Table 6.7 Comparison of the parenting behaviors in parents with different parenting styles, adjusting for adolescents' weight status, gender, age, parents' weight status, education level and family income.

	The number of authoritative parents			F	ANCOVA
	None	1	2		
Food and PA Monitoring	19.6(19.3-19.9) [b]	19.8(19.2-20.3) [c]	21.1(20.7-21.6) [bc]	14.43	P <.01
Use food or sedentary behaviors as rewards	5.3(5.2-5.5)	5.3(5.0-5.5)	5.5(5.3-5.7)	2.52	P >.05
Pressure to eat	9.8(9.7-10.0)	9.8(9.5-10.0)	9.7(9.5-9.9)	0.87	P >.05
Food and sedentary behaviors restriction	15.3(15.1-15.4) [b]	15.4(15.0-15.8) [c]	16.0(15.7-16.3) [bc]	10.94	P <.01
Reinforcement	6.8(6.6-6.9) [b]	7.1(6.8-7.4) [c]	7.6(7.4-7.8) [bc]	16.28	P <.01

[a]: difference between the family with no authoritative parent and the one with an authoritative parent is significant, p<.05
[b]: difference between the family with no authoritative parent and the one with two authoritative parents is significant, p<.05
[c]: difference between the family with an authoritative parent and the one with two authoritative parents is significant, p<.05

6.4 Discussion and conclusion

In this study, the relationship between adolescents' weight, dietary habits, physical activity, parenting behaviors, and parenting style was investigated in Chinese adolescents and parents. The results of the present study indicated a significant association between adolescents' dietary habits, physical activity, some parenting behaviors, and parenting style, but no statistical difference was found in the association between parenting style and the adolescents' weight.

Parenting style had been reported to play an important role in the children's diet. For instance, a more demanding parenting style was found to be associated with lower consumption of sugar-sweetened beverages in adolescents (van der Horst, Kremers, et al., 2007). It was also found that fruit intake and fruit-specific cognitions were most favorable among adolescents of authoritative parents (Kremers, Brug, de Vries, & Engels, 2003). The data of this study also suggested that the children of authoritative parents may have healthier dietary habits than the

children of parents with the other three types of parenting styles. In addition, compared with other parents, the parents with authoritative parenting style could be more likely to monitor their adolescents' food consumption and physical activity, and more likely to give positive reinforcement when their children choose healthy food. The results indicated that these parenting behaviors, which could contribute to the development of childhood obesity, may partly explain why the children of authoritative parents may have healthier dietary habits.

Moreover, research indicated that parenting style could be associated with children's physical activity (Arredondo, et al., 2006). It was also reported that parental behaviors could have an effect on the attraction to physical activity in overweight Chinese children (Lau, et al., 2007). Similarly, the results of the present study confirmed the association between adolescents' physical activity and parental responsiveness and demandingness. Furthermore, it was found that compared with the children of authoritative parents, the children of neglectful parents could be more physically inactive. This could be partly explained by the difference in parenting behaviors in authoritative and neglectful parents (e.g. PA monitoring and reinforcement) (Table 6.5 and Table 6.6).

In addition, the present study also suggested the association between the children's physical activity level, dietary habits and the concordance of their mother and father parenting styles. It was found out that, compared to the children raised by authoritative father and authoritative mother, the children grew up in the family with no authoritative parent had significant higher risk for having unhealthy diet and being physical inactive. However, no significant difference was found between the families with no authoritative parent and with an authoritative father or mother. Furthermore, the results also revealed the different parenting behaviors in the families with no, one and two authoritative parents. The data indicated that the role of

parenting style in children's development of diet and physical activity habits should not be ignored.

Although the significant relationships between dietary habits, physical activity, and parenting style were determined in the current study, there was no evidence for the direct association between parenting style and the adolescents' weight, which is not consistent with the findings on the strong association between parenting style and children's BMI in other studies. For instance, a significant increased risk of being overweight was found in the children of authoritarian, permissive, and neglectful mothers when compared with the children of authoritative mothers (Rhee, et al., 2006). However, the results of another study showed that fathers' but not mothers' parenting styles were related to increased risks of childhood obesity (Wake, et al., 2007). The reasons for these conflicting results on the relationship between parenting style and child's weight could be complicated. First, some researchers pointed out that the association between parenting style and children's weight status may vary in different nations (Wake, et al., 2007). Given that the social structure and traditional culture in China are quite unique, it is plausible that the relationship of parenting style and children's weight status in China could be different from that in the US and Australia. Research showed that the cultural setting in family may influence their parenting styles and interaction with their children (Xu, et al., 2005). Another study also suggested that differences in cultural orientation toward weight status should be taken into account, when interpreting the physical activity level of overweight children (Lau, et al., 2007). Second, as there is no standard cutoff points for the scales to measure parenting style, the four parenting styles were categorized based on a relative criterion rather than an absolute one. This means that considering the difference in parenting style of Chinese and American parents (P. Wu, et al., 2002), a neglectful mother in a Chinese study could be regarded as an authoritative mother if her data

were included in a study in the United States. Third, the difference in research design (longitudinal or cross-sectional) and the measurement of parenting styles may account for some of the conflicting results in different studies. To sum up, the relationship between parenting style and childhood obesity is still not clear, and additional studies are needed.

There are several limitations that need to be acknowledged regarding the present study. First, although a relatively large sample was recruited in this study, the study sample in the present research was a non-national representative sample. Therefore, the results could not generalized to all the Chinese. Other limitations may include the self-report nature of the data and the cross-sectional study design.

Despite these limitations, the current study still successfully demonstrated that the adolescents' dietary habits, physical activity, and some parenting behaviors may be associated with parenting style. However, the association between parenting style and the adolescents' weight was not found.

CHAPTER 7

GENERAL DISCUSSION AND CONCLUSION

During the past two decades, obesity among Chinese children has become an increasing important public problem especially in urban areas of China (Luo & Hu, 2002). One of the important steps for childhood obesity prevention is to determine the factors associated with the development of children's weight problem. Studies indicated that parents may play important roles in the etiology and treatment of childhood obesity (Dietz & Robinson, 2005; Robinson, 1999). The aim of the present study was to determine the relationship among adolescents' weight status, parenting behaviors, parents' perception of their children's weight and parenting styles in China.

To obtain the objectives, our study was divided into two steps. For the first step, questionnaires to measure parents' perception of their child's weight, parenting behaviors, parenting styles for Chinese adolescents and their parents were validated. The present study successfully demonstrated that the content validity, construct validity, test retest reliability and internal consistency of the developed questionnaire were acceptable, and could be applied in adolescents and parents in sourthern China. For the second step, a cross-sectional survey was held to investigate the relationship among parenting behaviors, parents' perception of their children's weight, parenting styles, adolescents' dietary habits, physical activity and weight status in China. It was found that adolescents' weight status, dietary habits and physical activity were statistically significant but weakly associated with some parenting behaviors, including "pressure to eat", "resticting access to unhealthy food and sedentary behaviors", "diet and physical activity monitoring"and some other parenting behaviors. Moreover, parental perception of their children's weight, which was found to be

associated with parents' gender, adolescents' gender, and adolescents' perceptions of their own weights, could be related to some parenting behaviors related to the development of adolescent obesity. In addition, it was found that the adolescents' dietary habits, physical activity, and some parenting behaviors were associated with parenting style. However, we failed to find the direct association between parenting style and the adolescents' weight status. As several parent-related factors, including genetic factors, home environment and neighborhood built environment & safety and other factors, were not investigated in the present study, the model proposed may not comprehensively explain the relationship among the parent-related factors and adolescents' weight status. However, it is still believed that the findings in this study may help us better understand the association among parenting behaviors, parenting styles, parents' perception of their children's weight and adolescent obesity in Chinese parents and adolescents, which is very important for the etiology, development and treatment of adolescent obesity.

Given that the social environment and tradition culture in China is different from western countries, it was hypothesized that the influence of parents on their children's weight could be different from the results found in America and Europe. However, most of the results found in the present study were consistent with the findings reported in western countries. For example, although the prevalence of childhood obesity was still lower than developed countries (Ji & Working Group on Obesity in China, 2005), Chinese parents did not show better ability in classifying their children's weights in this study. Moreover, in traditional Chinese culture, father and mother were arranged to play different parenting roles (Berndt, et al., 1993). However, the hypothesized gender differences in parenting behaviors were also not detected in the present study. The results maybe partly explained by the social change and influence of western culture during the past decades.

During the past a few years, parents involvement in the treatment of childhood obesity attracted many researchers' attention. Several scholars even promoted parents focused program, in which only parents were targeted in the intervention (Golan & Weizman, 2001). The effectiveness of this kind of intervention were proved by some studies (Golan & Crow, 2004b; McGarvey, et al., 2004). However, the data of some other studies showed that parenting behaviors may only explain relatively low percentage of variance of children's food intake (O'Connor, et al., 2010) and physical activity (Davison, Cutting, & Birch, 2003). The data of the current study confirmed that parenting behaviors, parenting style and parents' perception of their children's weight were associated with the development of adolescent obesity. However, the correlation is weak but statistically significant. Our data confirmed that parents involvement should be included in childhood obesity treatments (Dietz & Robinson, 2005; Robinson, 1999). However, since parents related factors could only explain low percentage of adolescents' Z-BMI, dietary habits and physical activity, parents may only play an important supporting role rather than a leading role in the etiology, development and intervention of adolescent obesity.

Most current family studies of obesity concentrated on parental influence on their child's dietary habits, physical activity and weight status (Anderssen & Wold, 1992; Heinberg, et al., 2009; Moore, et al., 1991; Savage, Fisher, & Birch, 2007; Wrotniak, et al., 2004). In fact, the relationship between parents' and their children could be bio-directional. For example, it was found that children may play an important role in helping their parents quit smoking (Winickoff, et al., 2006). Therefore, it is also possible for children to help their parents modify eating and physical activity behaviors, which could be applied in health promotion in adults. As a cross sectional study design was applied in the current study, cause and effect

relationship can not be determined. Further studies were still needed to explore the role of parents in the development of childhood obesity as well as the influence of children on parents' behaviors.

In addition, adolescent-parent conflicts should be considered for the parents involvement in adolescent obesity treatment. A study based on Chinese adolescents and their parents suggested that adolescents want to have greater autonomy to make decision than their parents granted them (Yau & Smetana, 1996). Three types of parent-child conflicts were found between the youth with eating disorders and their parents in mainland China, which include 1) intergenerational control and power struggle; 2) growing up versus remaining childlike, and 3) pursuit of personal goals or living up to parental expectations (J. L. C. Ma, 2008). As parents need to help their children modify their sedentary behaviors and unhealthy dietary habits, it is not surprising that the adolescent-parent conflicts may be increased, which could greatly influence the effectiveness of intervention. Therefore, adolescent-parent conflicts should be carefully dealt with and specific parenting skill training is recommended.

