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Childhood Obesity: Perceptions of the Calgary Public

by

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ABSTRACT

The purpose of this study was to investigate perceptions about childhood obesity as held by the adult public in Calgary. In this cross sectional study, which was modeled after Hardus et al *Int J Obes* 2003;27:1465-71, adults were recruited from a shopping mall located in a sociodemographically diverse region of Calgary. A total of 264 adults completed a questionnaire on which they provided demographic information and rated the importance of 25 potential causes of obesity and 13 potential preventive measures. Principal components analysis was used to reduce the “cause” and “prevention” items respectively into a smaller number of internally consistent factors. T-test and ANOVA were then used to assess differences on factor scores by demographic variables. These analyses revealed differences by sex and by weight category. This study thus offers preliminary guidance about publicly acceptable intervention strategies for this important public health problem.

TABLE OF CONTENTS

APPROVAL PAGE	ii
ABSTRACT	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	viii
LIST OF FIGURES	ix
CHAPTER 1: REVIEW OF THE LITERATURE	1
INTRODUCTION	1
PREVALENCE OF OBESITY	2
IMPACT OF OBESITY	3
IMMEDIATE HEALTH CONSEQUENCES	4
Diabetes	4
Hypertension	5
Neurological and Gastroenterological Complications	5
Sleep Disorders	5
Non Lethal Complications	6
Early Maturation	7
PSYCHOLOGICAL, SOCIAL, AND CULTURAL CONSEQUENCES	8
Self Esteem and Depression	9
Future Social Consequences	10
ADULT HEALTH CONSEQUENCES	10
Cardiovascular Disease	11
Diabetes	12
Hypertension	13
Cancer and Respiratory Function	13
Mortality	14
IMPACT ON SOCIETY	15
CONTRIBUTING FACTORS	16
PHYSICAL ACTIVITY	17
Cultural and Technological Influences on Physical Activity	18
Determinants of Physical Activity Levels	19
Sedentary Pursuits	19
Television Advertising	21
CHANGING FAMILIES CHANGING DIETS	22
Snacking	23
Soft Drink Consumption	23
School Meal Programs	24
PARENT CHILD INTERACTIONS AND THE HOME ENVIRONMENT	25
PARENTS AS DIETARY ROLE MODELS	27
PARENTAL USE OF FOOD	27
PARENTAL CONTROL	28
MATERNAL BELIEFS AND PERCEPTIONS	29
PARENTAL RECOGNITION OF OBESITY	31
SOCIOECONOMIC FACTORS	32

FACTORS INHERENT TO THE CHILD	33
GENETICS	33
RACE AND CULTURE	34
SEX	35
TREATMENT AND PREVENTION	35
PRIMARY CARE	36
WITHIN THE FAMILY SETTING	37
WITHIN SCHOOL SETTINGS	38
WITHIN COMMUNITY SETTINGS	39
TREATMENT OUTCOMES	39
BARRIERS TO TREATMENT	40
REASONS TO TARGET CHILDREN	40
THE PRESENT STUDY	41
RESEARCH QUESTION	43
CHAPTER 2: METHODS	44
RESEARCH DESIGN	44
DATA COLLECTION STRATEGY	44
THE SAMPLE	44
DATA ANALYSIS PROCEDURE	46
DATA CLEANING	46
FACTOR ANALYSIS	47
COMPARISONS	49
SAMPLE SIZE	50
PSYCHOMETRIC PROPERTIES OF SURVEY	51
ETHICAL CONSIDERATIONS	51
CHAPTER 3: RESULTS	53
DATA SCREENING	53
UNIVARIATE ANALYSIS	56
UNIVARIATE ANALYSIS FOR PREVENTION ITEMS	57
MISSING DATA	57
OUTLIERS	58
(1) PRINCIPAL COMPONENTS ANALYSIS OF QUESTIONNAIRE ITEMS THAT ASSESS CAUSES OF CHILDHOOD OBESITY	58
ROTATION	63
INTERNAL CONSISTENCY	64
INTERPRETATION OF FACTORS	65
CAUSE ITEM FACTOR SCORES	66
COMPARISONS	66
(1) COMPARISON OF MALES AND FEMALES	66
(2) COMPARISON AMONG PARENTS AND NON-PARENTS	67
(3) COMPARISON AMONG VARYING EDUCATION LEVELS	67
(4) COMPARISON AMONG SELF-REPORTED BMI CATEGORIES	70
INTERACTIONS	72
(2) PRINCIPAL COMPONENTS ANALYSIS FOR QUESTIONNAIRE ITEMS THAT ASSESS PREVENTION OF CHILDHOOD OBESITY	72

ROTATION	76
INTERNAL CONSISTENCY	76
INTERPRETATION OF FACTORS	77
PREVENTION ITEM FACTOR SCORES	79
COMPARISONS	79
(1) COMPARISON OF MALES AND FEMALES	79
(2) COMPARISON AMONG PARENTS AND NON-PARENTS	80
(3) COMPARISON AMONG VARYING EDUCATION LEVELS	80
(4) COMPARISON AMONG SELF-REPORTED BMI CATEGORIES	82
INTERACTIONS	84
RESULTS SUMMARY	85
RESULTS OF FACTOR ANALYSES	85
DEMOGRAPHIC DIFFERENCES IN FACTOR SCORES	86
COMPARISONS TO MELBOURNE AUSTRALIA	87
CHAPTER 4: DISCUSSION	94
CALGARY	94
COMPARISONS TO AUSTRALIA	99
UNIVARIATE ANALYSIS – CAUSE ITEMS	99
CALGARY – MELBOURNE DIFFERENCES IN CAUSE FACTOR SCORES	101
UNIVARIATE ANALYSIS – PREVENTION FACTORS	102
CANADA - MELBOURNE DIFFERENCES IN PREVENTION FACTOR SCORES	103
LIMITATIONS AND RECOMMENDATIONS	103
BIBLIOGRAPHY	105
APPENDIX A: ETHICS APPROVAL	118
APPENDIX B: PERMSSION TO REPLICATE THE STUDY	119
APPENDIX C: SURVEY COVER LETTER	121
APPENDIX D: THE SURVEY	122
APPENDIX E: ASSESSING ASSUMPTIONS	125
NORMALITY	125
LINEARITY	129
MULTICOLINEARITY AND SINGULARITY	129
HOMOSCEDASTICITY	129
APPENDIX F: OUTLIERS	130
UNIVARIATE OUTLIERS	130
MULTIVARIATE OUTLIERS	133
APPENDIX G: ASSESSING CAUSE FACTOR SCORE DISTRBUTIONS	134

LIST OF TABLES

Table 1 Distribution of demographic characteristics of the respondents (n=264).....	55
Table 2 Frequencies of the importance of causes of obesity in children in grades K to 6	56
Table 3 Frequencies of the importance for the prevention of obesity in children in grades K to 6.....	57
Table 4 Initial and rotated eigenvalues for cause items.....	59
Table 5 Rotated component matrix for cause items.....	62
Table 6 Criteria for evaluating whether or not a factor should be retained.....	63
Table 7 Component correlation matrix after oblique rotation of cause factors.....	64
Table 8 Internal reliability of cause factors.....	64
Table 9 Results of principal components analysis of lay perceptions of the importance of causes of obesity among children in grades K to 6.....	65
Table 10 Results of t-test by sex for each cause factor.....	66
Table 11 Results of t-test by parental status for each cause factor.....	67
Table 12 Results of the Kolmogorov-Smirnov (KS) test for each cause factor.....	68
Table 13 Results of the Kruskal Wallis (KW) test for cause factors 2, 3, and 4.....	68
Table 14 Results of Education ANOVA for each cause factor.....	68
Table 15 Results of the Kruskal Wallis (KW) for cause factors 2, 3, and 4.....	70
Table 16 Results of weight category ANOVA for each cause factor.....	70
Table 17 Scheffe Post Hoc tests for cause factor 3.....	71
Table 18 Tests for interactions for cause factors.....	72
Table 19 Initial and rotated eigenvalues for prevention items.....	73
Table 20 Rotated component matrix for prevention items.....	75
Table 21 Component correlation matrix after oblique rotation for prevention factors.....	76
Table 22 Internal reliability of prevention factors.....	77
Table 23 Results of principal components analysis of lay perceptions of the importance of prevention of obesity among children in grades K to 6.....	78
Table 24 Results of t-test by sex for each prevention factor.....	80
Table 25 Results of t-test by parental status for each prevention factor.....	80
Table 26 Results of the Kolmogorov-Smirnov (KS) test for each prevention factor.....	81
Table 27 Results of the Kruskal Wallis (KW) test for prevention factor 2.....	81
Table 28 Results of education ANOVA for each prevention factor.....	82
Table 29 Results of the Kruskal Wallis (KW) for prevention factor 2.....	83
Table 30 Results weight category ANOVA for each prevention factor.....	83
Table 31 Scheffe Post Hoc tests for prevention factor 1.....	83
Table 32 Tests for interactions for prevention factors.....	84
Table 33 Comparisons between Melbourne, Australia and Calgary, Canada.....	87

LIST OF FIGURES

Figure 1: Scree plot for principal components analysis of cause items.....	60
Figure 2: Scree plot for principal components analysis of prevention items.....	74
Figure 3: Brofenbrenner’s ecological theory of development.	95

CHAPTER 1: REVIEW OF THE LITERATURE

INTRODUCTION

Research indicates that globally, and particularly in the western world, the incidence of obesity in children and young people has risen alarmingly (Laing, 2002). This trend reflects the major epidemiological transition of the 20th century – the shift in morbidity and mortality from infectious diseases to chronic diseases. More recently this continuing trend is attributable to the social, economic, and public health changes that have taken place in North America during the first half of the century. A current abundance of food has led to better nutrition; however, it has also led to the current state of excess positive energy balance, which has been accelerated in recent decades by an increasingly sedentary lifestyle (Kimm and Obarzanek, 2002). At the beginning of this millennium, a new challenge has emerged – a dramatic increase in the incidence of childhood obesity, with a parallel increase in obesity-related health concerns.

Obesity is characterised by excess body fat and is to be distinguished from increased weight associated with high lean-body mass reflecting muscularity and bone (Diamond, 1998). Obesity and its associated metabolic consequences are major impediments to quality of life and are among the most important public health problems in industrialized countries today (O’Loughlin, Gray-Donald, Paradis, and Meshefedjian, 2000). Childhood obesity is one of the most challenging and frustrating problems public health professionals are facing. It is frustrating because it is difficult to define the problem, difficult to understand its etiology, difficult to predict its natural history over time, and difficult to effectively prevent or treat the condition (Williams, Gulli, and Deckelbaum, 2001).

There was no uniform definition of childhood obesity until recently when a group of researchers developed an internationally acceptable definition of child overweight and obesity, specifying the measurement, the reference population, and the age and sex specific cut offs (Cole, Bellizzi, Flegal, and Dietz, 2000). Previously childhood obesity has been variously described by absolute weight, tricep skinfolds, weight-for-height percentiles, percent of ideal body weight and, most recently, by body mass index (BMI = weight in kg/height in meters squared). Despite the fact that these measures reflect

slightly different aspects of body composition, they are moderately well correlated with body fat, even in growing children (Must and Strauss, 1999). Body weight is reasonably correlated with body fat but is also highly correlated with height, which is weakly correlated with body fat. Therefore, weight adjusted for height (body mass index; BMI) is a far more useful index with which to assess overweight and is a reasonable indicator of fatness at a population level. Additional benefits to the use of BMI are that the measurements used to derive BMI as an assessment of adiposity in children and adolescents are reliable and non intrusive; furthermore, BMI has been validated against measures of body density (Bellizzi and Dietz, 1999). However, it is important to note that the correlation between BMI and adiposity is influenced by race, sex, pubertal stage, and body fat distribution in both children and adolescents (Diamond, 1998). Because BMI depends on age, sex, and race, these factors must be considered when assessing adiposity. As a result reference BMI curves that enable age and sex specific percentiles to be determined have also been published by the Centers for Disease Control and Prevention and are often used in defining of obesity and overweight (Anzai, Lindsey-Dudley, and Bidwell, 2002). The literature also lacks consistency in the degree of adiposity that is considered overweight and what degree of adiposity is considered obese. However, for the majority of studies, a BMI greater than either the 85th or 95th percentile, or a weight-for-height greater than 120% of ideal was considered obese (Must and Strauss, 1999). Nevertheless, whatever method is used to classify obesity in children, studies consistently report a high prevalence of obesity with rates on the increase (Fruhbeck, 2000).

PREVALENCE OF OBESITY

In the following section current estimates of the prevalence of overweight and obesity in children will be presented. Estimates from both Canada and the United States will be reviewed to provide a clear picture of the problem we are facing.

In 1994-1995, 34% of Canadian children ages 2 to 11 were overweight, with an estimated 16% classified as obese. By 1998-1999, 37% of Canadian children ages 2 to 11 were overweight (BMI > 85th percentile), with 18% classified as obese (BMI >95th percentile) (Statistics Canada, 2002). Similar data from the United States show that

obesity is present in 25% of children and adolescents (Donnelly et al., 1996). Carriere (2003) reports that between 1981 and 1996, the prevalence of overweight among 7 to 13 year old Canadian boys rose from 15% to 35%; among girls of the same ages, the prevalence increased from 15% to 29%. The prevalence of obesity tripled during the same period, from 5% for both sexes to 17% for boys and 15% for girls. All indications are that the current generation of children will grow into the most obese generation of adults in U.S history (Hill and Trowbridge, 1998). If these trends to increasing obesity do not slow, the Centers for Disease Control and Prevention (CDC) predicts the entire U.S. population will be obese by the middle of the present century (Hassink, 2002). Additionally, the distribution curve of BMI has become skewed to the right over time, indicating that children who are overweight are getting fatter (Edmunds, Waters, and Elliot, 2001). Data from the National Health and Nutrition Examination Survey (NHANES), a nationally representative cross-sectional survey conducted in the United States, indicate that overweight incidence has not only increased over time but that the degree of obesity increased markedly between the NHANES 2 (1976 to 1980) and NHANES 3 (1988 to 1994) and continues to grow as more individuals become obese at an earlier age and the exhibited degree of obesity is larger (Bouchard, 1997). The World Health Organization (WHO) has recognized the rise in obesity rates as a worldwide epidemic requiring immediate action (Canadian Institute for Health Information [CIHI], 2004).

IMPACT OF OBESITY

In the following sections a review of the wide ranging impact of childhood obesity is provided, including a discussion of both the immediate physical and mental health consequences for the child and the future health consequences for the adult. It is important to recognize that the consequences of obesity do not occur only at the individual level, but also at the societal level. Therefore, the serious societal ramifications of obesity will also be reviewed.

The greatest health burden of overweight in children and adolescents arises from long-term consequences. However, as described by Dietz (1998), even before reaching adulthood, overweight and obese children experience medical and psychosocial effects

related to their overweight condition. As a result, childhood obesity has to be considered a risk factor of critical importance because of its association with both immediate health risks and adult morbidity and mortality (Dwyer et al., 1998; Himes and Dietz, 1994).

IMMEDIATE HEALTH CONSEQUENCES

The devastating physical health consequences of childhood obesity are well documented (Pi-Sunyer, 1993). Immediate health risks include type 2 diabetes mellitus, hypertension, increased intracranial pressure, gallstones, sleep disorders, and several non-lethal complications including orthopaedic problems and asthma (Daniels, 2001). Early maturation in these children will also be reviewed along with the social and psychological problems associated with childhood obesity. As I move through this section of the review of literature, I will highlight some important findings regarding these immediate health risks.

Diabetes

Until recently type 2 diabetes was considered a rare disease in children and adolescents. Type 2 diabetes in youth represents the most rapidly growing form of diabetes in America, Europe, Japan, and Australia, now responsible for up to about one fifth of new diagnoses of diabetes in pubertal children (Speiser et al., 2005). In a recent study a 10-fold increase in the incidence of type 2 diabetes among adolescents over the past 10 years was noted (Pinhas-Hamiel and Zeitler, 2000) and this increased prevalence parallels the increase in the prevalence and severity of paediatric obesity (Miller, Rosenbloom, and Silverstein, 2004). Perhaps of more concern is the fact that half of all cases of type 2 diabetes go undiagnosed in the adult population. If this trend also holds true in adolescents then current data may be dramatically under-estimating the occurrence of type 2 diabetes in adolescents (Pinhas-Hamiel and Zeitler, 2000). Equally alarming is the finding that type 2 diabetes is now the dominant form of diabetes in children and adolescents in some populations (Deckelbaum and Williams, 2001). Roche (2003) reports that type 2 diabetes accounts for 8-45% of child/adolescent diabetes in some communities compared with only 2-4% of cases in 1992. If insulin resistance is occurring in childhood it is quite possible that these children will develop diabetes in their twenties and then the complications of diabetes in their thirties and forties.

Complications include blindness, kidney failure, neuropathy, and atherosclerotic heart and large vessel disease leading to limb amputation and heart attacks (Willson, 2002).

Hypertension

Hypertension does not occur in high frequency among children but childhood obesity is the leading cause of paediatric hypertension (Speiser et al., 2005). Additionally, 60% of children with persistently elevated blood pressure have relative weights greater than 120% of the median for their sex, height, and age (Dietz, 1998). It has also been shown that childhood blood pressure along with change in BMI, are consistently the two most powerful predictors of adult blood pressure. Approximately 20-30% of obese children between the ages of 5-11 years have elevated systolic or diastolic blood pressure (Must and Strauss, 1999). Prospective data show that obese boys and obese girls are nine- to ten-fold more likely to develop high blood pressure as young adults than non-obese children (Must and Strauss, 1999).

Neurological and Gastroenterological Complications

Idiopathic increased intracranial hypertension (e.g., pseudotumor cerebri) usually presents with headaches, vomiting, blurred vision or diplopia (Must and Strauss, 1999) and may lead to visual impairment or blindness (Dietz, 1998). Epidemiological studies indicate a 14-fold increase in the presence of pseudotumor cerebri in patients with weights >10% above the ideal, and a 20-fold increase in the prevalence in people with weights 20% greater than ideal (Must and Strauss, 1999). Must and Strauss (1999) also report that obesity occurs in 30-80% of children with pseudotumor, and it also accounts for the vast majority of cases not associated with infection, medication, or underlying disease. It has also been reported in a review by Must and Strauss (1999) that obesity accounts for 8-33% of the gallstones observed in children, and childhood obesity accounts for the majority of gallstones in children without underlying medical conditions.

Sleep Disorders

Sleep apnea is another consequence of childhood obesity for which aggressive therapy is warranted. Dietz (1999) reports that the only published estimate of the prevalence of sleep apnea among obese children and adolescents suggests that sleep apnea occurs in approximately 7% of obese children. Sleep apnea is also associated with

decreased learning and memory function (The Centre for Health and Health Care in Schools, n.d.). Children with body weights greater than 150% of the ideal body weight were examined for sleep apnea and one third were positively diagnosed. Other serious immediate physical health consequences of childhood obesity include Pickwickian syndrome (obstructive apnea). Pickwickian syndrome consists of a constellation of signs and symptoms including alveolar hypoventilation, hypoxemia, cardiac enlargement, right heart failure, pulmonary hypertension, daytime somnolence, napping, and poor concentration (Hassink, 2002). The prevalence of the Pickwickian syndrome in children is unknown; however, the obesity-hypoventilation syndrome is associated with pulmonary embolism and sudden death in children (Must and Strauss, 1999). Obstructive sleep apnea can present with snoring, noisy breathing at rest, mouth breathing, and restless sleep, and can cause chronic alveolar hypoventilation, hyperapnea and hypoxia, orthopnea, and oxygen desaturation during sleep, and in severe cases, while awake (Hassink, 2002).

Non Lethal Complications

Potentially non lethal but serious complications of childhood obesity include such orthopedic disorders as genu valgum, slipped capita femoral epiphysis, tibia vara, and respiratory disorders such as upper airway obstruction, chest wall restriction, and asthma. The presence of unfused growth plates and softer, cartilaginous bones of children, contributes to the occurrence of orthopedic abnormalities in obese children. Additionally, the tensile strength of bone and cartilage did not evolve to carry substantial quantities of excess weight (Dietz, 1998). Blount's disease (tibia vara) involves bowing of the legs and tibial torsion in response to unequal or early excess weight bearing. Approximately 80% of patients with Blount's disease, or tibia vara, have been found to be obese (Must and Strauss, 1999). Slipped capita femoral epiphysis is when dislocation occurs at the femoral growth plate due to the effect of increased weight on the cartilaginous growth plate of the hip (Dietz, 1999). It may result in permanent damage to the femoral head (Must and Strauss, 1999). It has been estimated that between 50% and 70% of patients with slipped capital femoral epiphysis are overweight (Must and Strauss, 1999).

Asthma has been linked to obesity in childhood. In one survey of 171 four to 16 year old children, significantly more children with asthma were obese (30.6%) compared to controls (11.6%), and the asthmatic children were significantly more overweight than the non-asthmatic controls (Williams et al., 2001). In a recent study of children with asthma, obese children and adolescents used more medicine, wheezed more, and a greater proportion of these children made unscheduled visits to emergency rooms compared to their non-obese peers (The Centre for Health and Health Care in Schools, n.d.). Additionally, it is not uncommon for children with previously diagnosed asthma to gain weight as a result of inactivity due to exacerbations of disease or inactivity because parental fears of triggering an acute asthma attack (Hassink, 2002).

Early Maturation

Overweight children tend to be taller, have advanced bone ages, and mature earlier than children who are not overweight. Early maturation, determined by bone age, peak height velocity, and age of menarche, is associated with increased fatness in adulthood (Dietz, 1998) and in itself can have potential health consequences. Adiposity rebound, defined as the age at which BMI increases after reaching its lowest point during childhood, is an important predictor of which children are likely to become obese as adults (Knehan, 2002). Those children reaching adiposity rebound earlier than the mean age of 5.5 years are at greater risk of adult obesity than those reaching adiposity rebound after that age. Additionally, children who mature early are more likely to develop eating disorders (Dietz, 1998) and are often identified as being older than they actually are (Holm, Li, Spector, Hicks, Carlson, and Lanuza, 2001). Several studies show that such perceptions can lead to these children being treated in a manner which can lead to feelings of inferiority in the child (Holm et al., 2001). So although obesity-associated morbidities occur more frequently in adults, significant consequences of obesity as well as the antecedents of adult disease occur in obese children.

As outlined above the immediate health consequences of childhood obesity are several. In fact, there are few organ systems that are not affected by obesity in childhood (Must and Strauss, 1999). However, it is important to note that obesity related complications differ by ethnic origin and as a result of cultural factors. Black and

Hispanic youths, for example, are at greater risk for type 2 diabetes and cardiovascular disease than their caucasian counterparts (Ebbeling, Pawlak, and Ludwig, 2002). Perhaps even more importantly, it is important to realize that as the prevalence of childhood obesity continues to rise, we can anticipate that the once rare orthopaedic, endocrinal, gastroenterological, pulmonary, and neurological consequences will become far more commonplace (Must and Strauss, 1999).

PSYCHOLOGICAL, SOCIAL, AND CULTURAL CONSEQUENCES

Action is also needed to stem the increasing numbers of children who are being negatively affected by obesity in a psychological, social, and cultural context (Laing, 2002). Few problems in childhood may have as significant an impact on childhood emotional development as obesity (Must and Strauss, 1999). Overweight and obesity confer immediate psychosocial risks, such as social isolation, distorted body image, and social rejection in childhood. Obese children are often the targets of early and systematic discrimination (Dietz, 1998). Several studies have shown that children are negatively sensitized to obesity at a young age, and develop cultural preferences to thinness (Williams et al., 2001). As young as age six, overweight children were described by their peers as ugly, stupid, dishonest, and lazy (Must, 1996). Landmark studies conducted in the 1960s also demonstrate that obese children are uniformly ranked by other children as the least desired friends (Must and Strauss, 1999). In one study of ten to eleven year old children, children preferred handicapped children as friends more than obese children, and ranked obese children lowest among those with whom they would like to be friends (Williams et al., 2001). As obese children grow older, they are less likely than their lean peers to be chosen as “best friend”, invited to birthday parties, selected for sports teams, or become members of child initiated cliques (Williams et al., 2001). Teasing and bullying of obese children, as well as low self esteem, are also reported (Gibson, 2002). Unfortunately, peers are not the only source of stigmatization of the overweight child. Schwartz and Puhl (2003) examined attitudes towards obesity among junior and senior high school teachers and found biases including beliefs that obese persons are untidy; more emotional; less likely to succeed; and have more family problems. In addition, 43% of teachers strongly agreed that ‘most people feel uncomfortable when they associate

with obese people', 55% agreed that obesity often starts as a form of compensation for lack of love or attention and 28% agreed that 'one of the worst things that can happen to a person would be for him/her to become obese.' (Schwartz and Puhl, 2003). It is also clear from the evidence that the emotional stress, poor self esteem and psychological problems associated with the stigma of obesity can be seen in very young children, but are more pronounced in the adolescent population (Laing, 2002). The research on stigma suggests that parents may be stigmatizing their own overweight children in subtle ways which may be as harmful as other types of more overt stigmatization. In one study with 9-11 year old children and their parents, parents were more likely to describe girls as too heavy and boys as thin despite the fact that they were all of average weight (Schwartz and Puhl, 2003). Additionally, children were able to predict their parents' perceptions of their own bodies with 82% accuracy, indicating that children are keenly aware of parental perceptions. With this being said however, it is important to realize that the degree of impact of such effects on individual children will likely be influenced by characteristics inherent to them, including their sex and ethnicity. For example, adverse psychosocial effects are often more severe in caucasian children, particularly in girls, than in other ethnic groups.

Self Esteem and Depression

Middle childhood is a critical period for the development of body image and self-esteem. It has been found that obese girls more often have obsessive concern with body image alongside expectations of rejection and progressive withdrawal. In contrast to women who become obese as adults, women who become obese as children are more likely to have persistent severe disturbances in body image (Must and Strauss, 1999). Additionally, obese children with decreased levels of self-esteem reported increased rates of loneliness, sadness, nervousness, and were more likely to report smoking and alcohol consumption (The Centre for Health and Health Care in Schools, n.d.). Increased levels of depressive symptoms among overweight children have also been reported. A recent study of third-grade students reported higher depressive symptoms among overweight girls where concerns about being overweight largely explained the positive relationship between BMI and depression (Schwartz and Puhl, 2003). Not only do overweight

children feel badly about themselves, but they are more likely to blame themselves for their obesity, and therefore feel worse overall (Schwartz and Puhl, 2003). And the children who believed they had personally caused their overweight were those with the lowest self esteem.

Future Social Consequences

It has also been shown that obese children tend to achieve a lower level of education, earn less money, are less likely to marry and in other ways be deprived of the social privileges enjoyed by those of a more normal body weight (Rossner, 1998). Additionally, if an obese woman is to marry she is more likely than a non-obese woman to choose a partner in a lower socioeconomic class (Anzai, Lindsey-Dudley, and Bidwell, 2002). Data analyzed from the National Longitudinal Survey in Youth showed that women who were initially overweight completed 0.3 years less schooling, had lower household income (USD 6710 less annually), and had higher rates of poverty (10% higher) than those who were initially normal weight. These differences remained after adjusting for baseline family income, education, ethnicity, and self esteem (Must and Strauss, 1999). Psychosocial consequences represent a second major source of adult morbidity related to obesity in children and adolescents (Dietz, 1998). In a large sample studied during the US National Longitudinal Survey of Youth, Dietz demonstrated that obesity present in late adolescent females had severe social consequences 7 years later. Consequences included lower rates of marriage, lower family incomes and higher rates of poverty. The persistence of these results when controlled for the income and educational levels of family origin and for self esteem suggested that obesity in women was a determinant rather than a consequence of these socioeconomic correlates (Dietz, 1998).

ADULT HEALTH CONSEQUENCES

In addition to such immediate health risks, the risk that childhood overweight will persist into adulthood is a serious public health concern. It has been found that 80% of obese adolescents become obese adults (Clarke and Lauer, 1993). However, it is important to note that tracking childhood obesity into adulthood varies between studies because of the different methodologies employed. Approximately one-third of obese pre-school aged children become obese adults and approximately half of the obese school-age

children will become obese adults. It is important to keep in mind that several factors affect the persistence of obesity into adulthood. These include, but are not limited to, the age at which the child becomes obese, the severity of the obesity, and the presence and/or absence of obesity in one or both parents. At all ages a child is twice as likely to become an obese adult if obese in childhood (Roche, 2003). Therefore, if the childhood trend continues unchallenged we are undoubtedly facing future generations of obese adults far in excess of current numbers. As a result, we are also undoubtedly facing an excess of adult health consequences of childhood obesity. The significant consequences of childhood obesity on several adult health issues will be reviewed.

Cardiovascular Disease

The preponderance of evidence suggests that obesity is important as an independent long term risk factor in producing morbidity and mortality from cardiovascular disease (CVD). Dietz reported that 65% of obese 5 to 10 year old children have at least one cardiovascular disease risk factor, and 25% have two or more, again reinforcing that childhood obesity must be considered more than a cosmetic problem. The Cardiovascular Risk in Young Finns Study also showed that childhood LDL cholesterol and BMI correlated with adult cardiovascular disease and this increased risk in adulthood was irrespective of adult risk factor status, indicating that permanent damage to the arterial wall may occur during childhood (Miller et al., 2004). Coronary heart disease morbidity is defined generally in epidemiological studies as nonfatal myocardial infarction and angina pectoris. Pi-Sunyer (1991) found that a higher BMI is positively associated with the occurrence of each category of coronary heart disease. Studies also indicate that mild to moderate overweight increases risk for coronary heart disease (Must, 1996). Postmortem research by Miller et al. (2004) showed that 50% of children age 2-15 years had fatty streaks in their coronary arteries, and 8% of these children had raised fibrous plaques in their coronary arteries. In this research, the extent and severity of lesions correlated with BMI and lipoprotein levels (Miller et al, 2004). Additionally, numerous studies report that adverse levels of cardiovascular disease risk factors such as total cholesterol, low-density lipoprotein cholesterol (LDL), high-density lipoprotein cholesterol (HDL), triglycerides, fasting insulin levels, and systolic blood pressure are

associated with adiposity in children (Higgins, Gower, Hunter, and Goran, 2001). Blood lipid levels are often abnormal in obese persons. HDL cholesterol has been found to be low and LDL levels have been found to be normal or elevated (Pi-Sunyer, 1993). This results in a high HDL to LDL cholesterol ratio, leading to greater atherogenic risk. A report of a random sample of men and women from Naples found higher total cholesterol levels to be associated with increasing BMI; as well, triglycerides have generally been found to be higher in obese compared with lean persons (Pi-Sunyer, 1993). Furthermore a longitudinal study that followed children over 57 years found a two-fold increase in the risk of death from ischemic heart disease (Pi-Sunyer, 1991). The long term consequences of childhood obesity on the cardiovascular system have been detailed in the 20-year epidemiologic Bogalusa Heart Study (Myers and Vargus, 2000) that was carried out with rigid protocols and detailed observations. The study indicated that increased insulin and glucose levels in heavier children and adolescents might be risk factors for increased left ventricular mass corrected for growth (Speiser et al., 2005). The Bogalusa Heart study also demonstrated that atherosclerosis, a major cause of heart disease in adults, has its origins in early childhood, and childhood obesity is a major risk factor for the development of atherosclerosis (Myers and Vargus, 2000).

Diabetes

Type 2 diabetes affects more than 1.8 million Canadian adults and may result in the accelerated development of cardiovascular disease, end stage renal failure, loss of vision and limb amputations (Canadian Paediatric Society [CPS], 2002). Type 2 diabetes is strongly associated with overweight in both genders in all ethnic groups (Bray, 2004). The risk of type 2 diabetes increases with the degree and duration of overweight and with a more central distribution of body fat (Bray, 2004). As it has been shown that the duration of obesity is a more important determinant of the risk for developing diabetes this again highlights the importance of childhood obesity as a risk factor for adult morbidity. There is a strong linear relationship between BMI and risk of type 2 diabetes, and obese individuals have almost 10 times the risk of diabetes, compared with their non-obese peers (Stein and Colditz, 2004). The Nurses Health Study found that the risk of diabetes was lowest in individuals with a BMI less than 22kg/m^2 . As BMI increased, the

relative risk increased, such that at a BMI of 35kg/m^2 , the relative risk increased 40-fold, or 4000% (Bray, 2004).

Hypertension

The association between hypertension and obesity is well documented. Cross sectional studies have shown that obese persons have a greater risk for high blood pressure than do non-obese persons (Pi-Sunyer, 1993). In the Western world, about one third of cases of hypertension are thought to be due to obesity, and in men younger than 45 years this figure may reach 60% (Pi-Sunyer, 1993). In a prospective study persons who were only 20% overweight had an eightfold greater incidence of hypertension and a 15% gain in weight was associated with an 18% increase in systolic pressure (Pi-Sunyer, 1993).

Cancer and Respiratory Function

Obesity has also been shown to have effects on incidence rates of certain types of cancer. A prospective American Cancer Society study followed 750 000 men and women for 12 years and found that the mortality ratio for cancer for men who were 40% or more overweight was 1.33; the corresponding figure for women was 1.55 (Pi-Sunyer, 1993). Overweight men had significantly higher mortality rates for colorectal and prostate cancers, and overweight women had significantly higher rates of endometrial, gallbladder, cervical, ovarian, and breast cancers (Must, 1996). Information from the US in 1998 indicates that current patterns of overweight and obesity could account for 14% of cancer deaths in men and 20% of those in women (CIHI, 2004). However, it is important to realize that in these studies it is hard to differentiate between the effects of being overweight from the effect of diet and other lifestyle factors in these persons. Obesity also affects respiratory function. Increased fat in the chest wall and abdomen reduces lung volume, alters the respiratory pattern, and causes a decreased compliance of the respiratory system (Pi-Sunyer, 1993). Complications like this can also exacerbate the problem of obesity, as persons with poor respiratory function often have troubles being physically active. Dietz (1999) also reports that in both men and women, rates of diabetes, coronary heart disease, atherosclerosis, hip fracture and gout were increased in those who were overweight as adolescents.

Mortality

Several studies have investigated the link between childhood obesity and mortality (Dietz, 1998, Pi-Sunyer, 1991, and Maffeis and Tato, 2001). The results of available longitudinal studies demonstrate that early onset obesity is a risk factor for mortality later in life (Maffeis and Tato, 2001). An investigation in the United Kingdom found that mortality, including death due to cardiovascular events, was associated with a high childhood BMI (Pi-Sunyer, 1991). Those people who had a BMI above the 75th percentile as children were 1.5 times more likely to have died by the time the analysis was performed than were those whose childhood BMI were between the 25th and 49th percentiles, where mortality was the lowest (Pi-Sunyer, 1991). US research has predicted that a very obese 20-year-old white male (BMI>45) could have a 22% reduction in remaining years of life compared to someone with a normal weight (CIHI, 2004). The number of overweight and obesity related deaths in Canadian adults ages 20-64 years has increased from 2,514 in 1985 to 4,321 in 2000 (Katzmarzyk and Ardern, 2004). Another study found a link between adolescent obesity and a cluster of several cardiovascular disease risk factors, specifically hypertension, hyperlipidemia, and hyperglycemia. Sixty-nine percent of obese boys were found to have at least one risk factor, compared to only 34% of non-obese boys (Pi-Sunyer, 1991). The prevalence of two or more risk factors was nearly five times greater in obese children than in their non-obese counterparts. In addition, the Harvard Growth Study in which morbidity and mortality were evaluated in Harvard alumni from as far back as 1922 demonstrated the long-term risk associated with moderate overweight during adolescence. Excess mortality was found from all causes and from coronary heart disease when participants, overweight in adolescence, were compared with their lean classmates (Rossner, 1998). Additionally, it has been reported that being obese as an adolescent was a better predictor of overall mortality than being obese as an adult (Zametkin, Zoon, Klein, and Munson, 2004). Ample evidence suggests that obesity increases both morbidity and mortality risks. In conclusion, although controversy surrounds the strength of independent risk compared with the biological effects of obesity on other risk factors, little doubt exists about the severe impact of obesity on health and mortality.

In today's society mortality and morbidity related to behavioural or lifestyle factors has increased, and chronic diseases such as diabetes mellitus, heart disease, and cancer are among the leading causes of death in adults (Story, Evans, Fabitz, Clay, Rock, and Boussard, 1999). Several risk factors for such diseases have been identified, including high blood pressure, hyperlipidaemia, and abnormal glucose tolerance. As indicated above, since all of these factors occur with increased frequency in obese children and adolescents, it is logical that obese children stand a real risk of developing a chronic disease later in life (Pi-Sunyer, 1993).

IMPACT ON SOCIETY

Because of the close association of obesity with many chronic diseases, these adults will present an enormous challenge and a severe drain on the financial resources for both present and future health care provision. It is conservatively estimated that the direct cost of obesity was 45.8 billion (USD) in 1990, while indirect costs totalled 23 billion (USD) (Wolf and Colditz, 1994). Kiess et al. (2001) report that the annual economic costs due to medical expenses and lost income as a result of complications of adult obesity is approximately 70 billion (USD) in the USA. And at least another 30 billion (USD) are thought to be spent on diet foods, products and programming to lose weight. Additionally, hospitalizations among children and adolescents (6-17 years of age) for diseases associated with obesity increased sharply between 1979 and 1999. Obesity associated annual hospital costs, the only US cost data available that isolate childhood obesity, have more than tripled in the past 20 years, from 35 million in 1979 to 1981 to 127 million in 1997 to 1999 (Zametkin et al., 2004). The total impact of obesity on the Canadian economy is unknown. Birmingham et al. reported that obesity accounted for 1.8 billion (CD), or 2.4% of the total direct health care expenditures in Canada in 1997. The study did report the direct health care costs of obesity (e.g., drugs, hospital and physician care), however the indirect health care costs such as loss of work due to disability were not reported (Katzmarzyk and Janssen, 2004). The purpose of a review by Katmarzyk and Janssen was to estimate the direct and indirect economic costs of physical inactivity and obesity in Canada in 2001. This involved determining the relative risks of diseases associated with physical inactivity and obesity from a meta-analysis of

existing prospective studies and then applying these to the health care costs of these diseases in Canada (Katzmarzyk and Janssen, 2004). The authors reported that the economic burden of physical inactivity was 5.3 billion (CD) (1.6 billion in direct costs and 2.6 billion in indirect costs) while the cost associated with obesity was 4.3 billion (1.6 billion of direct costs and 2.7 billion of indirect costs). The total economic costs of physical inactivity and obesity represented 2.6% and 2.2%, respectively of the total health care costs in Canada (Katzmarzyk and Janssen, 2004). The highest costs attributable to physical inactivity were associated with coronary artery disease CAD (891 million), osteoporosis (352 million), stroke (345 million) and hypertension (314 million) (Katzmarzyk, Gledhill, and Shepard, 2000). Despite what estimations are correct, undoubtedly the monetary cost of obesity as these generations get older will be unmanageable, and it is therefore imperative that childhood obesity is tackled now to avert the impending healthcare crisis that threatens future generations (Laing, 1998).

In the above sections the enormous impact of childhood obesity has been presented. Perhaps the most important overall conclusion is that this problem has far reaching consequences not only for individuals and their families, but also for society.

CONTRIBUTING FACTORS

The alarming increase in the incidence of childhood obesity has come to light in the past two decades. Since the genetic composition of the population does not change this rapidly, this trend must reflect major changes in non-genetic factors (Hill and Towbridge, 1998). Specifically, epidemiological data on the prevalence of obesity can be linked to societal and cultural changes seen within our population and communities in recent decades. Increases in the consumption of high fat, energy-dense foods and declines in physical activity are two of the major factors thought to contribute to the current epidemic of obesity (Hill and Towbridge, 1998). In every country with better living standards, people continue to eat too much and engage in too little physical activity, despite public health and media attempts to counteract the problem (Holm et al., 2001). In reality, never before in the history of mankind have food calories been so available and so inexpensive (Willson, 2002). The question then becomes “Does today’s convenience-driven environment foster physical inactivity and unhealthy eating?”

Certainly, with the numerous pervasive environmental factors that both promote energy intake and limit energy expenditure, the answer to this question may be “yes”. I believe these factors are pervasive enough – even aggressive – as to effectively undermine individual efforts to maintain a healthy bodyweight. In the following sections I am going to review some of the commonly researched contributing factors to the recent trends in childhood obesity. Contributing factors include changing patterns of physical activity and dietary intake. However, to understand these changing patterns a discussion of several influences on these factors will ensue.

PHYSICAL ACTIVITY

Physical activity plays a role not merely in the development of childhood obesity, but also in numerous health consequences, lifestyle patterns, and psycho-social well-being. Physical activity is a highly multidimensional construct, traditionally conceptualized as ‘any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above basal level’ (Golan, Reynolds, and Lindquist, 1999). For children, physical activity is likely to encompass numerous behaviours such as play, chores, organized sports and exercise (Golan et al., 1999). Physical inactivity is currently reducing the quality of life in today’s children and tomorrow’s adults. A lack of regular activity in youth today exacerbates disease incidence and severity (Roberts, 2000). Children’s levels of physical activity are highly variable, and may be influenced by a multitude of factors including physiological, psychological, socio-cultural and environmental determinants. Children spend 75% of their waking hours being inactive, compared with remarkably little time in vigorous physical activity, estimated at only 12 minutes per day (Ebbeling et al., 2002). In fact, a study of a US nationally representative sample of 4063 children (aged 8-16 years) during 1988-1991, showed that 20% of children do not exercise vigorously more than twice a week (Golan et al., 1999). Approximately 28% of Canadians 12 to 14 years old and 66% of Canadian youth ages 15 to 19 years old are deemed to be physically inactive. In addition, only 46% of Canadian children between the ages of five and 17 years satisfy the energy expenditure guideline for optimal health and development (8kcal/kg/day), recommended by Sallis in an American consensus statement (CPS, 2002).

Cultural and Technological Influences on Physical Activity

Cultural changes and advances in technology have occurred over the past few decades that have had dramatic effects on physical activity trends in the population. It is also obvious that the environment in which we live is gradually becoming one that requires less and less physical activity and promotes an ever-increasing sedentary lifestyle (Golan et al., 1999). Even within the school environment societal shifts in what is deemed important have led to less and less physical activity. Participation in physical education classes has declined dramatically, with less than 36% of elementary and secondary schools offering daily classes (Mackenzie, 2000). Although information on the number of children in Canada taking regular physical education classes is incomplete, it is estimated that most schools offer half of the recommended provincial requirement, and less than 4% offer quality daily physical education programs (CPS, 2002). Additional sources cite that in 2001 approximately half (54%) of all schools reported having a policy to provide daily physical education classes, although only 16% actually were providing physical education on a daily basis (CIHI, 2004). Quebec is the only province requiring physical education in its curriculum until graduation. In other provinces, physical education becomes optional as early as grade eight. However, current practices are changing in some parts of the country. In 2003, Alberta announced that it would mandate daily physical education classes of 20 to 30 minutes for Grades 1 to 12 by 2005 (CIHI, 2004). At the same time we are learning more and more about the benefits of exercise in promoting and maintaining optimal health, physical activity in schools is becoming less available. Some claim that reducing the number of hours spent on physical activity will increase academic achievement. Yet, there is no evidence that regular physical activity hinders educational performance and there is modest evidence that shows that it actually enhances academic achievement (CPS, 2002). As well, forty percent fewer children reported that they walked or rode their bikes to school in 1995 than in 1977 (Dietz, Bland, Gortmaker, Molloy, and Schmid, 2002). In Canada, in 1998, only 37% of 5-to-13-years-olds and 33% of 14 to 18 year olds walked to school, and 2 to 4% bicycled (CIHI, 2004). In fact, Canadians on a whole are less likely to make use of active commuting. More than a quarter (28%) of Canadians living within 2.5 km of any

destination never choose walking as a mode of transportation. Seventy-two percent of Canadians living within 8 km of any destination never chose cycling as a mode of transportation (CIHI, 2004). In addition, working parents often don't have the time to walk their children to school and with parents still at work after school many children are under "latch and key", meaning they are forbidden by parents to engage in outdoor activities. In addition to parents' safety concerns, children may also be playing outdoors less due to lack of supervised recreational programs and scarcity of playgrounds. Moreover, western culture places a premium on convenience: cars are routinely used for short distances and the elevator is preferred to the stairs. These cultural forces arguably culminate in the drive-through window of fast-food restaurants, where a maximum of energy can be obtained with a minimum of exertion.