Although the results of the current study support that parent may play an important role in the development of adolescent obesity, some other factors, such as the influence of peer and school, should also be considered in the intervention of childhood obesity. Harmonious peer relationship not only provide important context for children's cognitive, psychological, and emotional development, but also influence children's physical activity, eating behaviors, and weight status (Salvy, et al., 2008; Salvy, Howard, Read, & Mele, 2009; Storch, et al., 2007). For instance, it was reported that children could do more vigorous physical activity in company of close friends (Salvy, et al., 2008). Moreover, school may also influence children's weight status, through frequency and intensity of activity in physical education

(The National Institute of Child Health Human Development Study of Early Child Care and Youth Development Network, 2003) as well as the food and soft drinks sold in schools (Committee on School Health, 2004). Therefore, the effects of intervention towards adolescent obesity would be maximized when all the relevant factors including parents, peer, school etc. are taken into account.

The limitations of this thesis may include the cross sectional study design, self-reported nature of survey data and non national representative sample. Therefore, in the present study, the cause and effect relationship can not be determined nor could the results be generalized in the Chinese all over the world. Longitudinal study design and objective instruments (eg. Using accelerators to measure PA, etc.) were recommended in further studies.

In general, the data of the present study show that the questionnaires applied in the present study were reliable and valid. Parenting behaviors are weakly but significantly associated with the development of adolescent obesity. Misclassifications of children's weight status were prevalent among Chinese parents. Parental perceptions of their children's weights were associated with some parenting behaviors related to children's weight development. The adolescents' dietary habits, physical activity, and some parenting behaviors were associated with parenting style. However, there was no direct association between parenting style and adolescent weight.

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APPENDICES

Appendix I

研究同意书

亲爱的家长：

您好！

香港中文大学体育运动科学系正在进行调查，期望了解您孩子的一些健康信息。这项研究计划由许世全教授指导，由本人执行。

本次研究拟邀请广东省汕头市和江西省赣州市各 1000 名初一和初二的学生及其父亲或母亲参与。在调查过程中，将邀请同学和家长各填写一份问卷，并测量学生的身高体重。学生问卷填写和身高体重测量将安排与下午第三节自习课进行，整个过程需要大概 30-45 分钟，不会影响学生的正常教学。家长问卷由学生带回家中，请家长填写后再由学生带回学校，填写该问卷需要大约 10-20 分钟。完成调查后，学生将得到本次调查的纪念品一份。

参与本次研究纯属自愿性质，学生和家长可自行决定是否参与，也可在调查过程中自由退出。本次研究所收集的个人资料仅作为整体统计计算，个人信息不会公开，个人的测试结果也将绝对保密。

烦请您填妥回条，并嘱咐子女与翌日交还负责老师。研究人员与负责老师将会直接与接受调查的学生联络，并解释和安排研究。如得到您的同意，不胜感激！

如有任何疑问，请向本次研究协调员温煦先生查询!

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同意书回条

研究协调员 温煦先生：

本人_____(家长姓名)及子女_____(子女姓名)

☐ 同意（联络电话：_____）

☐ 不同意

一起参加该项研究。本人已详阅此同意书，并清楚研究的目的和内容。

家长签名：_____ 日期_____

子女签名：_____ 日期_____

Appendix II

学生问卷（男生） 编号 _____

****

身高：_____ 厘米 体重：_____ 公斤

（此部分请由工作人员填写）

****

亲爱的同学：

你好！这份问卷的目的是想了解一些你的健康信息。**请注意这不是考试，答案没有对错之分。**同时问卷是**不记名的**，你所填写的个人资料也会**绝对保密。请你仔细阅读，依照你自己的想法和实际情况来选择！**

问卷填写说明：请在情况相符前面的“□”内打“✓”，或在横在线相应填写文字。无法回答或者不方便的回答的问题，可以在“不能回答”前面的“○”打“✓”。如有填写错误，请在划错“✓”处画“×”，再另选新答案。**除有特殊标明为多选题外，其它选择题均为单项选择题。**如对问卷有任何疑问可以随时问我们的工作人员！谢谢你的配合！并祝你学习进步！

基本数据：

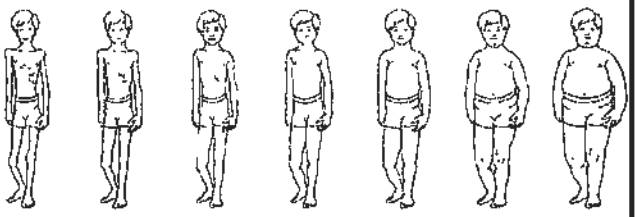
性别：□ 男生 □ 女生 出生年月：_____年_____月

第一部分

1. 请选择以下亲人平时是否和你住在一起？**（可多选）。**

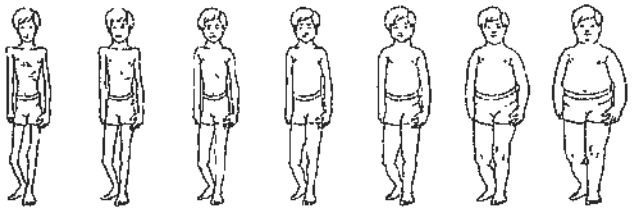
□母亲；□ 父亲；□ 继母；□ 继父；□ 奶奶；□ 爷爷；□ 外婆；□ 外公

2. 请选择下面哪幅图最像你？



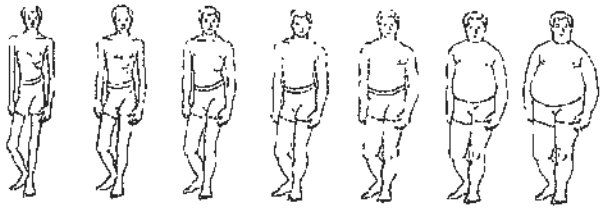
□ □ □ □ □ □ □

3. 请选择下面哪幅图是你希望自己的样子？



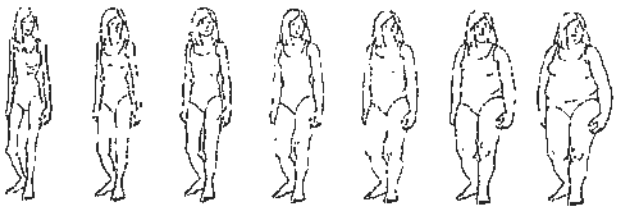
□ □ □ □ □ □ □

4. 请选择下面哪幅图最像你爸爸的外形？



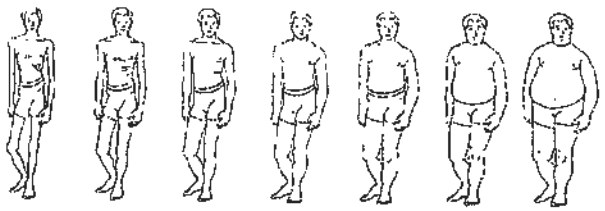
□ □ □ □ □ □ □

5. 请选择下面哪幅图最像你妈妈的外形？



□ □ □ □ □ □ □

6. 请选择下面哪幅图是你希望自己长大后的样子？



□ □ □ □ □ □ □

7. 在过去的一年中，你是否曾刻意地通过节食或运动减肥？假如有，时间有多长？

□1 从没有 □2 不到一周 □3 不到一个月 □4 一个月到三个月（不包括三个月）

□5 三个月到半年 （不包括半年） □ 6 坚持了半年或半年以上

第二部分 请在下列叙述中挑选出一个最能反映你过去一年总体上的饮食情况。

		从不	很少	有时	常常	总是	无法回答
1	我每天至少吃三份蔬菜（煮熟蔬菜一份约为 1/2 饭碗的量）	□	□	□	□	□	○
2	我每天至少吃两份水果(一份约一个中等大的苹果或香蕉)	□	□	□	□	□	○
3	我会尽量选择低脂牛奶或脱脂牛奶而不是全脂牛奶	□	□	□	□	□	○
4	我每天都会油炸类食品（如油条、煎饺，椒盐排条等）	□	□	□	□	□	○
5	我每天都喝含糖饮料（如可乐、芬达、雪碧，鲜橙多等）	□	□	□	□	□	○
6	我会在情绪不好、感觉压力大或者无聊的时候吃东西	□	□	□	□	□	○
7	我每周至少吃两次西式快餐（汉堡、批萨，炸鸡等）	□	□	□	□	□	○
8	我喝汤的时候，假如汤上有一层油，会设法去掉油再喝	□	□	□	□	□	○
9	我吃饭的时候，经常会用卤汁或菜汤拌着饭吃	□	□	□	□	□	○
10	我吃饭口味比较清淡（很少吃油腻，咸辣的食物）	□	□	□	□	□	○
11	我吃饭时，假如有合口味的菜，会比平时多吃一点	□	□	□	□	□	○
12	我每天都会吃早餐	□	□	□	□	□	○

第三部分

请分别选择以下描述中选择最符合你父母行为的选项。

			一点不像	有点像	比较像	非常像	不能回答
1	我爸爸/妈妈不让我自己决定事情该怎么做，总是吩咐我该怎么做。	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
2	我爸爸/妈妈制定规矩（如：我可以几点钟出去玩）从来不考虑我的想法	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
3	当我心情不好时，我爸爸/妈妈总能让我感觉好起来	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
4	我爸爸/妈妈总是太忙都没有空跟我聊聊天	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
5	我爸爸/妈妈总会倾听我说的话	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
6	在我爸爸/妈妈面前，我可以说真心话，表现真实的自己，不需要任何遮掩。	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
7	当我表现好的时候，我爸爸/妈妈会表扬我	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
8	我爸爸/妈妈愿意听我说我遇到的困难。	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
9	我的表现无论好坏，我爸爸/妈妈都喜欢。	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
10	我爸爸/妈妈制定的规矩（如：我可以几点钟出去玩），我必须遵守	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
11	我爸爸/妈妈会叮嘱我必须几点几点前回家	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
12	我去什么地方必须得告诉我爸爸/妈妈	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
13	我爸爸/妈妈总是让我准时睡觉	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
14	我爸爸/妈妈会过问我和朋友们都干了些什么	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
15	我爸爸/妈妈清楚我放学以后去什么地方	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
16	我爸爸/妈妈会检查我是否做完我的家庭作业	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
		妈妈	□	□	□	□	○

CUHK 学生课余运动量评级问卷

请您于下列 0-10 的等级中，选取其中一个等级代表您过去一年内平均每星期的运动量，然后填入下面方格中：(请参考下列附表中有关低强度、中等强度、及剧烈运动的例子)

低强度运动：是简单可以应付自如的运动，呼吸心跳没有明显加速，没有出汗。

中等强度运动：做这类运动时，呼吸和心跳稍微加快，轻微出汗，但不觉辛苦。

剧烈运动：做这类运动时，呼吸和心跳很快，大量出汗，觉得很辛苦。

从下表 0-10 的等级中，只选一个等级填入此方格 → □

没有运动习惯者，选 0 至 2

0 — 完全没有任何运动，大部份时间是坐着或睡觉。

1 — 除了在体育课有少许活动外，其余所有时间都没有运动。

2 — 除了上体育课时有积极参与运动外，其余所有时间都没有运动。

除了上体育课有运动外，平时间中有运动习惯者，选 3 至 6

3 — 每星期都有一至两次 20 分钟以上低强度运动。

4 — 每星期都有三次以上 20 分钟以上低强度运动。

5 — 差不多每天都有一次 20 分钟以上低强度运动。

6 — 每星期都有一至两次 20 分钟以上中等强度运动。

除了上体育课有运动外，平时经常有运动习惯者，选 7 至 10

7 — 每星期都有三次至五次中等强度运动(每次 20 分钟或以上)。

8 — 差不多每天都有中等强度运动(每次 20 分钟或以上)。

9 — 每星期都有不多于三次剧烈运动 (每次 20 分钟或以上)。

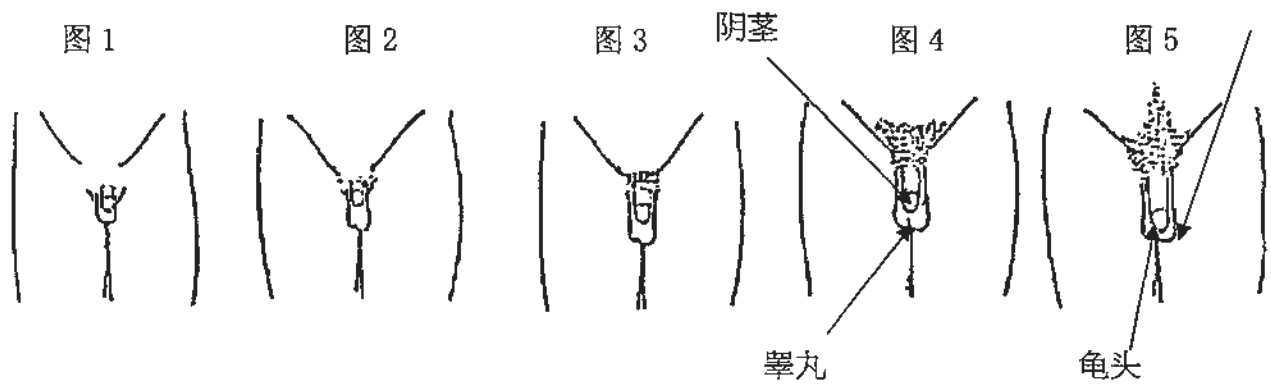
10 — 差不多每天都有剧烈运动(每次 20 分钟或以上)。

* 附表：低强度、中等强度、及剧烈运动的例子

	低强度运动	中等运动	剧烈运动
体育运动	速度很慢的散步、遛狗	散步（健步行，速度较快） 慢跑	快速跑（感觉很辛苦）
	保龄球	骑自行车	剧烈的篮球、足球比赛
	排球练习	投篮练习 嬉戏型式的游泳	连续游泳（不间断）
	节奏较慢的舞蹈 (如慢舞或华尔兹)	舞蹈或健美操(低冲击性的健美操)	越野跑步、定向越野
	玩飞碟	羽毛球练习	
家居活动	下楼梯	上下楼梯(混合)	搬运大型东西或家具上楼梯
	逛街（较轻松、速度较慢、没有携带大量物品）	用手或跪地型式的抹地；较辛苦的家务，如抹窗或洗车	剧烈的运动(如：连续做俯卧撑)
	做比较轻松的家务，如抹地吸尘或清洁家居	家中的运动，如柔软体操、仰卧起坐等	
	站立或轻量的玩耍	携带不超过 15 斤物品步行上楼梯	
	在家中行走及搬动轻的物品	在游乐场游玩（有一定体力消耗的项目）	
	弹吉他或其他乐器(站立)		

男性生殖器官发育的自我评估

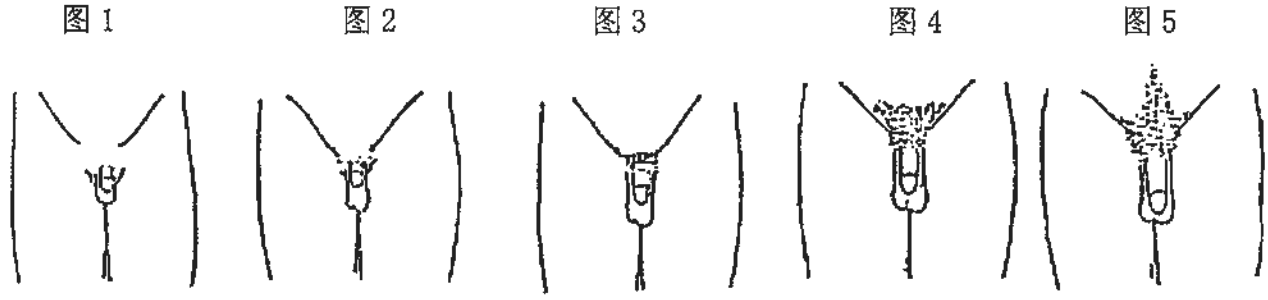
以下各图代表男性生殖器官发育的 5 个不同阶段（包抱阴茎、阴囊和睾丸）。
请细看以下各图及细阅图下文字，据你自己身体发育情况，选择你最接近的图前的“□”里打“√”。



□ 图一：睾丸、阴囊及阴茎的大小和形状跟小孩子一样
□ 图二：睾丸和阴囊比较大，而阴囊较前向下松弛及阴囊表皮有改变。 阴茎也比前较大。
□ 图三： 阴茎长度增加，而睾丸及阴囊也比较图二多向下松弛。
□ 图四： 阴茎长度继续增加及变粗，龟头也变大。阴囊比前深色，睾丸体积增大。
□ 图五： 阴茎、阴囊及睾丸的大小和形状至成年男性模样。

男性阴毛发育的自我评估

以下各图代表男性阴毛生长的不同分布及数量。 请细看以下各图及细阅图下文字，据你自己身体发育情况，选择你最接近的图前的“□”里打“√”。（在选择适当的图画时，请根据阴毛的分布及数量，而不是根据生殖器官的大小而作出决定）。



□ 图一：完全没有阴毛
□ 图二：有少量长而浅色的毛发可以是直或曲
□ 图三：毛发比较深色及曲，而生长范围较图二为大
□ 图四：毛发比较粗而生长范围图三为大
□ 图五：毛发生长范围接近成年男性

Appendix III

学生问卷（女生） 编号_____

****

身高：_____ 厘米 体重：_____ 公斤

（此部分请由工作人员填写）

****

亲爱的同学：

你好！这份问卷的目的是想了解一些你的健康信息。**请注意这不是考试，答案没有对错之分。**同时问卷是**不记名的**，你所填写的个人资料也会**绝对保密。请你仔细阅读，依照你自己的想法和实际情况来选择！**

问卷填写说明：请在情况相符前面的“□”内打“✓”，或在横在线相应填写文字。无法回答或者不方便的回答的问题，可以在“不能回答”前面的“○”打“✓”。如有填写错误，请在划错“✓”处画“×”，再另选新答案。**除有特殊标明为多选题外，其它选择题均为单项选择题。**如对问卷有任何疑问可以随时问我们的工作人员！谢谢你的配合！并祝你学习进步！

基本数据：

性别：□ 男生 □ 女生 出生年月：_____年_____月

第一部分

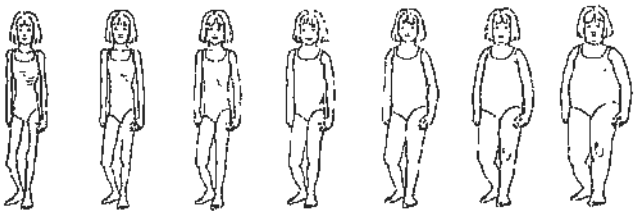
1. 请选择以下亲人平时是否和你住在一起？（**可多选**）。

□母亲；□ 父亲；□ 继母；□ 继父；□ 奶奶；□ 爷爷；□ 外婆；□ 外公

2. 请选择下面哪幅图最像你？

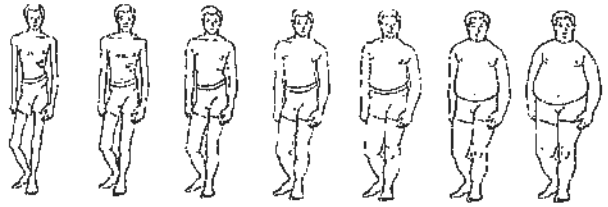
□ □ □ □ □ □ □

3. 请选择下面哪幅图是你希望自己的样子？



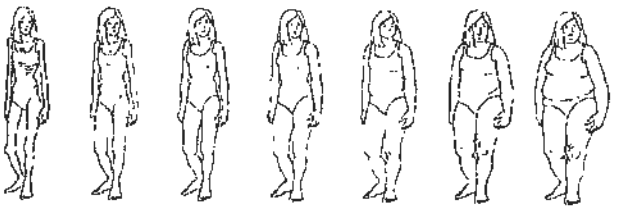
□ □ □ □ □ □ □

4. 请选择下面哪幅图最像你爸爸的外形？



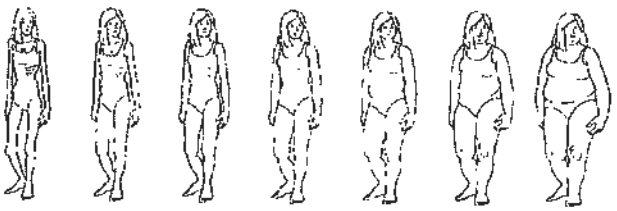
□ □ □ □ □ □ □

5. 请选择下面哪幅图最像你妈妈的外形？



□ □ □ □ □ □ □

6. 请选择下面哪幅图是你希望自己长大后的样子？



□ □ □ □ □ □ □

7. 在过去的一年中，你是否曾刻意地通过节食或运动减肥？假如有，时间有多长？

□1 从没有 □2 不到一周 □3 不到一个月 □4 一个月到三个月（不包括三个月）

□5 三个月到半年 （不包括半年） □ 6 坚持了半年或半年以上

第二部分 请在下列叙述中挑选出一个最能反映你**过去一年总体上**的饮食情况。

		从不	很少	有时	常常	总是	无法回答
1	我每天至少吃三份蔬菜（煮熟蔬菜一份约为 1/2 饭碗的量）	□	□	□	□	□	○
2	我每天至少吃两份水果(一份约一个中等大的苹果或香蕉)	□	□	□	□	□	○
3	我会尽量选择低脂牛奶或脱脂牛奶而不是全脂牛奶	□	□	□	□	□	○
4	我每天都会油炸类食品（如油条、煎饺，椒盐排条等）	□	□	□	□	□	○
5	我每天都喝含糖饮料（如可乐、芬达、雪碧，鲜橙多等）	□	□	□	□	□	○
6	我会在情绪不好、感觉压力大或者无聊的时候吃东西	□	□	□	□	□	○
7	我每周至少吃两次西式快餐（汉堡、批萨，炸鸡等）	□	□	□	□	□	○
8	我喝汤的时候，假如汤上有一层油，会设法去掉油再喝	□	□	□	□	□	○
9	我吃饭的时候，经常会用卤汁或菜汤拌着饭吃	□	□	□	□	□	○
10	我吃饭口味比较清淡（很少吃油腻，咸辣的食物）	□	□	□	□	□	○
11	我吃饭时，假如有合口味的菜，会比平时多吃一点	□	□	□	□	□	○
12	我每天都会吃早餐	□	□	□	□	□	○