Determinants of Physical Activity Levels

It is important to determine the characteristics influential in promoting or deterring physical activity. Four types of determinants have been identified including: physiological; psychological; socio-cultural; and ecological. Physiological determinants include un-modifiable biological or developmental characteristics, such as pubertal maturation, growth and aerobic fitness. Psychological determinants include personal characteristics such as motivation, self-efficacy and sense of control. Socio-cultural determinants include parental and family characteristics, role models, and socio-demographic factors such as age, gender and ethnicity. Finally, ecological determinants include environmental and contextual factors, such as the availability of facilities for activity, physical safety and climate (Golan et al., 1999). The majority of research exploring determinants of physical activity among children has focused on the psychological level, while broader sociocultural or ecological determinants have received less attention (Golan et al., 1999).

Sedentary Pursuits

The availability of sedentary pursuits, including television watching, video games, and the internet are undoubtedly some of the influences resulting in lower levels of childhood physical activity. Canadian data clearly demonstrates that access to in-home entertainment that promotes sedentary behaviour has increased in recent years. Between

1986 and 1996 the number of households with home computers more than tripled (10.3 - 31.6%) and the number of households with two or more colour TVs more than doubled (23.8 – 51.5%) (Tremblay and Willms, 2003). In fact some studies have indicated that obesity is directly related to the number of hours spent watching television. Golan and Crow (2004) report that television watching was an independent predictor of the change in a child's BMI, triceps, and sum of five skinfolds throughout childhood. Its effect was only slightly attenuated by controlling for baseline body fat and level of physical activity. Tremblay and Willms (2004) conducted the first study to examine the relation among physical activity, sedentary behaviour, and overweight and obesity, after controlling for SES and family background, in a representative sample of Canadian children. These findings support the intuitive belief that physical activity provides protection from being overweight or obese, while TV watching and video game use are risk factors. Although television viewing is associated with reduced energy expenditure, increased consumption of foods while watching television, and the increased consumption of foods advertised on television, may be as important as reduced activity in the genesis of obesity (Bar-Or et al., 1998). In fact, Robinson has suggested that at least two mechanisms may link television viewing and obesity: (1) reduced energy expenditure by displacing physical activity and (2) increased energy intake through eating while viewing television, perhaps prompted by food advertising. In fact there is widespread speculation that television viewing is one of the most easily modifiable causes of obesity among children. American children spend more time watching television, movies, and playing video games than doing anything else except sleeping (Robinson, 1999). Faith et al. (2001) report that the general population of 2 to 11 year old children watches approximately 23 hours of TV per week. Additionally, Dietz reports that in 12 to 17 year olds, prevalence for overweight increased 2% for each additional hour of television viewing. Golan and Crow (2004) report that the mean sum of skinfold thickness of those children who watched 3.0 hours or more of television per day was 1.5 times greater than those who watched less than 1.75 hours per day. Similar to excessive TV watching, the growing use of video and computer games has likely contributed to the progressive fattening of

Canadian children. An inverse relationship between video game playing and daily physical activity has recently been observed (Tremblay and Willms, 2003).

Television Advertising

A critical indirect influence on children's food choices and intake may be advertising of foods on television (Halford, Gillespie, Brown, Pontin, and Dovey, 2003). While watching television, children tend to consume excessive amounts of energy dense foods while being bombarded by television advertising. Viewing food advertisements while watching TV is designed to impel children to request such foods, and therefore appears to influence children's dietary patterns (Golan and Crow, 2004). Schwartz and Puhl (2003) report that children are exposed to an estimated 10, 000 advertisements for food per year, 95% of which are for fast foods, candy, sugared cereal and soft drinks. Over two consecutive weekends, 37% of the advertisements on TV channels in the USA and 49% on the UK TV channels were for food. The majority of advertised products were snack foods, followed by breakfast cereals and then fast food outlets (Halford et al., 2003). Studies on children's choices have consistently shown that children exposed to advertising choose advertised food products at significantly higher rates than those not exposed (Coon and Tucker, 2002). Exposure to 30-second commercials increases the likelihood that 3-5 year olds would later select an advertised food when presented with options (Ebbeling et al., 2002). Direct exposure to certain types of food, such as processed and snack foods high in fat and sugars, generally energy dense, may therefore contribute to the development of childhood obesity. It has also been suggested that such advertising fosters the belief that the consumption of such foods is unrelated to being overweight, as actors portrayed in such advertisements are generally thin to normal weight (Vandewater, Shim, and, 2004). In 1997, nearly seven times as much money was spent advertising confectionery and snacks (i.e., candy, gum, mints, cookies, crackers, nuts, chips, and other salty snacks) than was spent advertising fruits, vegetables, grains and beans (Schwartz and Puhl, 2003). Additionally, children who eat their meals in front of the TV tend to consume more dietary fat and the number of hours of TV viewing by teenagers has been found to be significantly correlated with the number of unhealthy food items consumed per day (Halford et al., 2003).

CHANGING FAMILIES CHANGING DIETS

Dynamic forces in western society in the past two decades have changed family life, with many trends having an impact on both the diet and physical activity patterns of children. Environmental influences that affect eating behaviours include: the changing nature of the food supply; increased reliance on foods consumed away from home; food advertising; marketing and promotion; and food prices (St-Onge, Keller, and Heymsfield, 2003). In the late 1970s children in the USA ate 17% of their meals away from home, and fast foods accounted for 2% of total energy intake. By the middle to late 1990s, the proportion of meals eaten away from home nearly doubled to 30%, and fast food consumption increased five-fold to 10% of total energy intake (Ebbeling et al., 2002). The proportion of foods that children consumed from restaurants and fast food outlets increased by nearly 300% between 1977 and 1996 (St-Onge et al., 2003). Accordingly, money spent on food away from home represented 25% of total food expenditures in 1977-1978, whereas in 1995 it represented 40% of food spending (St-Onge et al., 2003). Children also consume one-third of their total daily energy intake at school, with most schools serving meals averaging 38% of calories from fat (Bar-Or et al., 1998). If one considers all this evidence, and the fact that fast food and vending machines pervade school environments, should we be surprised if children over-consume sugar and saturated fat?

Changing economic realities and societal dynamics have resulted in more families having both parents working outside the home. As a result, there is less time for planning and cooking nutritional meals. Such time constraints have led to more family meals being eaten outside the home. As well, the food industry's response to these new family issues was to increase the number of convenience foods and prepared meals available. Additionally, the convenience and inexpensive alternative of running through the "drive-through" can not be underestimated. Typically, these types of meals are higher in energy, fat, saturated fat, and sodium than foods prepared from raw ingredients at home (Williams et al., 2001). Children consume more energy when meals are eaten in restaurants than at home, possibly because restaurants tend to serve larger portions and more energy dense foods. It is also possible that parents are more likely to encourage

children to eat all their food when it is purchased at a restaurant compared to when it is prepared at home (Knehans, 2002). A recent study comparing changes in portion size in restaurants found that foods such as french fries, hamburgers, and soft drinks are now two to five times larger than their original sizes. Also the average cookie sold is seven times larger than the half ounce size recommended by the USDA (Knehans, 2002). And let's not all forget our current obsession with super-sizing. Astonishingly, a regular size McDonald's™ meal, which provides approximately 600 calories is increasingly being super-sized which provides more than 1800 calories (Deckelbaum and Williams, 2001). We truly are a "super-sized" society, and our children are living caricatures (Willson, 2002).

Snacking

Snacking behaviours are a key area of concern; an increasing proportion of calories and nutrients in the child's diet are coming from snacks. Snacking was defined by participants in one study as the consumption of non-meal foods. The proportion of snacks from home foods decreased from a high of 76.4% in 1977-1978 to a low of 64.8% in 1994-1996 (St-Onge et al., 2003). Average energy intake from snacks has increased from 450 to 600 calories per day, and now accounts for 25% of daily energy intake (Williams et al., 2001). This finding is significant, as small increases in the energy density of foods has been shown to lead to large increases in total energy intake. Therefore, it is feasible that current snacking trends are in part responsible for the increase in childhood obesity. Remarkably, only 2 percent of school-age children meet the recommended minimum number of servings for all five major food groups in the Food Guide pyramid. Additionally, only 5% of 7-14 year old US children met the national recommendations for servings of fruit and 9% met the recommendations for dairy (St-Onge et al., 2003).

Soft Drink Consumption

The consumption of soft drinks is of special concern because many contain sugars and corn sweeteners but few essential nutrients, and because soft drinks are currently the leading source of added sugars in the adolescent diet (Fried and Nestle, 2002). As well, by the time children are 14 years of age or older, 32% of young women and 52% of

young men are consuming three or more servings of soda a day (The Centre for Health and Health Care in Schools, n.d.). There is also a trend toward increasing consumption of soft drinks with increasing age. In fact, it has been reported that approximately one-half of pre-schoolers consume soft drinks, whereas 64.1% of school-aged children and 82.5% of adolescents do the same (St-Onge et al., 2003). Soft drinks are now the second-leading source of carbohydrate among children 2-18 years of age in the United States (Knehans, 2002). In 1976, on average every Canadian consumed 56 litres of soft drinks annually, in 2002 that number had risen to 100 litres per person, an increase of nearly 80% (CIHI, 2004). The typical single serving of Coca-Cola has increased in size from 192ml in the 1950s to 591mL in 2000 (St-Onge et al., 2003). It has also been found that children who are habitually consuming soda are taking in more calories and fewer nutrients. These children are also more likely to be overweight or obese after adjustment for anthropometric, demographic, dietary, and lifestyle variables (Fried and Nestle, 2002). Furthermore, students who attend schools where they have access to snacks and sodas are less likely to consume fruits, juice, milk, and vegetables, compared to students who do not have such access (Fried and Nestle, 2002). In a 1998 Canadian survey of eating habits of grade 6 students, approximately 73% said they ate fruit at least once a day, while 45% said they had at least one serving of vegetables each day. Perhaps scariest of all was the finding that about 15% of these students ate french fries or potato chips daily and 24% ate candy or chocolate bars daily (CPS, 2002). Another change that has aligned with the current obesity crisis is the reduction in milk consumption among adolescents. Between 1965 and 1996, milk intake decreased by 36% and is obviously being displaced by the increased consumption of soft drinks already mentioned (Weaver and Boushey, 2003). Additionally, due to the fact that children do not reduce the amounts of other foods in their diets to compensate for the extra calories they were getting from the sweetened drinks, these children end up consuming more calories overall.

School Meal Programs

School meal programs have become more common in the past decade, but no one policy governs the amount and quality of these meals. In 1993, the US National School

Nutrition Dietary Assessment Study documented that school lunches were high in fat, with the average percentage of calories from fat being 38%, compared with the recommended goal of 30%. Furthermore, only 1% of schools offered lunches that provided an average of 30% calories from fat (Story, 1999). As a result, in 1994 the US Congress passed legislation that required meals served through the National School Lunch Program (NSLP) and National School Breakfast Program (NSBP) to comply with the Dietary Guidelines for Americans (Story, 1999). However these regulations are not controlled in any manner. Additionally, in some states schools may even contract with McDonald's™ or Burger King™ to run their cafeterias (Willson, 2002). Many schools also have foods available to children via school stores and vending machines. And, most of the items sold through these options are energy dense, high in fat and added sugars. St-Onge et al. (2003) report that 88% of food sold in these stores contained greater than 5 grams of fat, 20 grams of sugar, or both per item. In fact, high-fat cookies, potato chips and other snack chips, french fries, malts and nachos are best selling items in junior and senior high school cafeterias (Story, 1999). Evidence also suggests that children who have access to money are spending more on sweet snack items than ever before (Golan and Crow, 2004). Additionally, very few vending machines offer fruits or any healthy snacking option. For example, although more than half of vending machines had potato, corn or taco chips, only one quarter had pretzels, a lower fat choice. Additionally, only 8% of the schools with vending machines offered fruit whereas almost 80% of the school stores sold candy and candy bars (Story, 1999).

PARENT CHILD INTERACTIONS AND THE HOME ENVIRONMENT

Parent-child interactions and the home environment can also affect behaviours related to risk of obesity (Ebbeling et al., 2002), for example in influencing child food preferences, and levels of physical activity. In the following sections I review some important ways that parent child interactions and the home environment can impact both physical activity levels and nutritional intake of a child. Discussion will include: parents as role models; the ways in which parents use food in the household; effects of parental control on food intake; maternal beliefs and perceptions; parental recognition of obesity; and socioeconomic factors. As each is discussed the critical importance of parent child

interactions and the home environment will be highlighted. It will also become evident throughout this section is that reducing the rate of weight gain in the obese child will likely have greater success if intervention strategies are geared toward recognition of the beliefs and understandings of parents.

It is evident that early experiences with food, feeding practices, and family food choices affect a child's nutritional intake and eating habits (Laing, 2002). Evidence shows that if parents tend to enjoy and eat high fat foods, their children will develop similar eating habits (Mackenzie, 2000). It is important to realize that although these factors are experienced early in life they may permanently affect the dietary practices of children. Additionally, there appear to be parental influences on physical activity (Hill and Towbridge, 1998). Low levels of physical activity in parents correlates with decreased physical activity in their children. It is reported (Mackenzie, 2000) that youth aged 12 to 19 with a reporting parent who was inactive during leisure time were more likely to be inactive themselves. The opposite is also true; children of active parents are six times more likely to be active than children for whom neither parent is active (Mackenzie, 2000). In addition, several researchers have confirmed that parental modeling, rather than parental encouragement, is more effective in positively influencing physical activity in children (Davis, Northington, and Kolar, 2000). Therefore it is important that adults who care for these children adopt the habits they are trying to teach children.

Bruch (1975) poignantly summarized the importance of the family environment approximately a quarter of a century ago stating: "To understand the obese child, one needs to remember that he [sic] accumulated his [sic] extra weight while living in a family that, wittingly or unwittingly, encouraged overeating and inactivity." The role of the home environment in the development of childhood obesity has been recognized for a long period of time; but, few studies have documented the extent to which the home environment contributes to childhood obesity (Strauss and Knight, 1999). Obese children on average have been found to live with one or more adults who plan their meals, take them for fast food or at very least purchase high-energy, sugar dense foods. It is also the current generation of adults who are increasingly sedentary while making the most of

current convenience-driven technologies. Children are watching. Strauss and Knight (1999) report that children with obese mothers, low family incomes, and lower cognitive stimulation have significantly elevated risks of developing obesity, independent of other demographic and socioeconomic factors. In contrast, increased rates of obesity in black children, children with lower family education, and with parents working in non-professional jobs may be mediated through effects of low income and lower levels of cognitive stimulation. Strauss and Knight (1999) further suggests that future efforts to prevent childhood obesity should explore whether parental education programs can decrease the prevalence of obesity by encouraging more stimulating home environments in young children. Again, it must be remembered that helping a child reach healthy weight is nearly impossible if the family doesn't have the capacity to be motivated and supportive (Belfield, 2003).

PARENTS AS DIETARY ROLE MODELS

Parents and adult caregivers play an important role in the development of proper eating habits by young children (Golan, Weizman, Apter, and Fainaru, 1998). It has been hypothesized that one of the pathways by which parents shape children's habits is by serving as role models (Golan and Crow, 2004). The parents' food preferences, the quantities and variety of foods in the home, and the parents' eating behaviours work in tandem to establish an emotional environment in which obesity may or may not be encouraged (Golan et al., 1998). Additionally parents who smoked or infrequently ate fruits and vegetables had children who mimicked these behaviours (Statistics Canada, 2003). Additionally, parents who are obese and have had trouble adhering to a diet find it harder to restrict food for their obese child than parents who have never been obese (Davis et al., 2000). Although most of these findings come from cross sectional data thereby limiting causal inference, what does appear clear is the claim that parents can influence their children's attitudes and behaviours and play a role in the development and prevention of childhood obesity.

PARENTAL USE OF FOOD

Parents also play an important role in the development and prevention of obesity through the way they use food in the household. Chamberlin et al. (2002) report a

common theme of mothers using food as a coping mechanism and as a parenting tool. Some mothers frequently use food as a tool to reinforce appropriate behaviours and good conduct in their children (Baughcum, Burklow, Deeks, Powers, and Whitaker, 1998). Baughcum et al. (1998) also report that mothers frequently used food to quiet a fussy baby, calm a toddler's temper tantrum, or as a bribe to promote a toddler's good behaviour. The mothers also commonly used food to control their children's behaviour by frequently giving their children sugared snacks with low-nutrient density as a reward for good behaviour. It has been hypothesized that feeding children in this manner may interfere with the child's ability to perceive their normal hunger and satiety cues (Baughcum et al., 1998). Whether or not the use of such feeding practices actually leads to childhood obesity is a question that remains unanswered; however, what is apparent is the fact that these practices do not help a child learn to use food for nourishment rather than for emotional purposes.

PARENTAL CONTROL

There have been a number of studies that address the relationship between reported parental attempts to control a child's food intake and the amount of food children actually eat. Parents influence their children's eating habits not only through the foods that are offered but also through their child feeding strategies (telling the child what to eat, how much, finish the plate, etc.) that are intended to ensure adequate, well-balanced food intake but can be coercive and controlling (Golan and Weizman, 2001). A high degree of parental control of children's eating has been hypothesized to cause dysregulation of caloric intake, overeating, and weight gain in children (Saelens, Ernst, and Epstein, 2000). While some investigators have found support for this theory (Hodges, 2003), others have not (Saelens et al., 2000). Knehans (2002) reports that mothers who were more controlling of their 3 to 5 year-olds food intake had children who had less self regulation of intake and were more obese. Schwartz and Puhl (2003) report that maternal attempts to control their daughters' food intake correspond with increased intake when these girls were given free access to restricted foods. Golan and Crow (2004) report that parents who are overweight, who have problems controlling their own food intake, or are concerned about their children's risk for overweight may adopt controlling child-feeding

practices in an effort to prevent overweight in their children. They go on to state that such parental control efforts may interact with genetic predispositions to promote the development of problematic eating styles and childhood overweight (Golan and Crow, 2004). Blass (2003) reports that external control by parents is additionally harmful as it causes the child to ignore his/her internal state. The regular exchange of “I am hungry, can I eat?” answered by the apparently reasonable response of “we will eat in 10 minutes; please wait,” is an invitation to the child to become driven by external signals and controls (Blass, 2003). Furthermore, the common insistence that children finish a meal despite claiming they are full also exacerbates the tendency to ignore internal signals. To complicate this issue it is also reported that parents with overly permissive feeding practices have children that are more likely to be overweight and/or obese (Knehans, 2002). As a general rule, parents should be in charge of what foods children are offered and when, and children should be allowed to choose from the foods that are offered and control how much they eat (Dietz, 1999). However, again what is clear is that parents play an extremely important role in the development and prevention of childhood obesity. Therefore, identifying the critical parental behaviours that influence childhood obesity will be crucial for the development of effective prevention and treatment programs (Robinson, Kiernan, Matheson, and Haydel, 2001). There is a critical need for future research to explore the full range of parental influences, both positive and negative.

MATERNAL BELIEFS AND PERCEPTIONS

Maternal beliefs are particularly important in the development of childhood obesity. In a focus group study of low income mothers, all mothers believed that a heavy infant was a healthy infant and was the result of successful feeding and parenting (Baughcum et al., 1998). It is of particular interest that no mother indicated that a child could be too heavy and no mother could identify any particular age at which an infant or toddler might be considered overweight (Baughcum et al., 1998). Other findings included the mother’s consensus that a heavier child conveyed to others that they were effective parents. Perhaps an even more alarming theme reported by Chamberlin et al. (2002) was the fact many mothers do not believe their overweight children are overweight. Additionally, some mothers seemed completely unconcerned about their

child's condition, and others emphatically denied that their children were overweight (Baughcum et al., 1998). Such beliefs need to be recognized as major obstacles to successful treatment and prevention of childhood obesity. Chamberlin et al. (2002) report that many mothers were offended by the mere suggestion that a label such as obesity be used with regard to their child. Health care professionals have offered some possible explanations for this maternal perception. Mothers might simply feel that a "large" or "plump" child, especially in infancy, was healthier or more attractive. Additionally, another common misperception among mothers was that they were certain that their overweight child would "outgrow" their weight problem by school age (Chamberlin et al., 2002). Also, a belief in a predestined progression to obesity will also increase resistance to therapy. Furthermore, if parents believe that obesity "runs in the family" and that the child is going to be "big" like his/her mother, father or other relatives, then, chances of viewing obesity as a disease are rare (Davis et al., 2000). Baughcum et al. (1998) also report that among mothers who were overweight, there was the assumption that their children were genetically predisposed to be heavy and, therefore, it was not only expected but acceptable. Such findings again highlight the importance of parental perceived beliefs in both the prevention and treatment of childhood obesity. In addition, Myers and Vargus (2000) concluded that the lack of information about parents' perceptions of their child's obesity can easily lead to parent non-compliance and possibly worsening of the child's obese condition.