第三部分

请分别选择以下描述中选择最符合你父母行为的选项。

			一点不像	有点像	比较像	非常像	不能回答
1	我爸爸/妈妈不让我自己决定事情该怎么做，总是吩咐我该怎么做。	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
2	我爸爸/妈妈制定规矩（如：我可以几点钟出去玩）从来不考虑我的想法	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
3	当我心情不好时，我爸爸/妈妈总能让我感觉好起来	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
4	我爸爸/妈妈总是太忙都没有空跟我聊聊天	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
5	我爸爸/妈妈总会倾听我说的话	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
6	在我爸爸/妈妈面前，我可以说真心话，表现真实的自己，不需要任何遮掩。	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
7	当我表现好的时候，我爸爸/妈妈会表扬我	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
8	我爸爸/妈妈愿意听我说我遇到的困难。	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
9	我的表现无论好坏，我爸爸/妈妈都喜欢。	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
10	我爸爸/妈妈制定的规矩（如：我可以几点钟出去玩），我必须遵守	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
11	我爸爸/妈妈会叮嘱我必须几点几点前回家	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
12	我去什么地方必须得告诉我爸爸/妈妈	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
13	我爸爸/妈妈总是让我准时睡觉	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
14	我爸爸/妈妈会过问我和朋友们都干了些什么	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
15	我爸爸/妈妈清楚我放学以后去什么地方	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
16	我爸爸/妈妈会检查我是否做完我的家庭作业	爸爸	□	□	□	□	○
		妈妈	□	□	□	□	○
		妈妈	□	□	□	□	○

CUHK 学生课余运动量评级问卷

请您于下列 0-10 的等级中，选取其中一个等级代表您过去一年内平均每星期的运动量，然后填入下面方格中：**(请参考下列附表中有关低强度、中等强度、及剧烈运动的例子)**

低强度运动：是简单可以应付自如的运动，呼吸心跳没有明显加速，没有出汗。

中等强度运动：做这类运动时，呼吸和心跳稍微加快，轻微出汗，但不觉辛苦。

剧烈运动：做这类运动时，呼吸和心跳很快，大量出汗，觉得很辛苦。

从下表 0-10 的等级中，只选一个等级填入此方格 → □

没有运动习惯者，选 0 至 2

0 — 完全没有任何运动，大部份时间是坐着或睡觉。

1 — 除了在体育课有少许活动外，其余所有时间都没有运动。

2 — 除了上体育课时有积极参与运动外，其余所有时间都没有运动。

除了上体育课有运动外，平时间中有运动习惯者，选 3 至 6

3 — 每星期都有一至两次 20 分钟以上低强度运动。

4 — 每星期都有三次以上 20 分钟以上低强度运动。

5 — 差不多每天都有一次 20 分钟以上低强度运动。

6 — 每星期都有一至两次 20 分钟以上中等强度运动。

除了上体育课有运动外，平时经常有运动习惯者，选 7 至 10

7 — 每星期都有三次至五次中等强度运动(每次 20 分钟或以上)。

8 — 差不多每天都有中等强度运动(每次 20 分钟或以上)。

9 — 每星期都有不多于三次剧烈运动 (每次 20 分钟或以上)。

10 — 差不多每天都有剧烈运动(每次 20 分钟或以上)。

* 附表：低强度、中等强度、及剧烈运动的例子

	低强度运动	中等运动	剧烈运动
体育运动	速度很慢的散步、遛狗	散步（健步行，速度较快） 慢跑	快速跑（感觉很辛苦）
	保龄球	骑自行车	剧烈的篮球、足球比赛
	排球练习	投篮练习 嬉戏型式的游泳	连续游泳（不间断）
	节奏较慢的舞蹈 (如慢舞或华尔兹)	舞蹈或健美操(低冲击性的健美操)	越野跑步、定向越野
	玩飞碟	羽毛球练习	
家居活动	下楼梯	上下楼梯(混合)	搬运大型东西或家具上楼梯
	逛街（较轻松、速度较慢、没有携带大量物品）	用手或跪地型式的抹地；较辛苦的家务，如抹窗或洗车	剧烈的运动(如：连续做俯卧撑)
	做比较轻松的家务，如抹地吸尘或清洁家居	家中的运动，如柔软体操、仰卧起坐等	
	站立或轻量的玩耍	携带不超过 15 斤物品步行上楼梯	
	在家中行走及搬动轻的物品	在游乐场游玩（有一定体力消耗的项目）	
	弹吉他或其他乐器(站立)		

女性乳房发育的自我评估

以下各图代表女性乳房发育的 5 个不同阶段。 请细看以各图及细阅图下文字，根据你自己乳房发育的情况，选择你最接近的图前的“□”里打“√”。

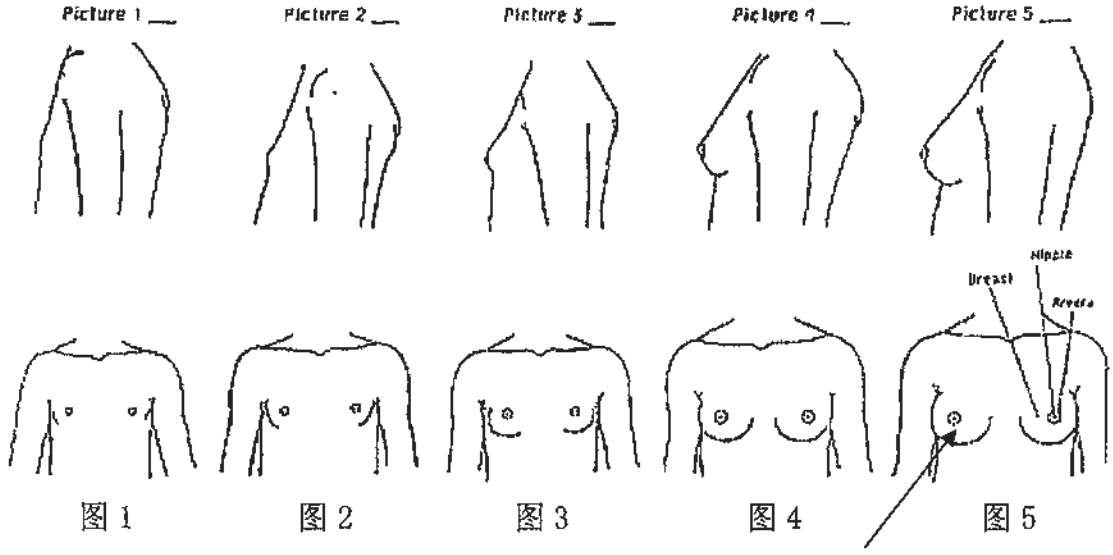


图 1　　图 2　　图 3　　图 4　　图 5

图中： Breast ---乳房; Areola ---乳晕; Nipple - 乳头：乳房最前端的突起的地方
乳晕：乳头外围粉红色略突起的部分

□ 图一：乳头有些微突起，乳房其它部份则平坦。
□ 图二：乳头比图一较突起，乳晕比图一为大，乳房有些微涨起。
□ 图三：乳晕和乳房比图二更大，但乳晕没有突起现象。
□ 图四：乳晕及乳头从乳房的轮廓中突起。（请注意，有些女性没有图四的现象，而由图三直接发展至图五）。
□ 图五：乳房完全发育至成年女性样，乳头呈现突出，但乳晕变为平坦。

女性阴毛发育的自我评估

以下各图代表女性阴毛生长的不同分布及数量。 请细看以下各图及细阅图下文字，根据你自己身体发育情况，选择你最接近的图前的“□”里打“√”。

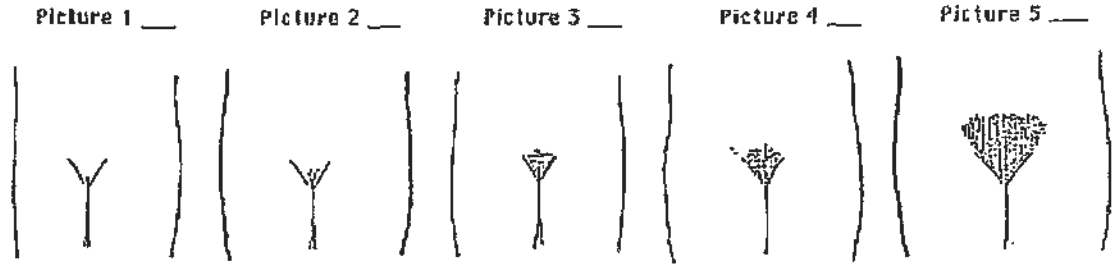


图 1　　图 2　　图 3　　图 4　　图 5

□ 图一：完全没有阴毛
□ 图二：有少量长而浅色的毛发，毛发可以是直或曲。
□ 图三：毛发比较深色及曲，而生长范围较图二为大
□ 图四：毛发比较粗而生长范围较图三为大
□ 图五：毛发生长范围接近成年女性

Appendix IV

此部分内容请孩子的父亲或母亲填写 编号_____

亲爱的家长：

您好！这份问卷是想了解一些您孩子的健康信息，以作为今后儿童青少年健康政策制订的依据。请您仔细阅读问卷内容，依据您的实际情况填写。**本问卷的问题，没有对错之分，问卷不记名，所填写的个人资料也绝对保密，请您放心。请注意，假如您有多名孩子，本问卷中 “孩子”是指参加本次调查的孩子。**问卷填写完，请交由子女带回学校。承蒙您百忙中填写问卷，不胜感激！谢谢您的协助与参与！并祝愉快！

填写说明：请在情况相符前面的“□”内打“✓”， 或在“____”上填写相应的数字。

第一部分

1. 您与孩子的关系

□ 母亲； □ 父亲； □ 继母； □ 继父 □ 其它亲属或朋友

2. 您家的常住人口有____人，有____个孩子

3. 您孩子出生时的体重是_____公斤（或____斤____两），或 □ 我记不得了.

4. 您孩子出生后母乳喂养（完全依靠母乳喂养，没有添加米糊、菜泥等辅食）的时间为：

_____个月 或 □ 我记不得.

5. 孩子父亲现在的身高_____厘米 体重_____公斤

6. 孩子母亲现在的身高_____厘米 体重_____公斤

7. 请根据您的判断，选择现阶段你们全家人的肥胖程度。

家庭成员	很瘦	有点瘦	正常体重	有点超重	严重超重	不能回答
孩子（指参加本次调查的孩子）	□	□	□	□	□	○
孩子的妈妈	□	□	□	□	□	○
孩子的爸爸	□	□	□	□	□	○
孩子的爷爷	□	□	□	□	□	○
孩子的奶奶	□	□	□	□	□	○
孩子的外公	□	□	□	□	□	○
孩子的外婆	□	□	□	□	□	○

8. 您的孩子是否曾患过可能导致肥胖的疾病（如糖尿病等内分泌类疾病）或曾经服用过可能导致肥胖的的药物（如：糖皮质激素、胰岛素等激素类药物）？

□ 1. 没有 □2. 有，请列出疾病或服用药物的名称 _____

9. 孩子母亲的教育程度

□ 小学或以下；□ 初中；□ 高中/中专；□ 大专；□ 本科 □ 研究生或以上

10. 孩子父亲的教育程度

□ 小学或以下；□ 初中；□ 高中/中专；□ 大专；□ 本科 □ 研究生或以上

11. 您全家的家庭月收入（包括所有家庭成员的薪金收入、投资收入等）大约是多少？

□ 1500 元及以下；□ 1501-3000 元；□ 3001-6000 元；□ 6001-10000 元；

□ 10001-20000 元； □ 20001-50000 元； □ 50001 元及以上

12. 平时您的孩子主要由谁照顾？

□ 我和丈夫（太太）；□ 孩子的爷爷奶奶或外公外婆；□ 保姆；□ 其他

13. 您家里人每周看电视，玩电脑游戏或上网加起来时间有多少？

孩子：_____小时/周 孩子父亲：_____小时/周 孩子母亲：_____小时/周

CUHK 成年人闲暇运动量评级问卷

请您于下列 0-10 的等级中，**选取其中一个等级**代表您**过去一年内平均每星期**的运动量，然后填入下面方格中：(请参考下列附表中有关低强度、中等强度、及剧烈运动的例子)

低强度运动：是简单可以应付自如的运动，呼吸心跳没有明显加速，没有出汗。

中等强度运动：做这类运动时，呼吸和心跳稍微加快，轻微出汗，但不觉辛苦。

剧烈运动：做这类运动时，呼吸和心跳很快，大量出汗，觉得很辛苦。

从下表 0-10 的等级中，只选一个等级填入此方格 → □

没有运动习惯者，选 0 至 2

0 — 完全没有任何运动，大部份时间是坐着或睡觉。

1 — 除了每次少于 10 分钟的慢步外，其余所有时间都没有运动。

2 — 除了每周一次少于 30 分钟的低强度运动外，其余所有时间都没有运动。

平时有运动习惯者，选 3 至 6

3 — 每星期都有一至两次 30 分钟以上低强度运动。

4 — 每星期都有三次以上 30 分钟以上低强度运动。

5 — 差不多每天都有一次 30 分钟以上低强度运动。

6 — 每星期都有一至两次 30 分钟以上中等强度运动。

平时经常有运动习惯者，选 7 至 10

7 — 每星期都有三次至五次中等强度运动(每次 30 分钟或以上)。

8 — 差不多每天都有中等强度运动(每次 30 分钟或以上)。

9 — 每星期都有不多于三次剧烈运动 (每次 30 分钟或以上)。

10 — 差不多每天都有剧烈运动(每次 30 分钟或以上)。

*** 附表：低强度、中等强度、及剧烈运动的例子**

	低强度运动	中等运动	剧烈运动
体育运动	速度很慢的散步、遛狗	散步（健步行，速度较快） 慢跑	快速跑（感觉很辛苦）
	保龄球	骑自行车	剧烈的篮球、足球比赛
	排球练习	投篮练习 嬉戏型式的游泳	连续游泳（不间断）
	节奏较慢的舞蹈 (如慢舞或华尔兹)	舞蹈或健美操(低冲击性的健美操)	越野跑步、定向越野
	玩飞碟	羽毛球练习	
家居活动	下楼梯	上下楼梯(混合)	搬运大型东西或家具上楼梯
	逛街（较轻松、速度较慢、没有携带大量物品）	用手或跪地型式的抹地；较辛苦的家务，如抹窗或洗车	剧烈的运动(如:连续做俯卧撑)
	做比较轻松的家务，如抹地吸尘或清洁家居	家中的运动，如柔软体操、仰卧起坐等	
	站立或轻量的玩耍	携带不超过 15 斤物品步行上楼梯	
	在家中行走及搬动轻的物品	在游乐场游玩（有一定体力消耗的项目）	
	弹吉他或其他乐器(站立)		

第二部分：请选择与您想法和行动一致的表述，并在相应的“□”内打“✓”。

		从不	很少	有时	经常	总是
1	我会关注我的孩子吃甜食的数量（如蛋糕、糖果、冰淇淋）	□	□	□	□	□
2	我会关注我的孩子吃高脂食品的数量（如：油炸、膨化食品）	□	□	□	□	□
3	我会关注我的孩子吃蔬菜水果的数量	□	□	□	□	□
4	我的孩子吃零食之前要经过我同意	□	□	□	□	□
5	我会关注我的孩子看电视、玩电子游戏、上网的时间	□	□	□	□	□
6	我会关注我的孩子的体育锻炼的运动强度和时间	□	□	□	□	□
7	假如我的孩子选择吃健康的食品，我会表扬他/她	□	□	□	□	□
8	假如我的孩子积极参加体育运动，我会表扬他/她	□	□	□	□	□
		完全不同意	不同意	中立	同意	完全同意
9	假如孩子表现好，我会给些零食（糖果，冰淇淋等）奖励他/她	□	□	□	□	□
10	我应该特别关注，确保让我的孩子吃饱饭	□	□	□	□	□
11	假如我的孩子说“我吃饱了”，我还是会尽量让他再吃一些	□	□	□	□	□
12	假如我不对我孩子的饮食加以指导和调节，他就会吃得比他该吃的量少。	□	□	□	□	□
13	假如孩子表现好，我会让他/她看电视或者玩电子游戏作为奖励。	□	□	□	□	□
14	我会控制我的孩子喝含糖饮料的量（可乐，雪碧，鲜橙多等）	□	□	□	□	□
15	我会控制我的孩子吃零食的数量	□	□	□	□	□
16	周一到周五，我会控制孩子看电视，玩电子游戏的时间。	□	□	□	□	□
17	周六周日，我会控制孩子看电视，玩电子游戏的时间。	□	□	□	□	□

非常感谢您的参与！请将此问卷交由子女带回学校交给班主任。

Appendix V

INFORMED CONSENT FORM

Dear participants,

We are conducting an investigation to collect some information about your children's health. The present study is leaded by Prof. Stanley S. C. HUI in the department of sports science and P. E. in The Chinese University of Hong Kong. Mr. Wen Xu is the project coordinator for this study.

About 1000 pairs of grade one and two students in secondary schools and their parents would be recruited from Shantou and Ganzhou respectively. During the survey, adolescents will be invited to complete an anthropometric test for body weight and height, and will be asked to fill out questionnaires inside a classroom with the assistance of investigators. The investigation would be held at the third class in the afternoon, and may takes about 30-45 minutes, so it will not influence children's study. The students will be also asked to take home the "questionnaires for parents" for either their mother or father to fill out, and to give the questionnaires back to the survey conductors. It may take parent 10-20 minutes to complete the questionnaire. Souvenirs will be given to the participants as compliments.

In this study, your name will not be recorded on the questionnaire and your responses will be anonymous. Again, your participation is voluntary and you may choose to not answer all of the questions on the questionnaire even after signing the consent. If you and your child are willing to participate, please sign this form and send it back to us.

If you have any questions pertaining to this study, please feel free to contact us!

Thank you for your assistance!

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(852)67605816 (Hong Kong)
Email: wenxu@cuhk.edu.hk

REPLY SHEET

To:

Mr. Wen Xu,

My child _____ (child's name) and I _____(parent's name)

☐ Agree (Tel: _____)

☐ Disgree

to participate in the study. I had read the consent form and clearly know the content of the study.

Parent's Signature: _____ Date: _____

Child's Signature: _____ Date: _____

Appendix VI

Questionnaire for Boys No. _____

****

Height： _____ cm Weight: _____ Kg

（This part should be completed by investigators）

****

Dear students,

Thank you for participating in this study. The purpose of this study is to collect some information about your health. **Please notice that this is not an examination, and there is no correct or incorrect reponse for any item. The questionnaire is anonymous. Please complete the questionnaire honestly.**

Note: Please tick **ONLY ONE** box for each question indicating the most applicable answer, (except for the questions informing you that you can choose more than one). For the questions that you can not answer or do not want to answer, you tick the box in front of "no answer". please inform our investigators, if you have any question regarding the questionnaire. Thank you !