Due to the critical importance of maternal perceptions and beliefs with regard to several potential cofactors in childhood obesity, it becomes clear that engaging in discussions with parents needs to be part of the initial assessment before any intervention can be attempted. Additionally, it is important to consider the possibility that perspectives and practices may differ between normal weight mothers, mothers from other socioeconomic or cultural backgrounds, or mothers who have normal weight children (Jain et al., 2001). Dietz (1999) suggests that an assessment of family readiness to change represents the first focus of therapy. He suggests that a family's interest in change should be sought out by open-ended non-judgmental questions about their child's weight. Dietz (1999) also provides example questions such as "How concerned are you

about your child's weight?, "What do you think your family needs to change in order to help your child lose weight?" and "Do you think you are ready to work on this problem?", that can help identify a family's readiness for change in addition to potential barriers they foresee facing. Baughcum et al. (1998) also report that the use of closed-ended questions in their survey did not allow for exploration of why mothers did not perceive their overweight children to be overweight and state that future research is needed to understand this maternal misperception. Regardless of how the information is obtained the critical finding is that information about parental attitudes and beliefs in varied demographic settings is crucial clinical research that is needed to assist practitioners who develop and implement successful prevention and treatment protocols (Myers and Vargus, 2000).

PARENTAL RECOGNITION OF OBESITY

Parental recognition of obesity is a critical factor in effecting dietary and lifestyle changes for children (Hodges, 2003). However, as indicated above, parental perceptions do not always coincide with assigned categories used in research and practice. In one study, among 99 mothers of overweight children, 95% of the obese mothers believed they themselves were overweight, with no difference in education groups. However, 79% of these same mothers did not perceive their overweight children as overweight, and this was more common among mothers with less education (Baughcum, Chamberlin, Deeks, Powers, and Whitaker, 2000). Among the 99 mothers with overweight children, low maternal education was associated with a failure to perceive their children as overweight after adjusting for low family income, maternal obesity, age, and smoking in addition to the child's age, race, and gender (Baughcum et al., 2000). Unfortunately, the survey used in this study did not specifically ask whether the mothers perceived their own weight or the child's weight as a social, emotional, or health problem. Such information may prove to be critical to understanding the views that these mothers have. In a second study with a sample of 200 parents of obese children, 35% did not identify their obese child as even overweight (Hodges, 2003). Another telling finding by Baughcum et al. (1998) was that growth charts, a proposed tool for recognition of obesity by both paediatricians and parents were not perceived as useful. In fact, a number of mothers had a common

perception that a child's place on the growth curve was directly related to child health and parenting competence. The higher the child was on the growth curve, the healthier the child and the more competent the parent (Baughcum et al., 1998). Knehans (2002) also reports that mothers often do not define a healthy weight by the growth charts; as they do not feel that the growth charts were applicable to their child. Jain et al. (2001) confirm this finding; mothers in their study had a shared dislike and distrust of growth charts and claimed that the charts were not relevant to their children. Jain et al. (2001) further report that mothers in their study were more likely to consider being teased about weight or developing limitations in physical activity as indicators of their child being overweight. Additionally, children were not recognized as being overweight if they were active and had a healthy diet and/or good appetite (Jain et al., 2001). Obviously recognition of the child's condition by the parent is a paramount first step in any treatment process. For parents to involve themselves in childhood obesity prevention, they must first recognize when their children are becoming overweight and be concerned about the consequences (Baughcum et al., 2000).

SOCIOECONOMIC FACTORS

In addition to the overt effects of the family as described above, socioeconomic factors including income and parental education level have also been shown to be a determinant of childhood obesity. Low socioeconomic status (SES) is one of the most powerful risk factors for poor health outcomes, including higher than average rates of obesity (Story et al., 1999). In 1998/99, 25% of Canadian children aged 2 to 11 living in families with incomes below the low income cut off (LICO) were obese; whereas only 16% of Canadian children in families above the LICO were in this weight category (Statistics Canada, 2002). Kimm et al. (1996) concluded that socioeconomic status, as measured by education and outcome, was related to the prevalence of obesity in girls, with racial variation in these associations. Lower rates of obesity were observed in caucasian girls when levels of household income and parental education were higher, but there was no clear relationship found in black girls. However, in both races, higher levels of parental education tended to be consistently related to more favourable nutrient intakes, including higher intake of essential vitamins and minerals, and lower fat intake

(Kimm and Obarzanek, 2002). This evidence illustrates the complex interplay of many of the determinants of obesity, and often leaves researchers asking more questions. For instance, it is not clear how SES affects behaviour (e.g., through overeating or physical inactivity), which then may lead to obesity. In addition, such findings raise new questions regarding the correlates of obesity in black girls. Despite what the direct causal factors may be, this evidence indicates that both family and culture have a very real impact on the risk of childhood obesity.

FACTORS INHERENT TO THE CHILD

The above discussion focuses on the factors that influence the risk of childhood obesity as they manifest through sociological, environmental, and family dynamics. In addition, there are also several factors inherent to the individual child, specifically genetics, race and culture, and sex, which are also determinants of both propensity to, and severity of, obesity. A discussion of these factors will follow, but it is important to remember that all of these factors are inextricably linked to one another and thus display complex interactions. Such interactions make the direct causal factors difficult (and perhaps inappropriate) to isolate.

GENETICS

Obesity results from an imbalance between energy intake and expenditure, and there are strong genetic influences of these components of energy balance (Hill and Towbridge, 1998). A large number of twin, adoption, and family studies have been conducted to determine the level of heritability (the fraction of the population variation in a trait that can be explained by genetic transmission) in obesity. Recent studies have estimated that 25 to 40% of obesity has genetics as a significant factor (Story et al., 1999). However, a genetic background alone cannot explain the current increased rates of obesity, since the gene pool did not change in the last 20 years, while the prevalence of obesity has increased more than 30% in the same period (Carroar and Garcia, 2003). Additionally, although a few well-known single gene mutations can produce obesity, most obese individuals do not show a specific genotype for obesity (Anzai et al., 2002). Familial factors that impact on children's weight include genetics. Fat parents beget fat children, even if they are not living in the same household. If both parents are obese, two

thirds of their children will be obese (Klish, 1998). Anzai et al. (2002) report that for children under the age of 5 years, parents' body mass is more informative than the child's own body weight for predicting future obesity. What is not made clear is what role other familial factors such as lifestyle play in this finding. Several authors claim that parental obesity is the strongest risk factor for childhood obesity (Maffeis, 1999). However, it is important to recognize that the family membership effect is the result of a genetic as well as an environmental component. Studies on twins, adopted children, and families have been employed to try to quantify the role of genes. A genetic influence on the development of obesity is suggested by studies on adopted children as adults who shared greater similarity in BMI to their biological parents than to their adoptive parents. However, in large samples, estimates of BMI heritability seem to range from 25% to 40% (Maffeis, 1999). In a discussion of genetic and environmental influences on obesity, Weinsier (1999) concluded that "whether we stay lean or become obese is ultimately determined not by our genes or our environment but by our behaviours". Although genetics contribute to obesity at the individual level, the genetic composition of the population does not change rapidly and therefore the large increase in the prevalence of obesity that has occurred over a relatively short period of time cannot be explained by genetics. Recent trends must reflect changes in non-genetic factors.

RACE AND CULTURE

Recent studies have shown that race (and associated culture) can be a powerful determinant of obesity. Data from the National Health and Nutrition Examination Survey (NHANES) demonstrate that prevalence of overweight increased in each adolescent racial group between the 1988-1994 survey and the 1999-2000 survey. However, the increase was markedly greater in non-Hispanic blacks (13.4% to 23.6%) and Mexican Americans (13.8% to 23.4%) (Cossrow and Falkner, 2004). Such findings support racial argument, but do not address the actual causal factors. Perhaps the varying incidence of obesity among different races reflects the social acceptability of obesity within a particular race or culture. Cultural factors are believed to be transmitted within family units and have been estimated to account for 30% of the variation in obesity (Kimm et al., 1996). The interplay of racial and cultural factors has been shown to have some very

strong influences on self-perception of physical appearance and social acceptance. In fact, it has been suggested that obesity is culturally defined and not equally stigmatized in all cultures (Davis et al., 2000). As discussed previously, in young children, self-image is derived in part from parental messages (Dietz, 1998). Therefore, how a child is perceived within the family will have a direct influence on the impact obesity may or may not have on the child. Further, culture and/or ethnicity of the family will also shape the way a family views an obese child. In some cultures an obese child may be seen as a status of wealth; in other cultures, a source of embarrassment and shame. For example, it has been suggested that the social environment of black women is less negative about obesity than that of Caucasian women and that being overweight is not necessarily synonymous with being unattractive in black cultures (Davis et al., 2000). As a result social or cosmetic motivations for weight loss may not be supported by some cultures, but rather, it may be more appropriate to place emphasis on health benefits of being a healthy weight (Davis et al., 2000). Additional evidence suggests that both eating disorders and preoccupation with weight exist among Caucasian children, particularly females, and may impair the normal regulation of food intake (Dietz, 1998). This could help explain data showing lower rates of obesity among Caucasian children, referred to above.

SEX

Sex alone has been found to influence the prevalence and impact of obesity. Findings from the Child and Adolescent Trial for Cardiovascular Health (CATCH) study in the US found that the prevalence of obesity among boys (9.1%) was higher than in girls (8.6%) (Dwyer et al., 2000). The causes for such findings are again unclear. Is the increasing societal pressure for girls to be thin a factor? What about the way parents treat their children? Is it more socially acceptable for a boy to be overweight than a girl? The answers to these questions will be important in determining the causal factors for recent trends in obesity.

TREATMENT AND PREVENTION

Imagine there were a chronic childhood condition that affected at least 20% of children and was increasing in prevalence to epidemic proportions. This condition has

virtually no effective cure, high relapse rates, is often under diagnosed, and is associated with significant adult morbidity and mortality. Would the health sector expect strong support to find a cure, and more importantly a prevention strategy? This is not the case with regard to this condition. The problem is childhood obesity and its prevention is a complex issue (Steinbeck, 2001).

PRIMARY CARE

The majority of treatment for childhood obesity is provided through primary care. The main goal of obesity intervention is regulation of body weight and fat with adequate nutrition for growth and development (Epstein, Myers, Raynor, and Saelens, 1998). The current clinical approach to management of obesity in paediatric patients is behavioural therapy directed at changing diet and physical activity (Daniels, 2001). But with treatment comes many unknown variables; in fact, important questions regarding all aspects of current treatment options remain unanswered. A question still besetting primary care physicians caring for obese children is the age at which one should undertake active weight reduction and the amount of caloric restriction that can be safely instituted in young growing children (Kimm and Obarazanek, 2002). As well, little research has been done on the effects of dietary change on food preference, which may be very important if long-term compliance is desired. Exercise treatments are designed to increase energy expenditure in hopes of creating or increasing negative energy balance. Yet the best approach to take with children still remains under debate. The fact that most obesity treatments are followed by relapse is an additional concern which needs to be addressed. In light of the recent explosion of childhood obesity, physicians are now starting to look at drug and surgical therapies as means to treat childhood obesity. But again, at what age should one entertain the use of pharmacological agents or even gastric bypass surgery? Perhaps of even greater significance is the question of what side effects or long term health consequences will be associated with the use of such treatments. Additionally, it must be recognized that given the current epidemic, the above options are not feasible at the population level.

WITHIN THE FAMILY SETTING

Using family-based treatment of childhood obesity has proven to be the most effective approach (Hassink, 2002). A systematic review found that family therapy prevented childhood obesity. As well, a randomized control trial (RCT) found that focusing on parents as the sole change agent was superior to targeting the child (Golan and Crow, 2004). One conceptual model is described for a familial approach to the treatment of young obese children with the parents as the sole agent of change, that is, change is delivered through the parents (instead of the obese child) emphasizing a healthy lifestyle and not weight reduction (Golan and Weizman, 2001). Hassink (2003) also identifies three goals of treatment including: (1) to prevent progression of obesity-related complications by addressing co-morbidities, which may interfere with successful treatment; (2) to achieve control of weight using a balanced nutritional approach allowing for adequate linear growth, increasing activity, and decreasing inactivity; and (3) to develop a family-based lifestyle change that will teach the child necessary skills to maintain a healthy balance between his or her genetic predisposition and the environment. The family provides a major social learning environment for the child through modeling, feedback, and instruction. Families also have control over the environment including activity and nutrition in which the child is immersed. The familial approach includes a strong emphasis on providing an environment that fosters healthy practices related to weight control issues and de-emphasizes the child's personal responsibility for the control of health behaviour (Golan and Weizman, 2001). The Golan and Weizman (2001) model emphasizes the importance of "parenthood presence": the parent is active, being there, taking responsibility, and serving as both an authority figure and a role model for the obese child. Golan and Crow (2004) also emphasize that family-based interventions that encourage reasonable and coordinated goals for both the parent and the child and that incorporate positive reinforcement and tools to facilitate behaviour change and increase problem solving capabilities appear more likely to succeed. It is therefore obvious that the families, especially parents, are instrumental in implementing desired change. Lack of family involvement and support will spell failure for some children, especially if this is seen as a punitive measure for the child while the rest of the family

continues to eat whenever, whatever, and how much they choose (Williams, Campanaro, Squillace, and Bollella, 1997). Additionally, Dietz (1998) suggests that families are reluctant to address the problem of a child's obesity directly. Reasons cited for this include: guilt, because of the belief that health care professionals are angry at them for having an obese child; health care professionals do not have the time to help them find a solution; and a lack of understanding of the problem (Davis et al., 2000). Also by directing preventive efforts at the family of overweight or obese children there is the added bonus that all members of the family are likely to benefit (Fruhbeck, 2000).

WITHIN SCHOOL SETTINGS

Schools have the potential to make valuable contributions to both prevention and treatment of childhood obesity. More than 95% of American youth, aged 5-17 years are enrolled in school, and no institution has as much continuous and intensive contact with children during their first two decades of life (Story, 1999). School nurses are well placed to spot the overweight child at an early stage and to help prevent obesity from developing (Edmunds, Waters, and Elliot, 2001). There are other benefits to school-based approaches including: they can be delivered at little or no cost to the family; can reach low income families; and perhaps reduce any stigmatization a child may feel for being in treatment. Since children eat one to two meals per day at school, the school cafeteria can provide a natural environment where children are exposed to and learn healthful eating habits (Story, 1999). The degree to which an intervention incorporates a variety of individuals in the child's environment (e.g., parents) will directly affect the success of the intervention. Again, what is being done at school needs to be transferred to the home environment. Once again without parental support and willingness this can't occur. It therefore seems obvious that getting parents on board is not only a logical but a mandatory first step before any intervention can be attempted. Story (1999) also cites Epstein and Wing's (1987) three reasons for having parents involved in obesity interventions: 1) obesity runs in families and it may be unrealistic to intervene with one member of a family, while other family members are modeling and supporting behaviours that may counteract the interventions effectiveness; 2) specific parental behaviours, such as promoting over eating and under-exercising, may be important in the

development and maintenance of unhealthy behaviours; and 3) to produce maximal behaviour change in children, it may be necessary to include specific behaviour-change strategies for parents to use. Within school systems access to resources for treatment of obesity vary greatly. While some schools have access to a school nurse other schools do not have this resource. In addition, while some schools have extracurricular physical activity opportunities, many do not. No one policy governs access to such resources within the school system.

WITHIN COMMUNITY SETTINGS

Within communities very few programs or resources for the treatment of childhood obesity exist. Well-known organizations like Weight Watchers™ and Jenny Craig™ do not have programs for children and even have disclaimers stating that their advice is not intended for children. Often the only community resource available for nutritional counselling is outpatient nutritional counselling at a local hospital, but this requires a doctor's referral. In addition, although most communities do have physical activity programs for children through their community centers, many of these programs are costly, creating unequal opportunities for participation. Therefore, effective prevention and treatment will require both individual and community-wide efforts. The importance of a community approach is indicated by Surgeon General Satcher's comment "Many people believe that dealing with overweight and obesity is a personal problem. To some degree they are right, but it is also a community responsibility. When there are no safe, accessible places for children to play or adults to walk, jog, or ride a bike, that is community responsibility. When school lunch rooms or office cafeterias do not provide healthy and appealing food choices, that is community responsibility. When new or expectant mothers are not educated about the benefits of breast-feeding, that is community responsibility. When we do not require daily physical education in our schools, that is community responsibility" (Dietz et al., 2002).

TREATMENT OUTCOMES

In general, the results of obesity treatment programs at obesity clinics have been disappointing (Edmunds et al., 2001). Treatment of obesity in children, like treatment of obesity in adults, is expensive, lengthy and generally only effective if the whole family is

involved, and even then it is not “curative”(Styne, 1999). Prevention is therefore essential to reduce the health burden of obesity on our children and society as a whole. It is vital to treat and prevent obesity in childhood, as lifestyle behaviours that contribute to and sustain obesity in adults are less well established in children and may be more amenable to change (Edmunds et al., 2001). Research also indicates that the earlier the intervention the better, and therefore, a large quantity of research has focused on children of ages 5 to 12 years (Edmunds et al., 2001).

BARRIERS TO TREATMENT

There are significant barriers to the treatment of childhood overweight and obesity including: time available for counselling families; lack of effective treatment protocols; reimbursement; and the commitment of primary care providers to care for affected patients (Dietz, 1999). This list is far from comprehensive but does address some critical barriers in the clinical management of childhood obesity. Both the treatment and prevention of childhood obesity have significant barriers that need to be addressed in all areas, including environment, family factors, and behaviours. Dietz (1999) also states that until primary care providers begin to treat obesity with the same vigour they now apply to chronic diseases with more immediate health consequences, only limited progress will be made toward the development of effective therapy for childhood and adolescent obesity. I therefore wonder if trying to ignite such a desire for change in protocol in primary care providers is the smart choice. Phinas-Hamiel and Zeitler (1998) suggest that as with seat belts, bicycle helmets, and vaccinations, the medical community must promote and support an aggressive public campaign, along with efforts within their own practices, to reverse this highly dangerous trend in childhood health. I suggest we ignite the parents of these children, provide them with passion for their cause, and allow them to be advocates for their children.

REASONS TO TARGET CHILDREN

There are several reasons to target children for health behaviour interventions. Because of the high rate at which obese children will become obese adults, clinicians and public health practitioners must be made aware that many overweight children will not lose their overweight status through linear growth, and therefore, it is both justified and

necessary to intervene at early ages (O'Loughlin, Gray-Donald, Paradis, and Meshefedjian, 2000). Children are at a critical stage of development where interventions are most likely to have impact. It is thought to be easier to establish healthful habits during childhood than later in life (Story et al., 1999). Children have been engaged in unhealthy behaviours for less time than adults, ultimately predicting that the modification of their behaviour will be more successful (Hill and Towbridge, 1998). There is also extensive evidence to suggest that children's food preferences are shaped by early experience with food and eating, and this may affect the dietary practices of the children for life (Hill and Towbridge, 1998). It has also been found that unhealthy behavioural patterns initiated in childhood, such as being sedentary, eating a diet high in fat, and later smoking, persist through adolescence and adulthood (Nader et al., 1999). Both of these pieces of evidence strongly advocate for prevention programs targeted at children. As discussed by Epstein et al. (1998) efforts to deal with childhood obesity may be more cost effective than efforts to deal with adult obesity. One study showed that every dollar spent in early intervention in obesity can save seven US dollars in future expenditures on health and social spending (Flegal, 1999).

The widespread nature and the continuing rise of childhood obesity has become a very significant health concern that will surely exact an enormous societal toll on health and well-being in coming decades. Research needs to systematically identify and address many fundamental questions reviewed here pertaining to childhood obesity. Dramatic steps are needed to stem the causal factors of obesity regardless of their origin, or childhood obesity will continue to rise. Additionally, program planners and front line health workers need evidence on which to build effective programs.

THE PRESENT STUDY

Despite the recognition of all of the above potential drivers, there is in fact relatively little empirical evidence regarding the specific factors that have led to the increases in childhood obesity observed in recent decades (Hardus, Van Vuuren, Crawford and Worsely, 2003). As a result, a number of different prevention strategies have been proposed by academic researchers, health professionals, and government authorities (Hardus et al., 2003). These have included educational strategies aimed at

promoting healthy eating and increased physical activity; changes in the physical environment such as changing the urban setting to make it safer for children to walk and play (Hardus et al., 2003); governmental policy changes to require mandatory physical education in the province of Alberta (CIHI, 2004). While a range of preventive strategies have been suggested, the pattern of public support for these initiatives in different locations is not well understood. The only study to have canvassed the public's views regarding the causes of childhood obesity and the most appropriate strategies for preventing it is that of Hardus et al. (2003) in Melbourne, Australia. The authors state that "an understanding of lay views is important to determine the likely level of community support for preventive initiatives and to identify where there is a need to educate the community about the epidemic".

In this context, the goal of the present study is to identify public perceptions (held by adult Calgarians) of the causes of the childhood obesity epidemic, what they deem to be unimportant factors, as well, as what preventive strategies they would either support or not support. This study represents a modified replication of the work of Hardus et al (2003) referenced above. It is likely, due to the different cultural and political climates of Melbourne and Calgary, that the portrait of public opinion will appear quite different in the two cities. The identification of where Calgarians currently stand on the issue of childhood obesity is a critical first step before any prevention or intervention strategies are developed.

This study inherently accepts the importance of understanding lay perspectives, in informing health interventions. Entwistle, Renfrew, Yearly, Forrester, and Lamont (2004) use the term "lay" to mean people who are neither health care professionals nor health services researchers, but who have specialised knowledge related to health. This includes patients, the general public, and consumer advocates. There are several reasons to include lay people in health research: 1) patients and other lay people often have insights and expertise that complement those of health care professionals and researchers; 2) input from lay people may influence the setting of research priorities; the identification of problems; the design and execution of projects; and the interpretation, dissemination, and implementation of research findings; and 3) lay involvement in generating

knowledge may increase the perceived relevance and acceptance of findings (Entwistle et al., 2004). In this project the involvement of lay people is to help create knowledge that is accessible both intellectually and practically, as well as to be locally relevant to the participants. The knowledge gained through this study will serve as a starting point for future participatory research.

RESEARCH QUESTION

What are the public perceptions in Calgary, Alberta of the causes and prevention of obesity among children in kindergarten to grade 6?

CHAPTER 2: METHODS

RESEARCH DESIGN

The present study comprised a modified replication of ‘Public perceptions of the causes and prevention of obesity among primary school children’ (Hardus, van Vuuren, Crawford, and Worsley, 2003). I have been in contact with Dr. Crawford and have received email permission to replicate this study (see Appendix B).

The design method employed was a *cross sectional survey* of adults recruited from Sunridge Mall, located in the northeast quadrant of Calgary, Alberta. The self administered questionnaire used in this study was developed by Hardus et al (2003) for their original study. The questionnaire requires respondents to rate the importance of 25 potential causes of childhood obesity (*healthy food often aren't available*), and the importance of thirteen potential preventive measures (*compulsory daily physical education*). This questionnaire, which was obtained via email from the original authors, is presented in Appendix D. In the present study, the questionnaire was pilot tested before the actual data collection was conducted to ensure that items were understandable and non offensive to adults in Calgary. The pilot test included a convenience sample of (n = 54) adults recruited through the researcher's professional associations. In the original study, Hardus et al. (2003) made use of a four-point likert scale that consisted of one negative response (not) and three positive responses (quite, very, and extremely). Being concerned that such responses may lead to a potential positive bias in the results, in the current study it was decided to modify the response scale to a four-point likert scale containing two negative response options (not, not very), and two positive response options (somewhat, very). The survey required the respondent to be literate in the English language to a grade 5 level based on an analysis performed by the author using the Flesch-Kincaid grade level index available through Microsoft™ word 2003.

DATA COLLECTION STRATEGY

THE SAMPLE

All persons entering Sunridge Mall through the main entrance in Calgary, Alberta, during a one week period in mid January 2005 were approached for inclusion in the study. The table for people to sit and complete the questionnaire was located

immediately inside the front entrance between Sport Check™ and Starbucks™. In addition to persons directly approached, the table drew some volunteers for the study; these persons were included in the sample. Those who were asked to fill out the questionnaire and declined were not asked a second time. Any surveys inadvertently filled out by someone under the age of 18 were destroyed and therefore not included in the analyses (n= 1). As a result the only volunteers excluded from the study were those under the age of 18 years and those not literate in English at a grade 5 level.

Gaining access to enter Sunridge mall was formally requested and was granted approval on October 22, 2004. The data collection took place on a Wednesday 9am-9pm; a Saturday 9am-9pm; and a Sunday 11am-5pm in mid January 2005. Regardless of whether target numbers were met already data collection occurred on all days in an effort to capture a diversity of shoppers.

The questionnaire package included a cover letter, the questionnaire itself, and items to collect demographic information. The cover letter served to introduce the study, communicate the importance of the study, to let participants know that their participation was voluntary, to inform them of privacy issues, and to let them know that by filling out the survey they were giving consent for their participation (see Appendix C). Demographic information collected included age; parental status (parent or not a parent); education level; and self reported height and weight. Age was collected to ensure that the respondent was at least 18 years of age. Other variables were collected for the purpose of making comparisons among different groups of people (e.g., parent / non parent) on views about cause and prevention. In the event that a respondent did not fill out any of the demographic information their survey was destroyed and not included in the analysis (n = 3).

Self-reported weight and height are frequently used in epidemiological studies to assess the distribution of BMI given the inconvenience and cost of directly measuring these parameters (Santillan and Camargo, 2003). However, self-report values are subject to reporting bias. The error in self-reported weight and height compared with measured weight and height was evaluated in a nationally representative sample of 11,284 adults aged 20-74 yrs from the second National Health and Nutrition Examination Survey of

1976-1980 (Rowland, 1990). The overall tendency was for men to over-report their weight by an average of 0.4kg, whereas women underreported their weight by an average of 1.0kg (Rowland, 1990). Despite this systematic error, correlations between self-reported and measured weight were extremely high: 0.97 for men and 0.98 for women (Rowland, 1990), lending support to the use of self reported weight as a satisfactory measure of actual weight. On average, men and women over-reported their height by 1.4 and 0.6cm respectively (Rowland, 1990). The correlations between measured and reported height were 0.94 for men and 0.91 for women (Rowland, 1990). Several studies have shown a high correlation between self-reported and measured BMI (Bolton-Smith, Woodward, Tunstall-Pedoe, and Morrison, 2000; Niedhammer, Bugel, Bonenfant, Goldberg and Leclere, 2000; Rimm, Stampfer, Colditz, Chute, Litin, and Willett, 1990), but systematic errors in self-reported values may affect the distribution of BMI, and consequently the measure of prevalence of obesity in society (Santillan and Camargo, 2003). Because this study did not aim to estimate prevalence of obesity, but rather was concerned with comparisons across BMI classifications only, this was of less concern.

DATA ANALYSIS PROCEDURE

Data analysis entailed a factor analysis followed by comparison of factor scores using t-test and analysis of variance. Before engaging into the analysis, data was examined for missing values, outliers, and adherence to statistical assumptions including normality and linearity. This “data cleaning” process will be described first, followed by a description of factor analysis and subsequent comparisons.

DATA CLEANING

If cases have missing data, either missing values are estimated, the cases are deleted, or a missing data (pairwise) correlation matrix is analyzed. Since there are benefits and drawbacks to each method, analysis of missing data was necessary before a route of action was determined. We considered the distribution of missing values (is it random?) and remaining sample size when deciding between estimation and deletion. According to Tabachnick and Fidell (2001), if cases are missing values in a non-random order pattern or if sample size becomes too small, estimation is in order. However, it

needs to be recognized that using estimation procedures are likely to over-fit the data and cause correlations to be too high, thus these procedures may “create” factors.

As in all multivariate techniques, cases may be outliers either on individual variables (univariate) or in combination of variables (multivariate). Univariate outliers were identified by both the inspection of z scores and through graphical methods. Cases with standardized scores in excess of 3.29 ($p < 0.001$, two-tailed test) were considered potential outliers. Once potential univariate outliers were located, the search for multivariate outliers began. One statistical method employed was the computation of Mahalanobis distance. A very conservative probability estimate for a case being an outlier, $p < 0.001$, was used (Tabachnick and Fidell, 2001).

Normality was assessed by examining distributions of the variables for skewness and kurtosis. If extreme deviations from normality were indicated, transformations of the offending variables were considered.

FACTOR ANALYSIS

Principal components analysis (PCA) and factor analysis (FA) are statistical techniques applied to a single set of variables where the researcher is interested in discovering which variables in the set form coherent subsets that are relatively independent of one another (Tabachnick and Fidell, 2001). In this study we employed principal components analysis using SPSS version 12.0. There are two major types of FA: exploratory and confirmatory. In exploratory FA, as was used here, one seeks to describe and summarize data by grouping together variables that are correlated (Tabachnick and Fidell, 2001). Exploratory FA was appropriate here due to the limited available data upon which to base confirmatory hypotheses. The primary benefit of using factor analysis was that it condensed the survey information from a large number of items into a smaller number of coherent factors, which were then included in additional analyses.

The principal components analysis (PCA) began with a set of variables, for which a correlation matrix was prepared (i.e., correlations among all items or variables). A set of factors was extracted from the correlation matrix, and then rotated to increase

interpretability. The final, and possibly most important, step was interpreting the results (i.e., interpreting the meaning of the factors).

The extraction technique used in this study was principal components analysis (PCA). PCA was the method employed by the study being replicated and it is used when a researcher wants an empirical summary of the data set, as was the case in this study. Additionally, PCA is the solution of choice for the researcher who is primarily interested in reducing a large number of variables down to a smaller number of components (Tabachnick and Fidell, 2001). The goal of FA is to summarize a pattern of correlations among variables with as few factors as possible. One criterion for deciding which factors to retain is the *eigenvalue*. Each potential factor has an eigenvalue, which corresponds to the amount of variance accounted for by that factor. A factor with a large eigenvalue explains a large proportion of variance from the correlation matrix. Typically, factors retained are those with an eigenvalue greater than one (Tabachnick and Fidell, 2001).

Rotation of factors is a process by which the solution is made more interpretable without changing its underlying mathematical properties; it is ordinarily used after extraction to maximize high correlations and minimize low ones (Tabachnick and Fidell, 2001). There are two general classes of rotation: orthogonal and oblique. In the latter, factors are allowed to correlate with one another; in the former, factors do not overlap. We made use of Varimax rotation, a type of orthogonal rotation, in this analysis for a few reasons: 1) Varimax rotation is the most commonly used; 2) it was employed in the study being replicated; and 3) factors rotated using Varimax are much easier to interpret, which is a distinct advantage when factor scores are to be used as independent or dependent variables in other analyses. However as a check we requested oblique rotation with 6 factors and looked at the correlations among factors. We examined the factor correlation matrix for correlations around .32 and above. If correlations exceed .32, then there is 10% (or more) overlap in variance among factors, enough variance to warrant oblique rotation (Tabachnick and Fidell, 2001). However, no correlations exceeded .32 and this finding supported the use of orthogonal rotation.

The adequacy of rotation was assessed by examining the simple structure of the rotated analysis. If simple structure is present several variables will correlate highly with

each factor and only one factor correlates highly with each variable (Tabachnick and Fidell, 2001). Following rotation, importance and internal consistency of factors was evaluated. The importance of a factor (or a set of factors) corresponds to the proportion of variance or covariance accounted for by the factor after rotation (Tabachnick and Fidell, 2001). The larger the proportion of variance explained, the more important that factor is for summarising the original items. The internal reliability of factors was evaluated based on a cronbach alpha computation. A cronbach alpha of 0.7 or above is considered acceptable (Santos, 1999).

The final step in principal components analysis was factor interpretation. In this step, one tries to understand the underlying dimension that unifies the group of variables loading on it. However, even after orthogonal rotation, not all variables necessarily correlate highly with their corresponding factor. In judging the correlations between variables and factors (Tabachnick and Fidell, 2001), we defined a meaningful correlation as 0.32 or higher. In other words, factors were interpreted based on those variables that correlate 0.32 or higher with their factor.

Factor scores are estimates of the scores that individuals would have received on each of the factors had they been measured directly (Tabachnick and Fidell, 2001). Regression-like coefficients were computed for weighting variable scores to produce factor scores, which were then be used in additional analyses (as follows).

COMPARISONS

The final stage of analysis in the present study involved comparisons of factor scores between groups defined based on the demographic variables. In particular, analysis of variance (ANOVA) (when there are more than two groups) and t-tests (when there are two groups) were used to make the following comparisons

- 1) Do factor scores differ between males and females?
- 2) Do factor scores differ between parents and non-parents?
- 3) Do factor scores differ between various education levels?
- 4) Do factor scores differ between categories of self-reported BMI?

For comparisons with two groups (e.g., parents vs non parents), independent samples t-test were used, with a 2-tailed test of significance (at the $p < .05$ level). For comparisons with more than two groups (e.g., BMI categories), one way analysis of variance was conducted, followed by post hoc tests to discern differences between pairs of groups. For these analyses, whether equal variances could be assumed or not was decided once the data had been examined for distributional characteristics. We also evaluated whether or not there were any statistically significant interactions between sex and education, sex and parental status, and education and parental status.

SAMPLE SIZE

It was difficult to compute a sample size estimate for the proposed study, because there are only limited data available on the survey being used and therefore several assumptions had to be made (e.g., about effect-size and group variances). However, as a guide, we made an estimate using the following formula (<http://www.tufts.edu/~gdallal/sizenotes.htm>)

$$\frac{2(Z_{1-\alpha/2} + Z_{\Pi})^2 \sigma^2}{\Delta^2}$$

Where $Z_{1-\alpha/2}$ is the percentile of the normal distribution used as the critical value in a two-tailed test of size α (1.96 for an 0.05 level test) and Z_{Π} is the 100x Π -th percentile of the normal distribution (0.84 for the 80-th percentile). To obtain an estimate of a within group standard deviation and an expected difference, we opted to use an average of those cited in the study being replicated. These values are 0.99 for within group standard deviation, and 0.18 for expected difference (Hardus et al., 2003)

Using these values the resulting sample size was 85 per group. The maximum number of groups we have in one comparison results from the 3 groups of BMI classifications. This indicated we need at least 255 participants to be able to make this comparison. However, against the backdrop of this estimate, we note that Tabachnick and Fidell, (2001) recommend 300 cases for use in factor analysis. Since 300 is not substantially more than the estimated 255 required, we aimed for 300 participants.

PSYCHOMETRIC PROPERTIES OF SURVEY

Since psychometric information on the survey being used has not been published, we aimed to contribute to the literature by evaluating one psychometric property of the survey – test-retest reliability. This was accomplished by asking all participants after they have filled out the survey whether or not they would voluntarily leave their first name and either a phone number or email address for contact information. It was explained to each participant that if they were willing, they would be contacted in 2 weeks time and asked to fill out the survey again. At this time the participant provided contact information so the survey could be mailed to them with a stamped return envelope inside. We wanted to obtain at least 10% of the original participants to be able to accurately evaluate the test retest reliability of the survey. Since adequate numbers were not achieved this part of the project could not be completed as envisioned. Despite two attempts to contact those individuals who agreed to leave their contact information, we only obtained a 3% (n = 8) response rate. However, we did evaluate the reliability of those eight persons who did fill out the survey a second time.

ETHICAL CONSIDERATIONS

This study was approved by CHREB. There were no risks to the participants involved with this study, and individuals were not required to identify themselves. The investigators and the research team were the only individuals who have access to information collected through the survey. Each survey was done anonymously and we were therefore able to keep individual opinions confidential. Participation was voluntary, and any individual could refuse to participate with no consequences whatsoever. Findings are only reported at an aggregate level, so there will be no risk of revealing an individual's identity through their data. Additionally, the completed surveys were kept in a locked box in a locked filing cabinet in a locked room. There was no monetary compensation to the subjects for participating in the study, as well, as there was no monetary cost to the subject for participating.

With regards to the smaller sample of participants who voluntarily took part in the evaluation of the test-retest reliability of the survey, some further ethical considerations needed to be addressed. These participants were asked to provide a first name and either

a phone number or email for contact information. This information was kept confidential and again no individual opinions were reported. The contact information was detached from the original survey and each survey was assigned a study ID number. The code linking the assigned study ID number to the name and contact information for these individuals was kept in a password protected database that was unlinked from the survey data. As a result, each survey was only identified by a study ID number. In addition, the contact information for these participants was destroyed after completion of the study.

CHAPTER 3: RESULTS

DATA SCREENING

Tabachnick and Fidell (2001, p.85) provide a checklist for screening data. It is provided below and outlines all the issues considered prior to the fundamental analysis.

1. Inspect univariate statistics for accuracy of input
 - a. Out-of-range values
 - b. Plausible means and standard deviations
 - c. Univariate outliers
2. Evaluate amount and distribution of missing data; deal with problem
3. Check pairwise plots for nonlinearity and heteroscedasticity
4. Identify and deal with non-normal variables
 - a. Check skewness and kurtosis, probability plots
 - b. Transform variables (if desirable)
 - c. Check results of transformation
5. Identify and deal with multivariate outliers
 - a. Variables causing multivariate outliers
 - b. Description of multivariate outliers
6. Evaluate variables for multicollinearity and singularity

The accuracy with which data was entered into the data file was checked by having a third party proofread a sample of original data against the computerized data file. The third party checked 50 random cases and no errors in data entry were found. Additionally, screening for accuracy involved computing descriptive statistics and examining graphical representations of the variables.

For the demographic variables, some data manipulation was conducted prior to analyses. First, for the education variable, categories from the original survey were collapsed in order to deal with insufficient numbers in some groups. In collapsing, we ensured that new categories were comparable in terms of size, and made intuitive sense. For example, previous categories “primary school”, “some high school”, and “completed high school” were collapsed to create a new category “complete high school or less”, which contained 22% of the sample (n=58). Secondly, for the purpose of analyses

(which involve making comparisons among weight categories), the continuous BMI variable was categorised according to Health Canada guidelines (Health Canada (2003) Canadian Guidelines for Body Weight Classification in Adults. Retrieved October 8, 2004, from http://www.hc-sc.gc.ca/hpfb-dgpsa/onpp-bppn/bmi_chart_java_e.html). Due to insufficient numbers in some categories, we opted to collapse the two lowest categories as there were only 2 persons classified as underweight. Because the BMI data were categorised, data assumptions such as non-normality of distribution are less important. Nonetheless, assessment of assumptions associated with continuous data and the general linear model is presented in Appendix E for the reader's interest. Descriptive statistics for demographic variables (in the new categories) are presented in Table 1. This table also reveals that the sample is fairly equally distributed in terms of sex and parental status.

Response frequencies for the questionnaire items for cause and prevention are presented in Tables 2 and 3 respectively. In all cases, absence of implausible values (e.g., questionnaire responses other than 1-4 increased our confidence that data were entered accurately. Drawing the reader's attention to Table 2, it is evident that most causes listed in the questionnaire were considered to be at least somewhat important by a majority of subjects. The univariate analysis showed that over 90% of those surveyed felt over-consumption of fast foods, eating too many high fat foods at home, media promotion of unhealthy foods, and lack of physical activity outside of school were either somewhat or very important causes of childhood obesity. While most of the causes were considered to be at least somewhat important by a majority of respondents, there were some causes that were considered to be not or not very important by many respondents. These included the following items: healthy foods often aren't available; healthy foods are expensive; lack of safe cycling and walking paths; lack of other safe places to be active; and an over emphasis on academic work.

The results of the univariate analysis of measures to prevent obesity presented in Table 3 shows that there was widespread support about the importance of several prevention strategies. Specifically, over 90% of respondents felt that the following prevention strategies were either somewhat or very important: prevention actions should

be directed to all children; more healthy foods should be served in school; daily physical education should be compulsory; and healthy eating should be promoted on children's television viewing. However, only directing prevention actions to children who are overweight but not yet obese, and an additional 5% tax on unhealthy foods was considered not or not really important by a majority of respondents. Many respondents also ranked giving 5% tax incentives to manufacturers of healthy foods and banning the advertising of high fat foods during children's viewing hours as either not or not really important.

Table 1 Distribution of demographic characteristics of the respondents (n=264)

Characteristic	Frequency	Percent
Sex		
Male	124	47.0
Female	139	52.7
Missing	1	0.4
Education		
High School or less	58	22.0
Incomplete Post Secondary	86	32.6
Completed community/tech/trade	55	22.8
Completed university or more	58	22.0
Missing	7	2.7
Parental Status		
Parents	123	46.6
Non-Parents	127	48.1
Missing	14	5.3
Weight Category		
Under/Normal	114	43.2
Overweight	84	31.8
Obese	45	17.0
Missing	21	8.0

UNIVARIATE ANALYSIS

Table 2 Frequencies of the importance of causes of obesity in children in grades K to 6

	Not n(%)	Not Really n(%)	Somewhat n(%)	Very n(%)	Missing n(%)
Genes	11(4.2)	37(14.0)	154(58.3)	60(22.7)	2(0.8)
Children don't know dangers of obesity	22(8.3)	50(18.9)	69(26.1)	123(46.6)	0(0.0)
Children don't care about eating healthy	20(7.6)	59(22.3)	83(31.4)	99(37.5)	3(1.1)
Children don't care physically active	11(4.2)	74(28)	98(37.1)	72(27.3)	9(3.4)
Parent's aren't aware of dangers of obesity	16(6.1)	55(20.8)	111(42.0)	81(30.7)	1(0.4)
Parent's don't care about eating healthy	8(3.0)	55(20.8)	123(46.6)	75(28.4)	3(1.1)
Parent's don't care about physically active	10(3.8)	63(23.9)	111(42.0)	79(29.9)	1(0.4)
Parent's don't know how promote activity	10(3.8)	43(16.3)	122(46.2)	89(33.7)	0(0.0)
Parent's don't know how promote eating	7(2.7)	40(15.2)	131(49.6)	85(32.2)	1(0.4)
Lack of physical activity at school	9(3.4)	51(19.3)	110(41.7)	93(35.2)	1(0.4)
Lack of physical activity outside school	4(1.5)	20(7.6)	100(37.9)	138(52.3)	2(0.8)
Over emphasis on academic work	40(15.2)	101(38.3)	81(30.7)	40(15.2)	1(0.4)
Eating too many high fat foods at school	5(1.9)	32(12.1)	89(33.7)	137(51.9)	1(0.4)
Eating too many high fat foods at home	0(0.0)	16(6.1)	103(39.0)	142(53.8)	3(1.1)
Children have too much money to spend	21(8.0)	66(25.0)	104(39.4)	71(26.9)	2(0.8)
Eating over-sized servings of food	2(0.8)	38(14.4)	74(28.0)	149(56.4)	1(0.4)
Over-consumption of fast foods	0(0.0)	9(3.4)	55(20.8)	199(75.4)	1(0.4)
Media promotion of unhealthy foods	5(1.9)	22(8.3)	74(28.0)	163(63.7)	0(0.0)
Eating in front of the TV	11(4.2)	40(15.2)	82(31.1)	129(48.9)	2(0.8)
Watching too much television	10(3.8)	31(11.7)	67(25.4)	155(58.7)	1(0.4)
Modern technology (e.g., cars computers)	7(2.7)	23(8.7)	73(27.7)	160(60.6)	1(0.4)
Lack of safe cycling and walking paths	56(21.2)	97(36.7)	73(27.7)	36(13.6)	1(0.4)
Lack of other safe places to be active	46(17.4)	96(36.4)	83(31.4)	37(14.0)	2(0.8)
Healthy foods are expensive	47(17.8)	90(34.1)	81(30.7)	44(16.7)	2(0.8)
Healthy foods often aren't available	74(28.0)	94(35.6)	71(26.9)	25(9.5)	0(0.0)

UNIVARIATE ANALYSIS FOR PREVENTION ITEMS

Table 3 Frequencies of the importance for the prevention of obesity in children in grades K to 6.