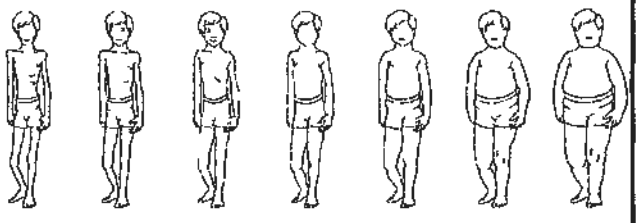
Gender：☐ boy ☐ girl Date of Birth：_____/_____(mm/yyyy)

Section I

1. Who do you live with in most of time? (you may tick more than one choice)

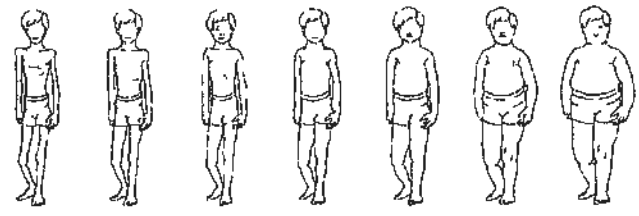
☐ mother; ☐ father; ☐ stepmother; ☐ stepfather; ☐ grandmother; ☐ grandfather

2. Which picture looks the most like how you look?



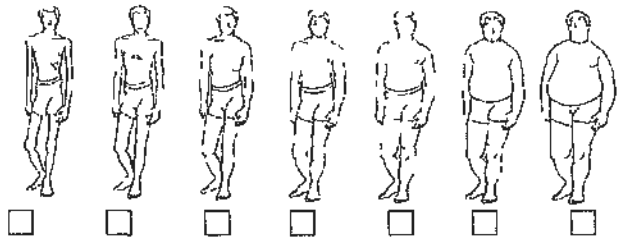
☐ ☐ ☐ ☐ ☐ ☐ ☐

3. Which picture looks the most like the way you want to look?



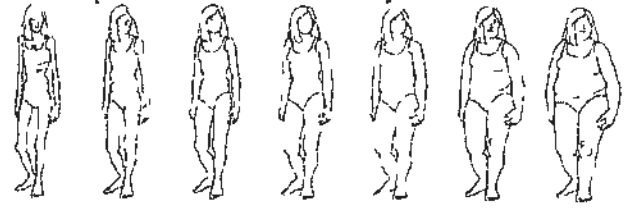
☐ ☐ ☐ ☐ ☐ ☐ ☐

4. Which picture looks the most like your father?



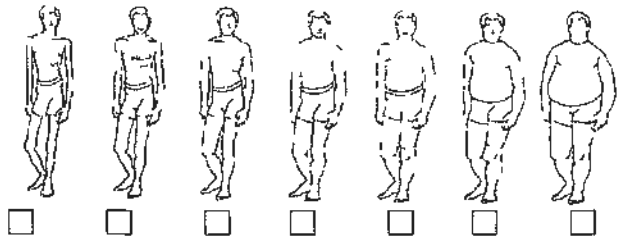
☐ ☐ ☐ ☐ ☐ ☐ ☐

5. Which picture looks the most like your mother?



☐ ☐ ☐ ☐ ☐ ☐ ☐

6. Which picture looks shows the way you want to look when you grow up?



☐ ☐ ☐ ☐ ☐ ☐ ☐

7.During the past year, did you lose weight through dieting or exercises? If yes, how long it last?

☐1. No ☐2. no more than a week ☐3. no more than a month ☐4. 1-3 months（not including 3

months) ☐5. 3-6months (not including 6 months) ☐6. At least 6 months

Section II Please tick **ONLY ONE** box for each question which best describe you.

		Never	Rarely	Sometimes	Frequently	Always	No Answer
1	I eat at least 3 servings of vegetables a day (one serving is about a half bow of boiled vegetables)	☐	☐	☐	☐	☐	○
2	I eat at least 2 servings of fruits a day (one serving is an apple or a banana)	☐	☐	☐	☐	☐	○
3	I drink low fat milk or fat free milk instead of whole milk	☐	☐	☐	☐	☐	○
4	I eat fried food everyday.	☐	☐	☐	☐	☐	○
5	I drink sugared beverages everyday.	☐	☐	☐	☐	☐	○
6	I would eat in negative mood states.	☐	☐	☐	☐	☐	○
7	I eat fast food (hamburger, fried chicken, pizza) at least twice a week.	☐	☐	☐	☐	☐	○
8	If there is a layer of oil on the surface of soup, I will only drink the soup after get rid of the oil.	☐	☐	☐	☐	☐	○
9	I eat rice mixed with gravy or soup frequently	☐	☐	☐	☐	☐	○
10	I eat light food frequently	☐	☐	☐	☐	☐	○
11	I would eat more in the dinner if the food is tasted good	☐	☐	☐	☐	☐	○
12	I have breakfast everyday.	☐	☐	☐	☐	☐	○

Section III Please tick **ONLY ONE** box for each question which best describe your parents

			Not like	Sort of	A lot like	Just like	No
1	She/He is always telling me what to do	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
2	She/He makes rules without asking what I think.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
3	She/He makes me feel better when I am upset.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
4	She/He is too busy to talk to me.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
5	She/He listens to what I have to say.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
6	She/He likes me just the way I am.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
7	She/He tells me when I do a good job on things.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
8	She/He wants to hear about my problems.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
9	She/He is pleased with how I behave.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
10	She/He has rules that I must follow.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
11	She/He tells me times when I must come home.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
12	She/He makes sure I tell her where I am going.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
13	She/He makes sure I go to bed on time.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
14	She/He asks me what I do with friends.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
15	She/He knows where I am after school.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
16	She/He checks to see if I do my homework.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○

CUHK Leisure Time Physical Activity Ratings for Children & Youth

From a scale of 0 to 10 listed below, that best describe your overall weekly level of physical activity in the past **12 MONTHS** period, then put the number in the square provided below: (refer to the annex table below for descriptions of light, moderate, and vigorous activities)

Select **ONLY ONE** rating and put into this square: → ☐

Choose 0 to 2 if you have no exercise habits at all:
0 — no physical activity at all, spend most of your time sitting or sleeping.
1 — no physical activity except little physical activity during PE lessons.
2 — no physical activity except being active during PE lessons。
Choose 3 to 6 if you, in addition to activity during PE lessons, participate in other physical activity occasionally:
3 — besides of the P.E. classes, I participate in light activities (3METs)# last longer than 60 minutes only once or twice every week.
4 — besides of the P.E. classes, I participate in light activities last longer than 20 minutes for three times a week.
5 — besides of the P.E. classes, I participate in light activities last longer than 20 minutes almost everyday.
6 — besides of the P.E. classes, I participate in moderate activities (5METs) last longer than 20 minutes once or twice a week.
Choose 7 to 10 if you, in addition to activity during PE lessons, participate in other physical activity regularly:
7 — besides of the P.E. classes, I participate in moderate activities last longer than 20 minutes three to five times a week.
8 — besides of the P.E. classes, I participate in moderate activities last longer than 20 minutes almost everyday.
9 — besides of the P.E. classes, I participate in vigorous activities (9METs) last longer than 60 minutes three times or less weekly.
10— besides of the P.E. classes, I participate in vigorous activities last longer than 20 minutes almost everyday.

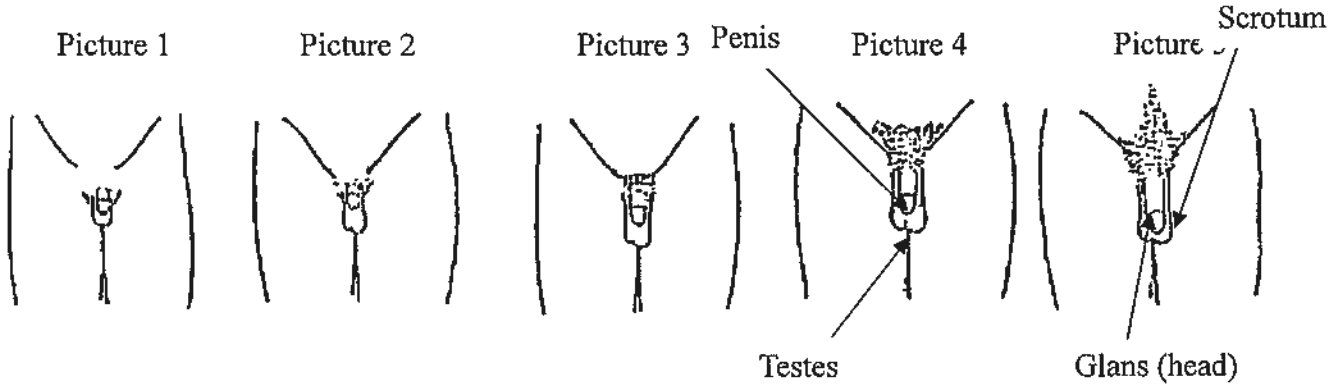
* **Annex Table: Examples of Light, Moderate & Vigorous Activities**

	Light *(3METs)	Moderate *(5METs)	Vigorous *(9METs)
Home Activities	Walk around home Handle household appliances	Walk upstairs while lifting a 1-15 lbs weight	Moving large furniture upstairs
	Walk downstairs	Walk stairs up and down	
	Light playing while standing	Home exercise such as calisthenics, sit-up etc.	Vigorous activities such as push up
	Household cleaning such as mopping floor and vacuuming	Floor cleaning by hand; window or car washing which requires heavy physical exertion.	Carrying heavy groceries upstairs
Sports Activities		Game playing inside water	Lap swimming
	Playing bowling	Basketball shooting (continuous)	Vigorous basketball competition
	Volleyball playing (1 ball for 6 – 9 persons)	Badminton playing (single or double)	Vigorous soccer competition
	Archery	Cycling; mixture of slow jogging and fast walking	Fast running (5.2mph or11.5min/mile)
	Frisbee	Playground playing	Orienteering
	Dancing in a dance room (slow dance, waltz)	Low impact aerobic dance & folk dance	Cross-country running / skiing

 # METs is Metabolic Equivalent, 1 MET is the energy expenditure during rest，3METs is three times the energy expenditure of resting，6METs is six times, and so on.

Tanner Stages Self-assessment Questionnaire (Boy)

The pictures on this page show different stages of growth of the testes, scrotum and penis. A boy goes through each of the 5 stages as shown. Please look at each of the pictures. Read the sentences. Choose the picture which is closest to your stage of growth.



☐ Picture 1: The testes, scrotum and penis are about the same size and shape as they were when you were a child

☐ Picture 2: The testes, scrotum are bigger. The skin of the scrotum has changed. The scrotum (the sack holding the testes) has gotten lower. The penis has gotten only a little bigger.

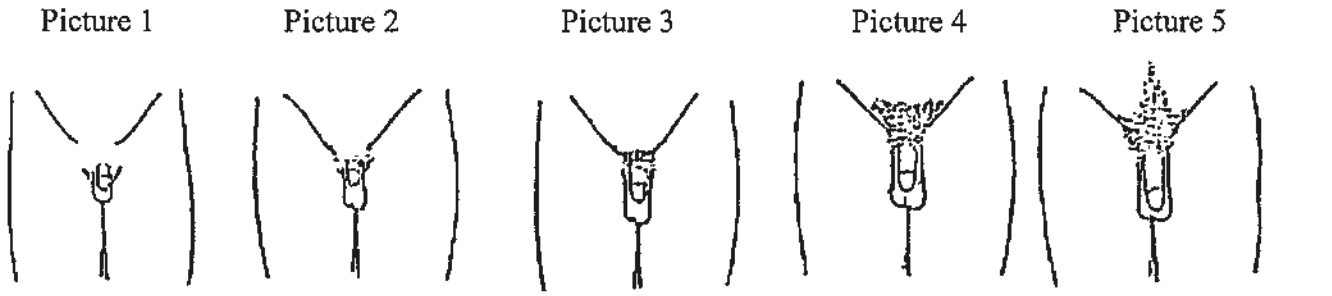
☐ Picture 3: The penis has grown in length. The testes and scrotum have grown and dropped lower than in picture 2.

☐ Picture 4: The penis has gotten even bigger. It is wilder. The glans (the head of the penis) is bigger. The scrotum is darker than before. It is bigger because the testes are bigger.

☐ Picture 5: The testes, scrotum and penis are the size and shape of that of an adult man.