	Not n(%)	Not Really n(%)	Somewhat n(%)	Very n(%)	Missing n(%)
Prevention actions directed to all children	3(1.1)	10(3.8)	56(21.2)	192(72.7)	3(1.1)
Only to overweight children but not obese	110(41.7)	63(23.9)	36(13.6)	54(20.5)	1(0.4)
More healthy foods served in schools	3(1.1)	6(2.3)	46(17.4)	209(79.2)	0(0.0)
Daily physical ed should be compulsory	3(1.1)	8(3.0)	35(13.3)	216(81.8)	2(0.8)
Healthy eating promoted on children's TV	2(0.8)	6(2.3)	55(20.8)	199(75.4)	2(0.8)
Advertising of high fat foods banned	23(8.7)	83(31.4)	82(31.1)	74(28.0)	2(0.8)
High fat foods should have add 5% tax	98(37.1)	79(29.9)	39(14.8)	47(17.8)	1(0.4)
Give 5% tax incentives to healthy manufac	60(22.7)	49(18.6)	66(25.0)	87(33.0)	2(0.8)
Govt build safe cycling walking tracks	16(6.1)	63(23.9)	101(38.3)	83(31.4)	1(0.4)
Reduce portion sized of take out foods	38(14.4)	65(24.6)	73(27.7)	86(32.6)	2(0.8)
Food labels highlight calorie content	11(4.2)	33(12.5)	78(29.5)	140(53.0)	2(0.8)
No more than 1 hour TV, video games	9(3.4)	46(17.4)	88(33.3)	120(45.5)	1(0.4)
Govt run healthy campaigns in media	11(4.2)	18(6.8)	97(36.7)	138(52.3)	0(0.0)

MISSING DATA

The pattern of missing data is more important than the amount of missing data. Missing values scattered randomly through a data matrix may pose few serious problems. Non-randomly missing values, on the other hand, are serious no matter how few of them there are because they affect the generalizability of the results (Tabachnick and Fidell, 2001).

To test whether the data were missing at random, we performed t-tests to examine whether or not those that answered were different in any way than those who did not answer. We decided to investigate the pattern of missing data for any variables that had 5 or missing values; these included education, parental status, BMI, and one of the items from the “causes of obesity” section of the questionnaire: ‘children don’t care about being physically active’. The procedure used to examine missing data will be illustrated using the education variable. We constructed a dummy variable with two groups, cases with missing and non-missing values on education. We then performed a test of mean differences between these two groups (t-test, or chi-square test) on the variables parental status, BMI, and sex. Any significant differences (at $p < .05$) between the missing and

non-missing groups on any of these variables would indicate a potentially non-random pattern of missing data on the education variable. Using this procedure, we found no differences between those with missing and non missing data on any of the above variables, and thus missing data in this study are assumed to be missing at random. For all analyses, we used pairwise deletion, which excludes from analyses cases with missing values for either or both of the pair of variables in computing a specific statistic. Pairwise deletion is thought to be a good alternative when only a few cases have missing data and they seem to be a random sub-sample of the whole sample (Tabachnick and Fidell, 2001), as is the case here.

OUTLIERS

Due to the categorical nature of this data, the process of evaluating outliers and their consequences is not critically important. For example, a univariate outlier on BMI would simply become part of the obese or normal/under weight category, and thus would not unduly influence results. However, for the reader's interest, the process of evaluating univariate and multivariate outliers is presented in Appendix F.

(1) PRINCIPAL COMPONENTS ANALYSIS OF QUESTIONNAIRE ITEMS THAT ASSESS CAUSES OF CHILDHOOD OBESITY

Next I will present results of principal components analysis (PCA), designed to reduce the questionnaire items into a smaller number of coherent factors. PCA was conducted separately for the 'cause' items and for the 'prevention' items, and results will thus be presented separately.

One of the first steps in PCA is to determine the appropriate number of components, or factors, to represent the data. Our principal components extraction revealed eight factors with an eigenvalue larger than 1 (see Table 4). However, after the 5th factor the changes in successive eigenvalues are small, and thus there could be as few as five factors.

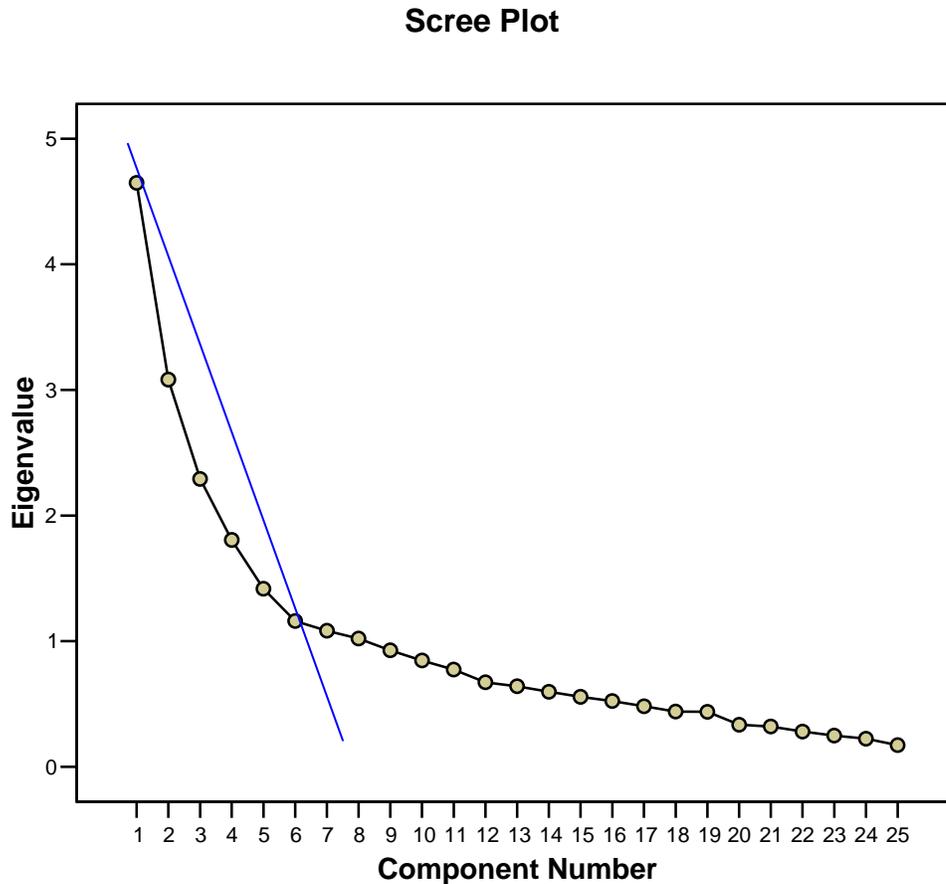
Table 4 Initial and rotated eigenvalues for cause items

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.649	18.595	18.595	4.649	18.595	18.595	3.085	12.341	12.341
2	3.083	12.331	30.926	3.083	12.331	30.926	2.524	10.097	22.439
3	2.292	9.169	40.095	2.292	9.169	40.095	2.205	8.821	31.259
4	1.806	7.225	47.320	1.806	7.225	47.320	2.183	8.734	39.993
5	1.417	5.669	52.989	1.417	5.669	52.989	1.930	7.719	47.712
6	1.161	4.644	57.633	1.161	4.644	57.633	1.861	7.444	55.156
7	1.083	4.334	61.967	1.083	4.334	61.967	1.527	6.108	61.264
8	1.021	4.085	66.051	1.021	4.085	66.051	1.197	4.787	66.051
9	.927	3.710	69.761						
10	.847	3.387	73.149						
11	.774	3.098	76.246						
12	.673	2.692	78.938						
13	.642	2.568	81.506						
14	.598	2.390	83.897						
15	.557	2.230	86.126						
16	.524	2.096	88.222						
17	.483	1.930	90.153						
18	.440	1.761	91.914						
19	.438	1.753	93.667						
20	.335	1.341	95.008						
21	.322	1.286	96.294						
22	.281	1.124	97.418						
23	.249	.995	98.412						
24	.224	.896	99.308						
25	.173	.692	100.000						

Extraction Method: Principal Component Analysis.

The scree test is a second criterion that may be used to assess the number of factors, and is illustrated by a plot of eigenvalues against factors. As shown in Figure 1, it appears that a line can comfortably fit through the first six factors in these data, suggesting that we may have six viable factors.

Figure 1: Scree plot for principal components analysis of cause items



As the number of factors indicated from the two above criteria differs, we investigated further. An alternative to allowing the maximum number of factors to emerge based on the eigenvalue criteria (as shown above), is to specifically request a particular number of factors. In this way, it is possible to evaluate the overall “fit” of the analysis, for a particular number of factors. To this end, we performed several factor analyses each time specifying a different number of factors (5, 6, 7 and 8), repeating the scree test, and examining the residual correlation matrix. The numbers in the residual correlation matrix are partial correlations between pairs of variables with the effects of factors removed (Tabachnick and Fidell, 2001). If the analysis is good, the residuals are small. Several moderate residuals (say, .05 to .10) or a few large residuals (say $>.10$)

suggest the presence of another factor (Tabachnick and Fidell, 2001). Of these four analyses, the five factor solution was found to have the lowest number of large residuals.¹

The next step in determining the appropriate number of factors was assessing the interpretability of each factor; for this we consulted the rotated component matrix (Table 5). A viable factor will have two or more variables loading on it, and these variables should load highly on only the one factor (loadings on other factors should be low). Furthermore, variables loading on the same factor should be highly correlated with each other, and relatively uncorrelated with other variables (Tabachnick and Fidell, 2001).

¹ The five factor solution was found to have 20% non-redundant residuals with absolute values greater than .05. In contrast, the six, seven, and eight factor solutions had 38%, 38%, and 31% respectively, residuals that were moderate or large in size.

Table 5 Rotated component matrix for cause items

	Component							
	1	2	3	4	5	6	7	8
genes	-.083	-.212	.074	-.061	.094	-.082	.055	.794
cdanger	.008	.019	-.034	.781	.063	-.054	.204	.087
ceat	.116	-.011	.083	.870	-.092	.001	.045	-.068
cact	.256	.075	.138	.769	.085	.019	-.015	-.044
pdanger	.580	.065	-.045	.167	.014	.391	.013	.117
peating	.824	.069	-.030	.073	-.027	.112	-.007	-.065
pactive	.870	.067	.013	.071	.011	-.068	-.027	-.053
promact	.737	-.041	.070	.064	.083	-.207	.334	-.031
promeat	.723	.076	.027	.096	.131	-.137	.287	-.038
lacksch	.142	.191	.063	.064	.130	.210	.697	.033
lackout	.213	.191	.088	.175	-.027	-.029	.776	-.093
academic	-.006	.294	.031	.051	.003	.238	-.137	.668
schfat	.087	.637	.075	.140	.051	.259	.137	.021
homefat	.190	.649	.022	.164	-.198	.032	.170	-.014
money	-.117	.343	.359	.236	.383	.040	-.031	.030
oversized	.023	.643	.121	-.022	.277	-.223	.067	.121
fast	-.040	.718	.139	-.065	-.065	-.165	.083	.021
media	.041	.559	.239	-.102	.143	.138	.010	-.152
eattv	.097	.284	.731	.023	.190	.060	-.092	-.071
watchtv	-.023	.122	.858	.082	.030	.069	.030	.083
tech	-.010	.079	.782	.051	.009	-.013	.209	.075
lackpaths	.130	.019	.189	.030	.823	.254	.061	.042
lacksafe	.065	.035	.000	-.011	.856	.233	.064	.053
expensive	-.046	.028	.084	-.069	.251	.802	-.062	.099
available	-.056	-.044	.047	-.011	.243	.763	.232	-.024

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

In Table 5, values in the cells represent the factor loading of each variable (down the left hand side) to a factor (across the top). To ease interpretation of the matrix, the highest factor loading for each variable is highlighted. Examination of the rotated component matrix from the original 8 factor solution resulted in the following. Factors 1 through 8 had between 2 and 5 variables that loaded highly on them, and in general, these variables did not load highly on other factors. Though factors 5 through 8 all had satisfactory variable loadings, we found that factor 8 was not easily interpreted (discussed in more detail below, under “rotation”)

Regarding the intercorrelations of variables loading on different factors, a spearman correlation matrix (not shown) revealed that variables loading on factors 5 and 6 were highly intercorrelated (spearman rho = .74 and .63, respectively) and relatively

uncorrelated with other variables. On the other hand, variables loading on factors 7 and 8 were less highly inter correlated (spearman rho .13 and .48, respectively) and also showed similar correlations with other variables.

Table 6 summarises the criteria used to determine the most appropriate number of factors to retain. As can be seen the decision not to retain factor 7 and 8 is clear cut. Additionally, it is clear that factor 5 should be retained in the analysis. Factor 6 is the only questionable factor, but as it does not meet all the criteria the decision was made not to retain factor 6.

Table 6 Criteria for evaluating whether or not a factor should be retained

	Viable factor according to Eigenvalue	Viable factor according to Scree Plot	Viable factor Residual Correlation Matrix	Viable factor based on Interpretability	Viable factor based on within factor correlations
Factor 5	1.930 yes	Yes	Yes(20.0%)	Yes	Yes (.74)
Factor 6	1.861 yes	Yes	No (38.0%)	Yes	Close (.63)
Factor 7	1.527 yes	No	No (38.0%)	Somewhat	Low (.48)
Factor 8	1.197 yes	No	No (31.0%)	No	Not (.13)

ROTATION

As outlined in the methods chapter, we first attempted an oblique rotation strategy, whereby factors are allowed to correlate. However, as can be seen in Table 7, the emergent factors did not correlate highly (i.e., no correlations exceeded .32). Therefore, orthogonal rotation (in which factors are assumed to be independent) is appropriate.

¹ Please note that our assessment of what constitutes a viable factor according to this criterion is relative in nature – i.e., the proportion of large residuals for factor 5 was substantially smaller than that for factors 6, 7, and 8; hence our judgement of “yes” for factor 5 on this criterion.

Table 7 Component correlation matrix after oblique rotation of cause factors

Component	1	2	3	4	5	6
1	1.000	-.129	.144	.130	-.255	-.091
2	-.129	1.000	-.094	-.237	.034	.162
3	.144	-.094	1.000	.089	-.157	.084
4	.130	-.237	.089	1.000	-.083	-.075
5	-.255	.034	-.157	-.083	1.000	.005
6	-.091	.162	.084	-.075	.005	1.000

Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization.

The adequacy of rotation was assessed by examining the simple structure of the rotated analysis. If simple structure is present several variables will correlate highly with each factor and only one factor correlates highly with each variable (Tabachnick and Fidell, 2001). Simple structure was found to be present with the exception of the one complex variable “*money*” that was shown above not to load on any one factor.

INTERNAL CONSISTENCY

Following rotation, importance and internal consistency of factors were evaluated. The importance of a factor (or a set of factors) corresponds to the proportion of variance or covariance accounted for by the factor after rotation (Tabachnick and Fidell, 2001). As seen in Table 4, factors one through five accounted for 12.3%, 10.1%, 8.8%, 8.7%, and 7.7% of the overall variance, respectively; collectively accounting for 47.7% of the variance in variables. Internal consistency of factors, represented by Cronbach’s alpha, is presented in Table 8. A Cronbach’s alpha value of 0.7 is considered acceptable (Santos, 1999), and based on this criteria, all five factors are adequate in this regard.

Table 8 Internal reliability of cause factors

Factor	Cronbach Alpha	# of items
1	.82	5
2	.69	5
3	.77	3
4	.79	3
5	.85	2

INTERPRETATION OF FACTORS

The final step in principal components analysis is factor interpretation. As shown in Table 9, we named each factor based on the cluster of variables that loaded highly on it.

Table 9 Results of principal components analysis of lay perceptions of the importance of causes of obesity among children in grades K to 6

Factor and Items	Factor Loadings
Factor 1: Parental responsibility	
Percent of variance: 12.34%	
Cronbach alpha: 0.82	
Parent's don't care about being physically active	87
Parent's don't care about eating healthy	82
Parent's don't know how to promote physical activity	74
Parent's don't know how to promote healthy eating	72
Parent's aren't aware of the dangers of obesity	58
Factor 2: Over-consumption and media promotion of unhealthy foods	
Percent of variance: 10.09%	
Cronbach alpha: 0.70	
Over-consumption of fast-foods	72
Eating too many high fat foods at home	65
Eating over-sized servings of food	64
Eating too many high fat foods at school	64
Media promotion of unhealthy foods	56
Factor 3: Misuse/Overuse of modern technology	
Percent of variance: 8.82%	
Cronbach alpha: 0.77	
Watching too much television	86
Modern technology (cars, computers, video games)	78
Eating in front of the TV	73
Factor 4: Children's lack of knowledge and motivation	
Percent of variance: 8.73%	
Cronbach alpha: 0.79	
Children don't care about eating healthy	87
Children don't know about the dangers of obesity	78
Children don't care about being physically active	77
Factor 5: Physical activity environment	
Percent of variance: 7.72%	
Cronbach alpha: 0.85	
Lack of other safe places to be physically active	86
Lack of safe cycling and walking paths	82

Factor loadings are expressed as whole numbers

CAUSE ITEM FACTOR SCORES

Factor scores were computed for each person; these refer to scores that individuals would have received on each of the factors had they been measured directly, and they are computed using regression-like coefficients that are computed for weighting variable scores (Tabachnick and Fidell, 2001). These factor scores were the “dependent variables” in comparisons of interest, and since they are continuous variables, they were first examined for distributional assumptions. This process is outlined in Appendix G. To summarise, factors 2, 3, 4, and 5 were analysed as normal, and factor 1 was analysed in its transformed state.

COMPARISONS

For comparisons with two groups (e.g., parents vs non parents), independent sample t-test were used, with a 2-tailed test. For comparisons with more than two groups (e.g., BMI categories), one way analysis of variance was conducted, followed by post hoc tests to discern differences between pairs of groups. As we are making multiple comparisons we used a Bonferroni correction ($0.05/5 = 0.01$) to account for increases in type 1 error. However, regardless of whether or not a statistically significant finding is robust to the Bonferroni correction I will report and discuss the findings. In this regard I am allowing the reader to decide what level of significance they are willing to accept.

(1) COMPARISON OF MALES AND FEMALES

As the sample had relatively equal amount of males (47.0%) and females (52.7%) the use of t-test is appropriate regardless of whether or not the samples are normally distributed (Ramsey and Shafer, 2002). Results of this comparison are shown in Table 10.

Table 10 Results of t-test by sex for each cause factor

Factors	Sex		P
	Male	Female	
1. Parental Responsibility	1.67 (0.27)	1.68 (0.32)	NS
2. Over-consumption/Media	-0.13 (1.02)	0.14 (0.96)	*
3. Misuse/Over Modern technology	-0.07 (1.06)	0.09 (0.92)	NS
4. Children’s lack knowledge/motivation	0.05 (0.92)	-0.04 (1.07)	NS
5. Physical Activity Environment	-0.24 (0.97)	0.23 (0.98)	***

***P < 0.001, **P < 0.01, *P < 0.05 NS= not significant. Mean (s.d.).

Males and Females had significantly different mean factor scores on Factor 2 ($p = .04$). However, this difference was not robust to the Bonferroni correction factor. Males and Females also had significantly different factor scores on Factor 5 ($p < .001$). This finding was robust to the Bonferroni correction factor. This result means that women felt that the items about lack of safe cycling and walking paths and lack of other safe places to be physically active were more important factors in causing childhood obesity, relative to men.

(2) COMPARISON AMONG PARENTS AND NON-PARENTS

As the sample had relatively equal amount of parents (46.6%) and non-parents (48.1%) the use of t-tools is appropriate despite whether or not the samples are normally distributed. Results (shown in Table 11) reveal that there were no significant differences between parents and non-parents mean factors scores.

Table 11 Results of t-test by parental status for each cause factor

Factors	Parental Status		P
	Parents	Non-parents	
1. Parental Responsibility	1.72 (0.30)	1.64 (0.28)	NS
2. Over-consumption/Media	-0.00 (0.96)	-0.03 (1.04)	NS
3. Misuse/Over Modern technology	0.13 (0.86)	-0.10 (1.10)	NS
4. Children's lack knowledge/motivation	-0.11 (1.08)	0.06 (0.91)	NS
5. Physical Activity Environment	0.01 (1.04)	-0.05 (0.98)	NS

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$ NS= not significant. Mean (s.d.).

(3) COMPARISON AMONG VARYING EDUCATION LEVELS

The group sizes for the various education levels was not similar even after collapsing of categories. As a result, the validity of using t-tools becomes more questionable.

Therefore, to determine the validity of using a parametric test like an ANOVA we evaluated the normality of the distribution of education scores using a Kolmogorov-Smirnov Test (KS). If this test was found to be significant we then used the Kruskal-Wallis (KW) test (a non parametric test) to determine whether there were differences among various education levels. However, we also performed ANOVA in these instances to assess for agreement between non-parametric and parametric methods. If the

two tests were in agreement, we reported the findings of the ANOVA as it is a more powerful statistical tool. (T.Fung, personal communication, March 7/05).

Results for Kolmogorov-Smirnov (KS) tests for all factors are shown below

Table 12 Results of the Kolmogorov-Smirnov (KS) test for each cause factor

Factors	Mean	s.d.	Z	P
1. Parental Responsibility	1.68	0.30	0.92	NS
2. Over-consumption/Media	0.00	1.00	1.83	**
3. Misuse/Over Modern technology	0.00	1.00	1.97	**
4. Children's lack knowledge/mot	0.00	1.00	1.36	*
5. Physical Activity Environment	0.00	1.00	0.91	NS

***P < 0.001, **P < 0.01, *P < 0.05 NS= not significant. Mean (s.d.).

For those factors (2, 3, and 4) with a significant KS test, non-parametric Kruskal Wallis tests were conducted; the results are shown in Table 13.

Table 13 Results of the Kruskal Wallis (KW) test for cause factors 2, 3, and 4

Factors	Chi-Square	d.f.	P
2. Over-consumption/Media	1.30	3	NS
3. Misuse/Over Modern technology	3.10	3	NS
4. Children's lack knowledge/mot	0.69	3	NS

***P < 0.001, **P < 0.01, *P < 0.05 NS= not significant.

The KW tests revealed no significant differences among varying education levels for factors 2, 3, and 4.

We next employed ANOVA on all factors, those in with a normal distribution and those without a normal distribution. These results are shown in Table 14.

Table 14 Results of Education ANOVA for each cause factor

Factors	Education Level				F	d.f.	P
	1	2	3	4			
1. Parental Responsibility	1.71(0.30)	1.70(0.29)	1.71(0.27)	1.56(0.32)	3.50	3	*
2. Over-consumption/Media	-0.08(1.18)	0.00(0.92)	0.14(0.87)	-0.09(1.08)	0.55	3	NS
3. Misuse/Over Modern tech	-0.21(1.18)	-0.04(1.00)	0.13(0.91)	0.14(0.88)	1.34	3	NS
4. Children's lack knowledge	-0.02(0.98)	0.01(1.09)	0.07(0.89)	-0.09(1.02)	0.22	3	NS
5. Physical Activity Environment	0.14(0.98)	-0.12(0.96)	0.13(1.05)	-0.14(0.97)	1.27	3	NS

***P < 0.001, **P < 0.01, *P < 0.05 NS= not significant. Mean (s.d.).

1. High School or Less
2. Incomplete Post-Secondary
3. Completed College/Trade/Tech
4. Completed University or More

FACTOR 1: Parental responsibility

The ANOVA indicated that there was at least one significant difference among the various education categories ($F(3,223) = 3.495, p = .02$). However, Scheffé post hoc tests revealed no significant differences in mean factor 1 scores between the various education categories (not shown).

FACTOR 2: Over-consumption and media promotion of unhealthy foods

The KW test was non-significant ($\chi^2(3) = 1.309, p = .727$) indicating no significant differences among the means.

As a check we also ran an ANOVA and both the parametric and non-parametric tests are in agreement that there are no significant differences in mean factor 2 scores among the varying education levels.

The ANOVA indicated that there are no significant differences in mean factor 2 scores among the various educational categories ($F(3,223) = .552, p = .647$).

FACTOR 3: Misuse/Overuse of modern technology

The KW test indicated no significant differences in factor 3 scores among the various education levels ($\chi^2(3) = 3.104, p = .376$).

We again ran an ANOVA as well. The ANOVA is in agreement with the KW test and therefore we will report the results of the ANOVA as it is a more powerful statistical tool.

There were no significant differences ($F(2,223) = 1.336, p = .263$) in mean factor 3 scores among the various education levels.

FACTOR 4: Children's lack of knowledge and motivation

The KW test indicated no significant differences in factor 4 scores among the various education levels ($\chi^2(3) = .692, p = .875$).

We again, ran an ANOVA as well to determine if there was agreement between the non-parametric and parametric tests.

There were no significant differences ($F(3,223) = .222, p = .881$) in mean factor 4 scores among the various education levels.

FACTOR 5: Physical activity environment

The ANOVA revealed that there were no significant differences ($F(3,223) = 1.272, p = .285$) among the mean factor 5 scores for the various education levels

(4)COMPARISON AMONG SELF-REPORTED BMI CATEGORIES

The same comparisons were made among the BMI categories. Since unequal sample sizes were a problem here, too, we followed the same procedure as above.

Table 15 shows the results of the KW tests for factors 2, 3, and 4. This test revealed a significant difference in mean factor 3 scores among the various weight categories.

Table 15 Results of the Kruskal Wallis (KW) for cause factors 2, 3, and 4

Factors	Chi-Square	d.f.	P
2. Over-consumption/Media	0.66	2	NS
3. Misuse/Over Modern technology	7.81	2	*
4. Children's lack knowledge/mot	0.11	2	NS

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$ NS= not significant. Mean (s.d.).

We then ran ANOVA for all five factors; results are shown in Table 16.

Table 16 Results of weight category ANOVA for each cause factor

Factors	Weight Category			F	d.f.	P
	Under/normal	Overweight	Obese			
1. Parental Responsibility	1.68(0.32)	1.65(0.29)	1.68(0.28)	0.15	2	NS
2. Over-consumption/Media	0.00(1.05)	0.01(0.96)	-0.13(1.06)	0.30	2	NS
3. Misuse/Over Modern technology	-0.15(1.01)	-0.04(1.03)	0.33(0.78)	3.62	2	*
4. Children's lack knowledge/mot	-0.04(1.04)	0.03(0.99)	0.05(0.95)	0.16	2	NS
5. Physical Activity Environment	-0.00(0.99)	0.07(1.03)	-0.06(o.92)	0.24	2	NS

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$ NS= not significant. Mean (s.d.).

FACTOR 1: Parental responsibility

There are no significant differences in the mean Factor 1 scores among persons of varying weight categories ($F(2,211) = .154, p = 0.86$).

FACTOR 2: Over-consumption and media promotion of unhealthy foods

The KW test resulted in no significant differences ($\chi^2(2) = .655, p = 0.72$) in mean factor 2 scores among the various weight categories. The results of the ANOVA were in agreement with those of the KW test, and indicated that there are no significant differences ($F(2, 211) = .299, p = 0.74$) in mean factor 2 scores among the various weight categories.

FACTOR 3: Misuse/Overuse of modern technology

The KW test indicated a significant difference ($\chi^2(2) = 7.811, p = 0.02$) in factor scores among the various weight categories. The results of the ANOVA (which were in agreement with those from the KW test) indicated the presence of a difference ($F(2,211) = 3.615, p = 0.03$). The results of scheffe post hoc tests are presented in Table 17, and indicate that there was a significant difference between the under/normal weight and obese groups. The obese group scored significantly higher on Factor 3, indicating they felt that 'modern technology' was more important in causing childhood obesity.

Table 17 Scheffe Post Hoc tests for cause factor 3

Scheffe	Under/Normal weight	Overweight	-.10501530	.15077533	.785	-.4767106	-.2666800
		Obese	-.48610835(*)	.18162946	.030	-.9338661	-.0383506
	Overweight	Under/Normal weight	.10501530	.15077533	.785	-.2666800	-.4767106
		Obese	-.38109305	.19114711	.140	-.8523139	-.0901278
	Obese	Under/Normal weight	.48610835(*)	.18162946	.030	-.0383506	-.9338661
		Overweight	.38109305	.19114711	.140	-.0901278	-.8523139

* The mean difference is significant at the .05 level.

FACTOR 4: Children's lack of knowledge and motivation

The ANOVA was in agreement with the KW test; both indicated that there were no significant differences among mean factor 4 scores among the various weight categories ($F(2, 211) = .155, p = 0.86$).

FACTOR 5: Physical activity environment

The ANOVA indicated no significant differences ($F(2,211) = .241, p = 0.79$) in mean factor 5 scores among the various weight categories.

INTERACTIONS

We also evaluated whether or not there were any statistically significant interactions between sex and education, sex and parental status, and education and parental status. The only significant interaction was between sex and education for factor 5 scores ($F(3,218) = 3.41, p = .02$). All results are shown in Table 18.

Table 18 Tests for interactions for cause factors

Factors	Interactions								
	Sex*Education			Sex*Parental			Education*Parental		
	F	d.f.	P	F	d.f.	P	F	d.f.	P
1. Parental Responsibility	0.75	3	NS	2.20	1	NS	0.25	3	NS
2. Over-consumption/Media	1.66	3	NS	0.37	1	NS	1.87	3	NS
3. Misuse/Over modern tech	0.17	3	NS	0.04	1	NS	0.19	3	NS
4. Children's lack knowledge	1.02	3	NS	1.23	1	NS	1.78	3	NS
5. Physical Activity Environment	3.41	3	*	0.38	1	NS	0.40	3	NS

***P < 0.001, **P < 0.01, *P < 0.05 NS = not significant

(2) PRINCIPAL COMPONENTS ANALYSIS FOR QUESTIONNAIRE ITEMS THAT ASSESS PREVENTION OF CHILDHOOD OBESITY

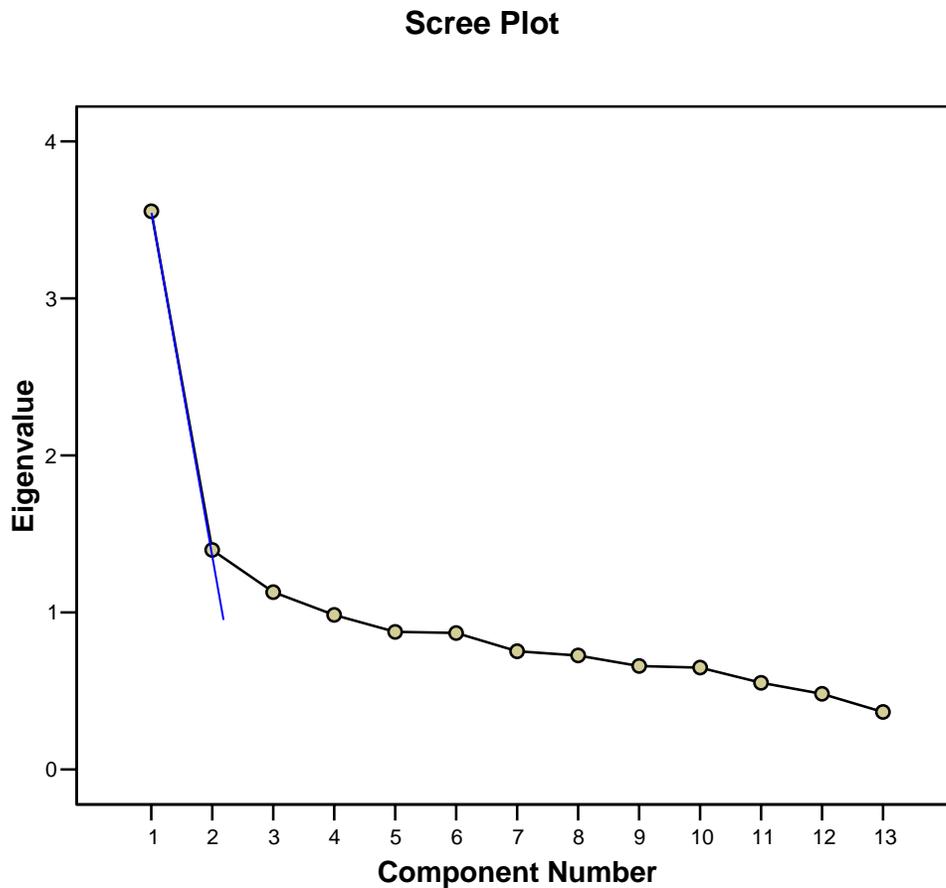
Our principal components analysis for prevention items revealed three factors with an eigenvalue larger than 1 (see table 19). However, retention of 3 factors may not be reasonable so sharp breaks in size of eigenvalues were sought using the scree test. As shown in Figure 2, it appears that a line can comfortably fit through the first 2 eigenvalues in these data, suggesting that we may have two viable factors.

Table 19 Initial and rotated eigenvalues for prevention items

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.555	27.347	27.347	3.555	27.347	27.347	2.721	20.932	20.932
2	1.398	10.755	38.102	1.398	10.755	38.102	1.787	13.747	34.679
3	1.129	8.687	46.789	1.129	8.687	46.789	1.574	12.110	46.789
4	.984	7.569	54.359						
5	.876	6.742	61.101						
6	.869	6.686	67.787						
7	.753	5.792	73.579						
8	.726	5.588	79.167						
9	.659	5.069	84.236						
10	.649	4.993	89.229						
11	.552	4.248	93.477						
12	.482	3.708	97.185						
13	.366	2.815	100.000						

Extraction Method: Principal Component Analysis.

Figure 2: Scree plot for principal components analysis of prevention items



As the number of factors indicated differs from the two above criteria we decided to investigate further. An alternative to allowing the maximum number of factors to emerge based on the eigenvalue criteria (as shown above), is to specifically request a particular number of factors. To this end, we then performed different factor analyses each time specifying a different number of factors, repeating the scree test, and examining the residual correlation matrix.

¹ The two factor solution was found to have 58% non-redundant residuals with absolute values greater than .05. In contrast, the three factor solution had 60% residuals that were moderate or large in size.

The next step was assessing the interpretability of each factor; for this we consulted the rotated component matrix (Table 20). A viable factor will have two or more variables loading on it, and these variables should load highly on only the one factor (loadings on other factors should be low). Furthermore, variables loading on the same factor should be highly correlated with each other, and relatively uncorrelated with other variables (Tabachnick and Fidell, 2001).

Table 20 Rotated component matrix for prevention items

	Component		
	1	2	3
p_allchil	.104	-.046	.740
p_over	.575	-.037	-.493
p_health	.045	.278	.457
p_daily	-.033	.753	.071
p_promo	.137	.690	.076
p_ban	.637	.206	.089
p_tax	.761	.039	.147
p_incen	.716	-.045	.260
p_govt	.431	.298	.032
p_reduce	.570	.301	.207
p_labels	.350	.098	.517
p_one	.280	.235	.355
p_camp	.386	.611	.171

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 4 iterations.

In Table 20, values in the cells represent the factor loading of each variable (down the left hand side) to a factor (across the top). To ease interpretation of the matrix, the highest factor loading for each variable is highlighted. Examination of the rotated component matrix from the original 3 factor solution resulted in the following. Factors 1 through 3 had between 3 and 6 variables that loaded highly on them, and in general, these variables did not load highly on other factors. Though factor 3 had satisfactory variable loadings, the eigenvalue and scree plot criteria were questionable. Additionally, we found that factor 3 was not easily interpreted and thus the decision not to retain factor 3 was made. One variable (*p_one*), which asked respondents to rank ‘children should spend no more than 1 hour a day watching TV or playing computer games, was

determined to not load on any factor as it had small loadings (.235, .280, .355) on three factors none of which made intuitive sense.

ROTATION

As outlined in the methods chapter, we first attempted an oblique rotation strategy, whereby factors are allowed to correlate. However, as can be seen in Table 21, the emergent factors did not correlate highly (i.e., no correlations exceeded .32). Therefore, orthogonal rotation (in which factors are assumed to be independent) was appropriate.

Table 21 Component correlation matrix after oblique rotation for prevention factors

Component	1	2
1	1.000	.285
2	.285	1.000

Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization.

The adequacy of rotation was assessed by examining the simple structure of the rotated analysis. If simple structure is present several variables will correlate highly with each factor and only one factor correlates highly with each variable (Tabachnick and Fidell, 2001). Simple structure was found to be present with the exception of the one complex variable “*p_one*” that was already decided not to load on any one factor.

INTERNAL CONSISTENCY

Following rotation, importance and internal consistency of factors were evaluated. The importance of a factor (or a set of factors) corresponds to the proportion of variance or covariance accounted for by the factor after rotation (Tabachnick and Fidell, 2001). The larger the proportion of variance explained, the more important that factor is for summarising the original items.

The importance of a factor (or set of factors) is evaluated by the proportion of variance or covariance accounted for by the factor after rotation. The proportion of variance accounted for by a factor is the amount of variance in the original variables (where each has contributed one unit of variance) that has been condensed into the factor. For the first factor, the proportion of variance is .21. Twenty-one percent of the variance in the variables is accounted for by the first factor. The second factor accounts for 14%

of the variance in the variables, and because rotation is orthogonal, the two factors together account for 35% of the variance in the variables.

Internal consistency of factors, represented by Cronbach's alpha is presented in Table 22. A Cronbach's alpha value of 0.7 had been indicated as an acceptable reliability coefficient (Santos, 1999).

Table 22 Internal reliability of prevention factors

Factor	Cronbach Alpha	# of items
1	.71	6
2	.58	3

The cronbach alpha for factor 2 does not meet the cut off of 0.7. However, 0.58 is not drastically low and factor 2 was retained for further analysis.

INTERPRETATION OF FACTORS

The final step in principal components analysis is factor interpretation. In this step, one tries to understand the underlying dimension that unifies the group of variables loading on it. As shown in Table 23, we named each factor based on the cluster of variables that loaded highly on it.

Table 23 Results of principal components analysis of lay perceptions of the importance of prevention of obesity among children in grades K to 6.

Factor and Items	Factor Loadings
Factor 1: Healthy public/private policy	
Percent of variance: 20.93%	
Cronbach Alpha: 0.71	
High fat foods should have an additional 5% tax	76
Give 5% tax incentives to manufacturers of healthy food	72
Advertising of high fat foods should be banned during children's viewing hours	64
Obesity prevention action should only be directed to children who are overweight but not yet obese	58
The food industry should reduce the portion sizes of take out foods	57
The government should build more safe cycling and walking tracks	43
Factor 2: Media campaigns and compulsory physical education	
Percent of variance: 13.75%	
Cronbach Alpha: 0.58	
Daily physical education in school should be compulsory	75
Healthy eating should be promoted on children's TV	69
The govt should run regular healthy eating and physical activity campaigns in the mass media	61
Items not included/loading on more than one factor	
Obesity prevention actions should be directed to all children	
More healthy foods should be served in schools	
Food labels should highlight the calorie/kilojoule content of foods	
Children should spend no more than 1 hour a day watching TV or playing computer games	
Factor loadings are expressed as whole numbers	

In addition to adequate factor loadings, factor interpretability is based on what “makes sense”. It was judged that the above solution was a sensible one. For example, five of the items loading on factor 1 had to do with private/public policy while the sixth item asked about targeted intervention. This sixth item was not supported by the majority of respondents. Therefore, the factor was named ‘Healthy public/private policy’ because of the five items concerned with this, four of which, were supported by the majority of respondents.

PREVENTION ITEM FACTOR SCORES

Factor scores are estimates of the scores that individuals would have received on each of the factors had they been measured directly (Tabachnick and Fidell, 2001). Regression-like coefficients are computed for weighting variable scores to produce factor scores, such that each individual in the sample has a factor score for each of the two retained factors. These factor scores were the “dependent variables” in comparisons of interest, and since they are continuous variables, they were first examined for distributional assumptions. This process is outlined in Appendix H. To summarize both factors were left untransformed.

COMPARISONS

The final stage of analysis in the present study involved comparisons of factor scores. In particular, analysis of variance (when there are more than two groups) and t-tests (when there are two groups) were used to make the following comparisons

- 1) Do factor scores differ between males and females?
- 2) Do factor scores differ between parents and non-parents?
- 3) Do factor scores differ between various education levels?
- 4) Do factor scores differ between categories of self-reported BMI?

As described earlier we were again making multiple comparisons and therefore used a Bonferroni correction ($0.05/2 = 0.025$) to account for increases in type 1 error. However, regardless of whether or not a finding is robust to the Bonferroni correction, I will report and discuss the findings. In this regard I am allowing the reader to decide what level of significance they are willing to accept.

(1) COMPARISON OF MALES AND FEMALES

As the sample had relatively equal amount of males (47.0%) and females (52.7%) the use of a t-test is appropriate regardless of whether or not the samples are normally distributed (Ramsey and Shafer, 2002). Results of this comparison are shown in Table 24.

Table 24 Results of t-test by sex for each prevention factor

Factors	Sex		P
	Male	Female	
1. Healthy public/private policy	-0.09 (1.04)	0.08 (0.95)	NS
2. Media campaigns and compulsory phys ed	-0.09 (1.03)	0.08 (0.97)	NS

***P < 0.001, **P < 0.01, *P < 0.05 NS= not significant. Mean (s.d.).

There were no statistically significant differences between the way males and females ranked prevention factor 1 ($p = 0.18$) or prevention factor 2 ($p = 0.20$).

(2) COMPARISON AMONG PARENTS AND NON-PARENTS

As the sample had relatively equal amount of parents (46.6%) and non-parents (48.1%) the use of a t-test is appropriate despite whether or not the samples are normally distributed. Results (shown in Table 25) reveal that there were no significant differences between parents and non-parents mean prevention factor scores.

Table 25 Results of t-test by parental status for each prevention factor

Factors	Parental Status		P
	Parents	Non-parents	
1. Healthy public/private policy	0.06(1.02)	-0.09(0.96)	NS
2. Media campaigns and compulsory phys ed	-0.01(1.15)	-0.02 (0.87)	NS

***P < 0.001, **P < 0.01, *P < 0.05 NS= not significant. Mean (s.d.).

(3) COMPARISON AMONG VARYING EDUCATION LEVELS

The group sizes for the various education levels were not similar even after collapsing of categories, as indicated in the data screening section. As a result, the validity of using a t-test with non-normal distributions becomes more questionable.

Therefore, to determine the validity of using a parametric test like an ANOVA we decided to evaluate the normality of the distribution of education scores using a Kolmogorov-Smirnov Test (KS). If this test was found to be significant we then made use of a non-parametric test such as the Kruskal-Wallis(KW) test to determine whether there were differences among various education levels. Following the non-parametric Kruskal-Wallis test we then performed ANOVA to assess for agreement between non-

parametric and parametric methods. If both tests were in agreement, we reported the findings of the ANOVA as it is a more powerful statistical tool. The reason why we choose ANOVA if KW provides us consistent conclusions is ANOVA is more powerful and use the original score of the data rather than the ranking of the data (as what KW did) (“ T.Fung”, personal communication, March 7/05).

Table 26 Results of the Kolmogorov-Smirnov (KS) test for each prevention factor

Factors	Mean	s.d.	Z	P
1. Healthy public/private policy	0.00	1.00	1.00	NS
2. Media campaigns and compulsory phys	0.00	1.00	2.28	***

***P < 0.001, **P < 0.01, *P < 0.05 NS= not significant. Mean (s.d.).

For prevention Factor 2 with a significant KS test, a non-parametric Kruskal-Wallis tests was performed; the results are shown in Table 27.

Table 27 Results of the Kruskal Wallis (KW) test for prevention factor 2

Factors	Chi-Square	d.f.	P
2. Media campaigns/compulsory phys ed	0.77	3	NS

***P < 0.001, **P < 0.01, *P < 0.05 NS= not significant.

The KW tests revealed no significant differences among varying education levels for prevention factor 2.

We next employed ANOVA's on both factors one with a normal distribution and one without a normal distribution. The results are shown in Table 28.