The pictures on this page show different amounts of male pubic hair. Please look at each of the pictures. Read the sentences. Then choose the picture which is closest to your stage of growth.

In choosing the appropriate drawing, look only at the pubic hair and not at the size of the penis or scrotum.



☐ Picture 1: There is no pubic hair at all.

☐ Picture 2: There is a small amount of long lightly colored hair. This hair maybe straight or a little curly.

☐ Picture 3: There is hair that is darker, curlier and thinly spread out to cover a somewhat larger area than in stage 2.

☐ Picture 4: The hair is thicker and more spread out, covering a larger area than in stage 3.

☐ Picture 5: The hair now is widely spread covering a large area, like that of an adult male.

Appendix VII

Questionnaire for Girls No. _____

****

Height： _____ cm Weight: _____ Kg

（This part should be completed by investigators）

****

Dear students,

Thank you for participating in this study. The purpose of this study is to collect some information about your health. **Please notice that this is not an examination, and there is no correct or incorrect reponse for any item. The questionnaire is anonymous. Please complete the questionnaire honestly.**

Note: Please tick **ONLY ONE** box for each question indicating the most applicable answer, (except for the questions informing you that you can choose more than one). For the questions that you can not answer or do not want to answer, you tick the box in front of "no answer". Please inform our investigators, if you have any question regarding the questionnaire. Thank you!

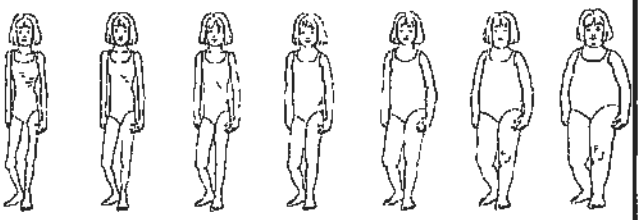
Gender：☐ boy ☐ girl Date of Birth：_____/_____(mm/yyyy)

Section I

1. Who do you live with in most of time? (you may tick more than one choice)

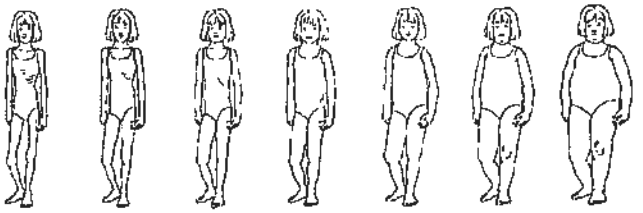
☐ mother; ☐ father; ☐ stepmother; ☐ stepfather; ☐ grandmother; ☐ grandfather

2. Which picture looks the most like how you look?



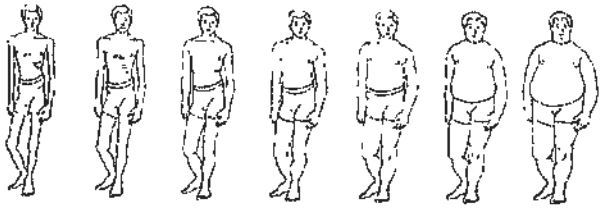
☐ ☐ ☐ ☐ ☐ ☐ ☐

3. Which picture looks the most like the way you want to look?



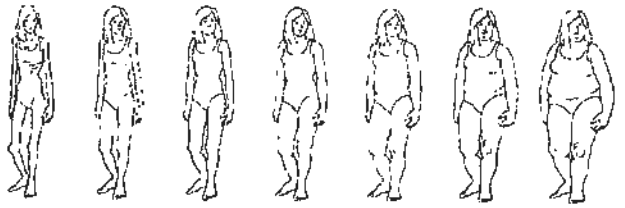
☐ ☐ ☐ ☐ ☐ ☐ ☐

4. Which picture looks the most like your father?



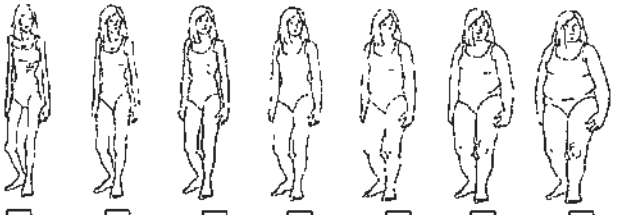
☐ ☐ ☐ ☐ ☐ ☐ ☐

5. Which picture looks the most like your mother?



☐ ☐ ☐ ☐ ☐ ☐ ☐

6. Which picture looks shows the way you want to look when you grow up?



☐ ☐ ☐ ☐ ☐ ☐ ☐

7. During the past year, did you lose weight through dieting or exercises? If yes, how long it last?

☐ 1. No ☐ 2. no more than a week ☐ 3. no more than a month ☐ 4. 1-3 months（not including 3

months） □5. 3-6months （not including 6 months） □ 6. At least 6 months

Section II Please tick **ONLY ONE** box for each question which best describe you.

		Never	Rarely	Sometimes	Frequently	Always	No Answer
1	I eat at least 3 servings of vegetables a day (one serving is about a half bow of boiled vegetables)	□	□	□	□	□	○
2	I eat at least 2 servings of fruits a day (one serving is an apple or a banana)	□	□	□	□	□	○
3	I drink low fat milk or fat free milk instead of whole milk	□	□	□	□	□	○
4	I eat fried food everyday.	□	□	□	□	□	○
5	I drink sugared beverages everyday.	□	□	□	□	□	○
6	I would eat in negative mood states.	□	□	□	□	□	○
7	I eat fast food (hamburger, fried chicken, pizza) at least twice a week.	□	□	□	□	□	○
8	If there is a layer of oil on the surface of soup, I will only drink the soup after get rid of the oil.	□	□	□	□	□	○
9	I eat rice mixed with gravy or soup frequently	□	□	□	□	□	○
10	I eat light food frequently	□	□	□	□	□	○
11	I would eat more in the dinner if the food is tasted good	□	□	□	□	□	○
12	I have breakfast everyday.	□	□	□	□	□	○

Section III Please tick **ONLY ONE** box for each question which best describe your parents

			Not like	Sort of	A lot like	Just like	No
1	She/He is always telling me what to do	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
2	She/He makes rules without asking what I think.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
3	She/He makes me feel better when I am upset.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
4	She/He is too busy to talk to me.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
5	She/He listens to what I have to say.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
6	She/He likes me just the way I am.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
7	She/He tells me when I do a good job on things.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
8	She/He wants to hear about my problems.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
9	She/He is pleased with how I behave.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
10	She/He has rules that I must follow.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
11	She/He tells me times when I must come home.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
12	She/He makes sure I tell her where I am going.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
13	She/He makes sure I go to bed on time.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
14	She/He asks me what I do with friends.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
15	She/He knows where I am after school.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○
16	She/He checks to see if I do my homework.	Father	☐	☐	☐	☐	○
		Mother	☐	☐	☐	☐	○

CUHK Leisure Time Physical Activity Ratings for Children & Youth

From a scale of 0 to 10 listed below, that best describe your overall weekly level of physical activity in the past **12 MONTHS** period, then put the number in the square provided below: (refer to the annex table below for descriptions of light, moderate, and vigorous activities)

Select **ONLY ONE** rating and put into this square: → ☐

Choose 0 to 2 if you have no exercise habits at all:
0 — no physical activity at all, spend most of your time sitting or sleeping.
1 — no physical activity except little physical activity during PE lessons.
2 — no physical activity except being active during PE lessons。
Choose 3 to 6 if you, in addition to activity during PE lessons, participate in other physical activity occasionally:
3 — besides of the P.E. classes, I participate in light activities (3METs)# last longer than 60 minutes only once or twice every week.
4 — besides of the P.E. classes, I participate in light activities last longer than 20 minutes for three times a week.
5 — besides of the P.E. classes, I participate in light activities last longer than 20 minutes almost everyday.
6 — besides of the P.E. classes, I participate in moderate activities (5METs) last longer than 20 minutes once or twice a week.
Choose 7 to 10 if you, in addition to activity during PE lessons, participate in other physical activity regularly:
7 — besides of the P.E. classes, I participate in moderate activities last longer than 20 minutes three to five times a week.
8 — besides of the P.E. classes, I participate in moderate activities last longer than 20 minutes almost everyday.
9 — besides of the P.E. classes, I participate in vigorous activities (9METs) last longer than 60 minutes three times or less weekly.
10— besides of the P.E. classes, I participate in vigorous activities last longer than 20 minutes almost everyday.

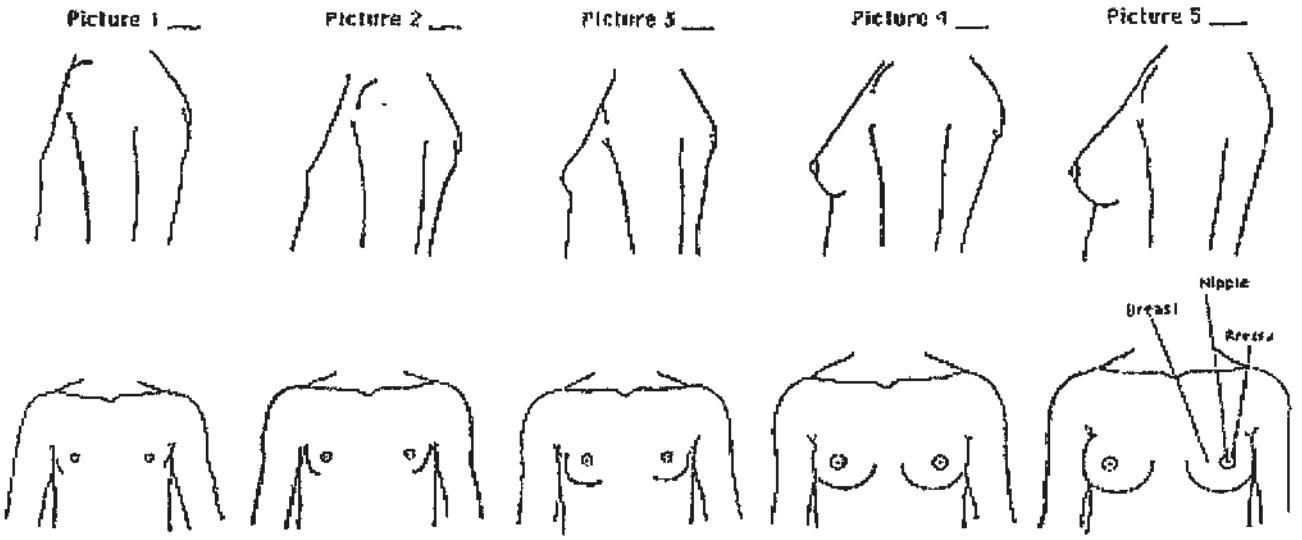
*** Annex Table: Examples of Light, Moderate & Vigorous Activities**

	Light *(3METs)	Moderate *(5METs)	Vigorous *(9METs)
Home Activities	Walk around home Handle household appliances	Walk upstairs while lifting a 1-15 lbs weight	Moving large furniture upstairs
	Walk downstairs	Walk stairs up and down	
	Light playing while standing	Home exercise such as calisthenics, sit-up etc.	Vigorous activities such as push up
	Household cleaning such as mopping floor and vacuuming	Floor cleaning by hand; window or car washing which requires heavy physical exertion.	Carrying heavy groceries upstairs
Sports Activities		Game playing inside water	Lap swimming
	Playing bowling	Basketball shooting (continuous)	Vigorous basketball competition
	Volleyball playing (1 ball for 6 – 9 persons)	Badminton playing (single or double)	Vigorous soccer competition
	Archery	Cycling; mixture of slow jogging and fast walking	Fast running (5.2mph or11.5min/mile)
	Frisbee	Playground playing	Orienteering
	Dancing in a dance room (slow dance, waltz)	Low impact aerobic dance & folk dance	Cross-country running / skiing
Others	Guitar playing (standing)		
	Band marching		

 # METs is Metabolic Equivalent, 1 MET is the energy expenditure during rest, 3METs is three times the energy expenditure of resting, 6METs is six times, and so on.

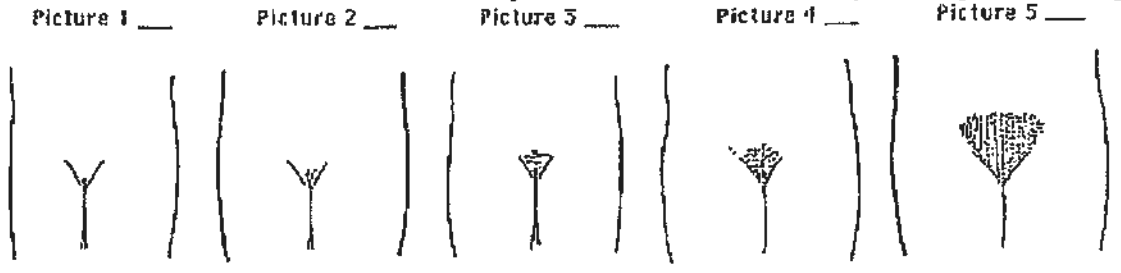
Tanner Stages Self-assessment Questionnaire (Girl)

The pictures on this page show different stages of how the breasts grow. A girl can go through each of the 5 stages as shown. Please look at each of the pictures. Read the sentences and choose the picture which is closest to your stage of growth.



☐ Picture 1: The nipple is raised a little in this stage. The rest of the breast is little flat.
☐ Picture 2: This is the breast bud stage. In this stage the nipple is raised more than in stage 1. The breast is a small mound. The areola is larger than in stage 1.
☐ Picture 3: The areola and the breast are both larger than in stage 2. The areola does not stick out away from the breast.
☐ Picture 4: The areola and the nipple make up a mound that sticks up above the shape of the breast. (Note: This stage may not happen at all for some girls. Some girls go from stage 3 to stage 5, with no stage 4.)
☐ Picture 5: This is the mature adult stage. The breasts are fully grown. Only the nipple sticks out in this stage. The areola has moved back to the general shape of the breast.

The pictures on this page show different amounts of female pubic hair. Please look at each of the pictures. Read the sentences. Then choose the picture which is closest to your stage of development.



☐ Picture 1: There is no pubic hair at all.
☐ Picture 2: There is a small amount of long lightly colored hair. This hair maybe straight or a little curly.
☐ Picture 3: There is hair that is darker, curlier and thinly spread out to cover a somewhat larger area than in stage 2.
☐ Picture 4: The hair is thicker and more spread out, covering a larger area than in stage 3.
☐ Picture 5: The hair now is widely spread covering a large area, like that of an adult female.

Appendix VIII

Questionnaire for Parents **No._____**

Dear Parents:

Thank you for participating in this study. The purpose of this study collect some information about your child's health. **Please notice that there is no correct or incorrect response to any item.** This questionnaire is **ANONYMOUS. Please complete the questionnaire honestly**. And the "child" mentioned in this questionnaire refers to your child recruited in this investigation. Thank you so much for your cooperation!

Section I

1. Your relationship with the child

   ☐ mother; ☐ father; ☐ stepmother; ☐ stepfather; ☐ other relative or friend

2. The number of people living in your household: _____ persons; including _____ children

3. The birth weight of your child _____kg, or ☐ I can not remember.

4. The duration of breastfeeding for your child: _____months or ☐ I can not remember.

5. Mother's height: _____cm Mother's weight: _____Kg

6. Father's height: _____cm Father's weight:_____Kg

7. Please report the weight status of the child's relatives

family	Underweight	slightly Underweight	normal	Slightly Overweight	Overweight	Not applicable
The child	☐	☐	☐	☐	☐	○
mother	☐	☐	☐	☐	☐	○
father	☐	☐	☐	☐	☐	○
Paternal grandfather	☐	☐	☐	☐	☐	○
Paternal grandmother	☐	☐	☐	☐	☐	○
Maternal grandfather	☐	☐	☐	☐	☐	○
Maternal grandmother	☐	☐	☐	☐	☐	○

8. Did your child get any disease (such as endocrine diseases, et al.) or take any medicine that may cause obesity?

☐ 1. No ☐2. Yes , please list the disease or the medicine _____

9. Mother's Education Level _____

①Primary school or less ②junior middle school; ③senior middle school; ④Matriculation; ⑤Tertiary non-degree; ⑥Tertiary degree; ⑦graduate school

10. Father's Education Level _____

①Primary school or less ②junior middle school; ③senior middle school; ④Matriculation; ⑤Tertiary non-degree; ⑥Tertiary degree; ⑦graduate school

11. Your household monthly income _____

☐ ¥1500 or below; ☐¥1501~¥3000; ☐¥3001~¥6000; ☐¥6001~¥10000;

☐ ¥10001~¥20000; ☐ ¥20001~¥50000; ☐ ¥50001 or above

12. Who is responsible for looking after the child in most of time?

☐ my wife(husband) and me; ☐ the child's grandfather and grandmother; ☐ babysitter; ☐ others

13. The screen time in your family (eg. watching TV, playing video games or using computers et al.)

The child: _____hours/week; Father: _____hours/week; Mother: _____hours/week;

CUHK Leisure Time Physical Activity Ratings for Adults

From a scale of 0 to 10 listed below, chose the number that best describes your overall **WEEKLY** level of physical activity in the past **12 MONTHS**, and then put the number in the square below: (refer to the annex table below for descriptions of light, moderate, and vigorous activities)

Select **ONLY ONE** rating and put it into this square: → ☐

Choose 0 to 2 if you have no exercise habits at all:
0 — no physical activity at all, spend most of your time sitting or sleeping.
1 — no physical activity except occasional slow walking that last less than 10 min each.
2 — no physical activity except less than once a week light activities that last less than 30 min.
Choose 3 to 6 if you participate in physical activity occasionally:
3 — I participate in light activities (3METs)# that last longer than 30 minutes only once or twice every week.
4 — I participate in light activities that last longer than 30 minutes three times a week.
5 — I participate in light activities that last longer than 30 minutes almost everyday.
6 — I participate in moderate activities (5METs) that last longer than 30 minutes once or twice a week.
Choose 7 to 10 if you participate in physical activity regularly:
7 — I participate in moderate activities that last longer than 30 minutes three to five times a week.
8 — I participate in moderate activities that last longer than 30 minutes almost everyday.
9 — I participate in vigorous activities (9METs) that last longer than 30 minutes three times or less weekly.
10— I participate in vigorous activities that last longer than 30 minutes almost everyday.

* **Annex Table : Examples of Light, Moderate & Vigorous Activities**

	Light *(3METs)	Moderate *(5METs)	Vigorous *(9METs)
Home Activities	Walk around home Handle household appliances	Walk upstairs while lifting a 1-15 lbs weight	Moving large items of furniture upstairs
	Walk downstairs	Walk up and down stairs	
	Light playing while standing	Home exercise such as calisthenics, sit-ups etc.	Vigorous activities such as push-ups
	Household cleaning such as mopping floor and vacuuming	Floor cleaning by hand; window or car washing that requires heavy physical exertion.	Carrying heavy groceries upstairs
Sports Activities		Game playing in water	Lap swimming
	Bowling	Basketball shooting (continuous)	Vigorous basketball competition
	Playing volleyball (1 ball for 6 – 9 persons)	Badminton playing (single or double)	Vigorous soccer competition
	Archery	Cycling; mixture of slow jogging and fast walking	Fast running (5.2 mph or 11.5 min/mile)
	Frisbee	Playing in the playground	Orienteering
	Dancing (slow dance, waltz)	Low impact aerobic dance and folk dance	Cross-country running/skiing
Others	Guitar playing (standing)		
	Marching band		

 # MET is the Metabolic Equivalent, 1 MET is the energy expenditure during rest, 3METs is three times the energy expenditure of resting, 6METs is six times, and so on.

Section II Please tick **ONLY ONE** box for each which best describe your thought and behaviors.

		never	rarely	sometimes	mostly	always
1	How much do you keep track of sweets (candy, ice cream, cake) that your child eats?	☐	☐	☐	☐	☐
2	How much do you keep track of the high-fat foods that your child eats?	☐	☐	☐	☐	☐
3	How much do you keep track of servings of fruits and vegetables your child is eating?	☐	☐	☐	☐	☐
4	How often must your child ask permission before getting a snack?	☐	☐	☐	☐	☐
5	How much do you keep track of the amount of TV or videos your child is watching?	☐	☐	☐	☐	☐
6	How much do you keep track of exercise your child is getting?	☐	☐	☐	☐	☐
7	How often do you praise your child for eating a healthy snack?	☐	☐	☐	☐	☐
8	How often do you praise your child for being physically active?	☐	☐	☐	☐	☐
		disagree	slightly disagree	neutral	slightly agree	agree
9	Offer sweets (candy, ice cream, cake) to my child as a reward for good behavior	☐	☐	☐	☐	☐
10	I have to be especially careful to make sure my child eats enough	☐	☐	☐	☐	☐
11	If my child says "I am not hungry" I try to get him/her to eat anyway	☐	☐	☐	☐	☐
12	If I don't regulate or guide my child's eating, he/she would eat much less than he/she would eat much less than he/she should	☐	☐	☐	☐	☐
13	I offer TV, or video game to my child as a reward for good behavior	☐	☐	☐	☐	☐
14	I limit the amount of soda my child drinks	☐	☐	☐	☐	☐
15	I limit the number of snacks my child eats	☐	☐	☐	☐	☐
16	I limit the amount of time my child watches TV or videos during week (Mon-Fri)	☐	☐	☐	☐	☐
17	I limit the amount of time my child watches TV or videos during weekend (Sat/Sun)	☐	☐	☐	☐	☐

Thank you for your coopration! Please send it back to us!