Table 28 Results of education ANOVA for each prevention factor

Factors	Education Level				F	d.f.	P
	1	2	3	4			
1. Healthy public/private policy	0.09(1.09)	-0.16(1.02)	-0.00(0.96)	0.09(0.94)	0.99	3	NS
2. Media campaigns/compulsory	-0.08(1.15)	0.04(0.92)	-0.05(1.17)	0.12(0.81)	0.45	3	NS

***P < 0.001, **P < 0.01, *P < 0.05 NS= not significant. Mean (s.d.).

5. High School or Less
6. Incomplete Post-Secondary
7. Completed College/Trade/Tech
8. Completed University or More

FACTOR 1: Healthy public/private policy

The KS test had a p-value of .269 which indicated no significant deviations from the normal distribution and indicated the use of ANOVA is valid. The ANOVA indicated there were no significant differences in mean prevention factor 1 scores among the various education categories ($F(3,239) = 0.99, p = 0.40$).

FACTOR 2: Media campaigns and compulsory physical education

The KW test indicated no significant differences in mean prevention factor 2 scores among the various education categories ($\chi^2(3) = .772, p = .856$).

As a check we also ran an ANOVA and both the parametric ($F(3,239) = .449, p = 0.72$) and non-parametric tests ($\chi^2(3) = .772, p = 0.86$) are in agreement that there are no significant differences in mean prevention factor 2 scores among the varying education levels.

(4) COMPARISON AMONG SELF-REPORTED BMI CATEGORIES

The same comparisons were made among the BMI categories. Since unequal sample sizes were a problem here, too, we followed the same procedure as above. Table 29 shows the results of the KW tests for prevention factor 2.

Table 29 Results of the Kruskal Wallis (KW) for prevention factor 2

Factors	Chi-Square	d.f.	P
2. Media campaigns/compulsory phys ed	1.43	2	NS

***P < 0.001, **P < 0.01, *P < 0.05 NS= not significant.

The K-W test revealed no significant difference in prevention factor 2 scores among the various weight categories.

We then ran ANOVA's for both factors; results are shown in Table 30.

Table 30 Results weight category ANOVA for each prevention factor

Factors	Weight Category			F	d.f.	P
	Under/normal	Overweight	Obese			
1. Healthy public/private policy	-0.14(0.95)	0.02(0.97)	0.32(1.05)	3.48	2	*
2. Media campaigns/compulsory	0.01(1.06)	0.12(0.70)	-0.11(0.88)	0.95	2	NS

***P < 0.001, **P < 0.01, *P < 0.05 NS= not significant. Mean (s.d.).

FACTOR 1: Healthy public/private policy

The ANOVA indicated that there was at least one significant difference in the mean prevention factor 1 scores among the various weight categories ($F(2,227) = 3.47$, $p=0.03$). We then employed post-hoc tests to determine where this difference occurred; results are shown in Table 31.

Table 31 Scheffe Post Hoc tests for prevention factor 1

(I) weight category	(J) weight category	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Under/Normal weight	Overweight	-.15943079	.14533355	.549	-.5175308	.1986693
	Obese	.45989853(*)	.17492511	.033	-.8909118	-.0288852
Overweight	Under/Normal weight	.15943079	.14533355	.549	-.1986693	.5175308
	Obese	-.30046774	.18440592	.267	-.7548416	.1539061
Obese	Under/Normal weight	.45989853(*)	.17492511	.033	.0288852	.8909118
	Overweight	.30046774	.18440592	.267	-.1539061	.7548416

* The mean difference is significant at the .05 level.

The post-hoc scheffe indicated that there was a significant difference ($p = 0.03$) between those persons in the obese category compared to the under/normal weight

category. Obese persons ranked prevention factor 1 scores more importantly than those persons who were under/normal weight.

FACTOR 2: Promotion of healthy eating and activity for children

The KW test indicated no significant differences in mean prevention factor 2 scores among the various weight categories ($\chi^2(2) = 1.429, p = .490$). As a check we also ran an ANOVA and both the parametric ($F(2,227) = 0.95, p=0.40$) and non-parametric tests are in agreement that there are no significant differences in mean prevention factor 2 scores among the varying education levels.

INTERACTIONS

We also evaluated whether or not there were any statistically significant interactions between sex and education, sex and parental status, and education and parental status. There were no statistically significant interactions; results are shown in Table 32.

Table 32 Tests for interactions for prevention factors

Factors	Sex*Education			Interactions			Education*Parental		
	F	d.f.	P	F	d.f.	P	F	d.f.	P
1. Healthy public/private policy	2.55	3	NS	0.62	1	NS	0.25	3	NS
2. Media campaigns/compulsory	0.46	3	NS	0.45	1	NS	1.87	3	NS

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$ NS= not significant

RESULTS SUMMARY

RESULTS OF FACTOR ANALYSES

Five factors were retained from the principal components analysis of cause items. These are presented in Table 4, which included details of what items loaded on each factor and their internal consistency scores. Together the 5 factors account for 47.7 % of the variance. Factor 1 was named 'Parental responsibility' as it had 5 items loading on it that all had to do with potential parental influence on childhood obesity. Factor 2 was named 'Over-consumption and media promotion of unhealthy foods'. This factor had five items loading on it. The items all had to do with eating either too many fast foods, high fat foods, over-sized portions of food, or media promotion of unhealthy foods. Factor 3 was named 'Misuse/Overuse of modern technology and had three loadings. The items loading on factor 3 were concerned with watching too much TV, modern technology, and eating in front of the TV. Factor 4 was named 'Children's lack of knowledge and motivation' and it had three items loading on it. All three items included children not knowing or caring about common causes of childhood obesity. Factor 5 was named 'Physical activity environment' and has two items loading on it. Both items were concerned about a lack of safe places to be physically active. Factors 1 to 4 all had variables loading on them that were supported by the majority of those surveyed. However factor 5 had two variables loading on it that were perceived to be not/not really important by the majority of those surveyed. Therefore, a lack of safe cycling, walking, and other places to be active was perceived as not an important cause of childhood obesity.

Factor analyses of the prevention items resulted in two factors with eigenvalues greater than 1 being retained. Together these two factors account for 34.7% of the variance. Factor 1 was named 'Healthy public/private policy'. Factor 1 had six items loading on it. Five of which were concerned with public or private policy, 4 of which were supported by the majority and one which was not supported by the majority, and a sixth variable which was concerned with targeted prevention. This variable was not supported by the majority of those surveyed. Factor 2 was named 'Media campaigns and compulsory physical education'. This factor had three items loading on it that broadly

focused on children's health promotion. Two variables about media campaigns were supported by the majority of respondents as was the prevention item about compulsory physical education.

DEMOGRAPHIC DIFFERENCES IN FACTOR SCORES

The results of the analysis of variance of the factor scores revealed that on two of the cause factors, 'over-consumption and media promotion of unhealthy foods' and 'physical activity environment' women had significantly higher scores than men, indicating women considered these two factors more important in causing childhood obesity. With regards to analyses by parental status and education level, there were no significant differences. There was, however, a statistically significant interaction between sex and education for factor 5 'Physical activity environment'. Men and women with lower levels of education (High school or less, Incomplete post secondary) had similar means for factor 5, whereas men and women with higher levels of education (Completed community college/tech/trade, or Completed at least university) had different means for factor 5. Thereby, the relationship between education and factor 5 differs by sex, such that women with a higher education ranked factor 5 more importantly than similarly educated men. With regard to analyses by weight category, obese persons ranked factor 3 'Misuse/Overuse of modern technology' more importantly than those who were under/normal weight.

For the prevention factors, there were no statistically significant differences in analyses by sex, parental status, or education level. There were also no statistically significant interactions. With regards to analyses by weight category, the obese category ranked factor 1 'Healthy public/private policy' significantly higher than the under/normal weight group. This indicates that persons classified as obese feel that prevention factor 1 is more important than those persons who were classified as under/normal weight.

COMPARISONS TO MELBOURNE AUSTRALIA

In Table 33 below, comparisons between the Hardus et al. (2003) study in Melbourne Australia and the present study in Calgary, Canada are made.

Table 33 Comparisons between Melbourne, Australia and Calgary, Canada

	Hardus et al Melbourne	Potestio et al Calgary
Univariate Analysis for causes of childhood obesity		
Finding 1	More than half felt over-consumption of fast foods (50%) and media promotion of unhealthy foods (52%) to be extremely important causes of childhood obesity	More than half of adults surveyed felt that over consumption of fast foods (75.4%) and media promotion of unhealthy foods (63.7%) to be very important causes of childhood obesity.
Finding 2	Most causes listed in the questionnaire were considered to be at least very important by a significant majority of subjects	Most causes listed in the questionnaire were considered to be at least somewhat important by a significant majority of subjects
Finding 3	There were a number of causes that were considered to be not important or only quite important by many respondents. These included the following items: parent's don't care about being physically active (46%), parent's don't care about healthy eating (36%), lack of safe cycling and walking paths (54%), lack of other safe places to be physical active (57%), healthy food are expensive (56%), healthy foods often aren't available (67%), genes (57%), there is an overemphasis on academic work (56%)	There were a number of causes that were considered to be not important or not really important by many respondents. These included the following items: parent's don't care about being physically active (27.7), parent's don't care about healthy eating (23.8%), lack of safe cycling and walking paths (57.9%), lack of other safe places to be physical active (53.8%), healthy food are expensive (51.9%), healthy foods often aren't available (63.6%), genes (18.2%), there is an overemphasis on academic work (53.5%). Calgarians ranked items about parents not caring about physical activity or eating healthy more important in causing childhood obesity than Australians. Calgarians also ranked genes far more importantly (81%) than did Australians (43%)

	Hardus et al	Potestio et al
Factor Analyses for Cause items	Eight factors with eigenvalues greater than unity were derived from the PCA. Eight factors accounted for 67% of the variance.	Eight factors with eigen values greater than 1 were derived from the PCA. However, only five factors were retained, and these five factors accounted for 47.7% of the variance.
Factor 1	Factor 1 was provisionally named 'parental responsibility' because the five items loading on it were related to parents' lack of knowledge and motivation	Factor 1 was named 'parental responsibility' because the five items loading on it were related to parents' lack of knowledge and motivation. This factor was identical to that of Hardus et al
Factor 2	Factor 2 was named 'modern technology and media' and included four items about television viewing , the media and the use of modern technology	Factor 2 was named 'over-consumption and media promotion of unhealthy foods' and included four items about over consumption of fast foods, high fat foods, and serving sizes as well one factor about media promotion of unhealthy foods. This factor is similar to Factor 3 for Hardus except they have one additional item loading on it.
Factor 3	Factor 3 was named 'over consumption of food' and included five items about fast foods, high-fat foods and oversized servings of food. The factor also included the item children have too much money to spend on unhealthy foods	Factor 3 was named 'misuse/overuse of modern technology' and included three items about television and other modern technologies such as cars, computers, and video games. This factor is similar to Factor 2 for Hardus et al except they have the additional item of media influence.
Factor 4	Factor 4 comprised three items and was labelled	Factor 4 comprised three items and was labelled

	‘children’s lack of knowledge and motivation’	‘children’s lack of knowledge and motivation’. The items loading on this factor were identical to those loading on Hardus et al
Factor 5	‘Physical activity environment’ included two items regarding the lack of facilities for cycling and walking and safety	‘Physical activity environment’ included two items regarding the lack of facilities for cycling and walking and safety. This factor was identical to Hardus et al Factor 5
Factor 6	Factor 6 included two items and was labelled ‘lack of unhealthy food’	Factor 6 included the same two items. However, this factor was not included in further analysis (see table above)
Factor 7	Factor 7 with two items, was named ‘lack of physical activity’	Factor 7 included the same two items about lack of physical activity but was not included in further analysis (see table above)
Factor 8	Factor 8 exhibited low internal reliability ($\alpha = 0.21$) and was not included in further analysis.	Factor 8 included the same two items as Hardus et al and was also not retained for further analysis (see table above)
Demographic Differences in Factor Scores	Hardus et al	Potestio et al
Finding 1	On two of the cause factors ‘modern technology and media’ and ‘physical activity environment’ women had significantly higher scores than men	On two of the cause factors ‘over consumption and media promotion of unhealthy foods’ and ‘physical activity environment’ women had significantly higher scores than men.
Finding 2	Women scored lower than did men on ‘lack of physical activity’	This factor was not retained in the analysis
Finding 3	Parents scored higher than non-parents on ‘modern technology and media’, ‘physical activity	There were no significant differences between parents and non-parents

	environment' and 'lack of physical activity'	
Finding 4	Respondents who were not tertiary educated scored higher on 'modern technology and media'	There were no significant differences between the varying education levels
Finding 5	There was a statistically significant interaction between sex and education level for 'children's lack of knowledge and motivation'. Nontertiary educated men had higher scores than tertiary educated men. Nontertiary educated women scored lower than tertiary educated women	There was a statistically significant interaction between sex and education level for 'Physical Activity Environment'
Finding 6	A statistically significant interaction between sex and education level for 'lack of physical activity'. Nontertiary educated men had higher scores, while tertiary educated men had low scores. In contrast, nontertiary women had low scores.	
Finding 7	There was no statistically significant interaction between sex and parental status for any of the factors	There was no statistically significant interaction between sex and parental status for any of the factors
Finding 8	Hardus did not evaluate this potential interaction	There was no statistically significant interaction between education and parental status.
Finding 9	Hardus et al did not collect weight and height information	Obese persons ranked factor 3 'misuse/overuse of modern technology' more importantly than those who were under/normal weight.

Univariate Analyses for Prevention Strategies	Hardus et al	Potestio et al
Finding 1	There was widespread consensus (very + extremely) about the desirability of several prevention activities, specifically, the promotion of healthy eating during children's television viewing (91%), the provision of healthy food at school (89%), obesity prevention strategies that target non obese as well as obese children (82%), regular government funded healthy eating campaigns in the mass media (76%) and the highlighting of the energy content of foods on their labels (79%).	There was widespread consensus (somewhat + very) about the desirability of several prevention activities, specifically, the promotion of healthy eating during children's television viewing (96.2%), the provision of healthy food at school (96.6%), obesity prevention strategies that target non obese as well as obese children (93.9%), regular government funded healthy eating campaigns in the mass media (89%) and the highlighting of the energy content of foods on their labels (82.5%). All of these prevention activities were even more highly supported by Calgarians
Finding 2	Far less support (very, extremely) for coercive measures such as the banning of food advertising during children's television programmes (59%) or for an additional tax on high-fat foods (38%). There were also many people who did not see a reduction in the portion sizes of take away foods as an important measure to prevent obesity (35%)	Far less support (somewhat, very) for coercive measures such as the banning of food advertising during children's television programmes (59.1%) or for an additional tax on high-fat foods (32.6%). There were also many people who did not see a reduction in the portion sizes of take away foods as an important measure to prevent obesity (60.3%). Calgarians were more opposed to an additional 5% tax on high-fat foods and more supportive of reducing the portion sizes of take away foods
Finding 3	Compulsory daily physical education was not as heavily supported by Australians (81% very + extremely)	Compulsory daily physical education in school was well supported (95.1% somewhat + very)
Finding 4	The government should build more safe cycling and walking paths was less supported in Australia (59% very +extremely)	The government should build more safe cycling and walking paths was moderately supported (69.7% somewhat + very)

Factor Analyses for Prevention items	Hardus et al	Potestio et al
	Two factors with eigenvalues greater than unity, which together accounted for 50% of the variance	Two factors with eigenvalues greater than 1 were retained, together they accounted for 35% of the variance
Factor 1	Factor 1 was named 'government action', which included five items concerned with taxation, banning advertising, the provision of safe recreational facilities and community wide prevention initiatives	Factor 1 was named 'healthy public/private policy', which included six items, those same five as the Hardus study and an additional item about the food industry reducing the size of take away foods.
Factor 2	Factor 2 comprised four items broadly concerned with 'children's health promotion'	Factor 2 was named 'media campaigns and compulsory physical education' and was comprised of three items, two of which were identical to the four items loading on the Hardus factor 2

Demographic differences in prevention factor scores	Hardus et al Melbourne	Potestio et al Calgary
Finding 1	For the prevention factors, women had higher scores 's than men on 'children's health promotion'	There were no statistically significant differences in the way men and women ranked the importance of prevention factors
Finding 2	Parents had higher scores than non-parents on the 'government action' factor	There were no statistically significant differences in the way parents and non-parents ranked the importance of prevention factors
Finding 3	There was no statistically significant education differences on the prevention factors.	There was no statistically significant education differences on the prevention factors.
Finding 4	There was a statistically significant interaction	There was no statistically significant interaction

	<p>between sex and education level for 'children's health promotion'. Non-tertiary educated men had higher scores than tertiary educated men. Conversely, tertiary educated women had higher scores than their non-tertiary educated peers.</p>	<p>between sex and education, sex and parental status, or education level and parental status, for any of the prevention factor scores.</p>
<p>Finding 5</p>	<p>Hardus et al did not collect height and weight information and was therefore unable to make this comparison</p>	<p>The obese group scored significantly higher on prevention factor 1 'healthy public/private policy' scores than the under/normal weight group.</p>

CHAPTER 4: DISCUSSION

CALGARY

To the best of our knowledge, this is the first Canadian study that has examined community perceptions of the causes and prevention of childhood obesity. As the Hardus study states, the research findings are important for health policy makers as they develop interventions and implement strategies in an attempt to reverse the obesity epidemic (Hardus et al., 2003). Some of the strengths of this study, which reflect modifications to Hardus et al's procedures, include the modification of the response scale and the inclusion of BMI as a variable. First, I opted to replace Hardus et al's asymmetrical response scale, with a symmetrical one. According to Dillman (2000), a scale is improved when there are an equal number of positive and negative responses. Second, I incorporated body mass index (BMI) as a variable in the present study, based on self-reported values of height and weight. Because the survey was on the topic of body weight, it seemed possible or even likely that respondents' own body size might influence their responses. In this way, the present study expanded on the research on which it was based (Hardus et al., 2003).

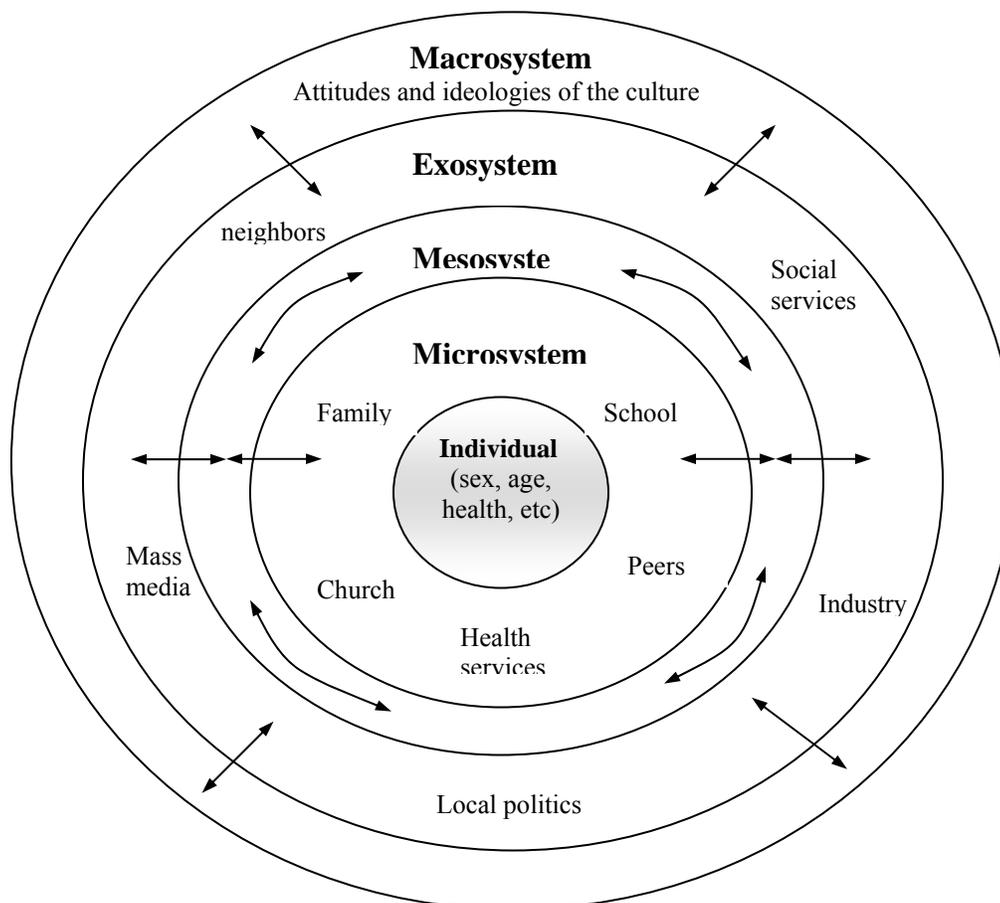
In this chapter I am going to discuss the findings of the present study, and then discuss our findings in relation to those by Hardus et al. (2003) in Melbourne, Australia. Additionally, there will be discussion of the study limitations concluding with recommendations for future research.

This study found that the Calgarians who participated in the study did not indicate one particular causal factor for childhood obesity, but rather consider multiple factors as important. This multifactorial view is consistent with the multidimensional nature of obesity as described in the literature review. With respect to causes of childhood obesity these Calgarians predominantly endorsed 'Parental responsibility' indicating that they think parents are in part at fault for childhood obesity. Although there were other factors this was the most important. The second most important theme surrounded 'Over-consumption and media promotion of unhealthy foods'. In this factor participants were blaming children's tendency to over eat both in home and at school but were also acknowledging the influence of media and portion size that may both facilitate

overeating. ‘Misuse/Overuse of modern technology’ (TVs, cars, computers) was also acknowledged as the third most important theme followed by a lack of knowledge and motivation on the part of children. The final and smallest factor concerned the role of the environment for physical activity.

These results may be interpreted using an ecological approach such as that outlined by Bronfenbrenner (see figure 3) (Santrock, 1992). Bronfenbrenner describes several aspects of the ecological environment including the individual, the microsystem, the mesosystem, the exosystem, and the macrosystem. The individual level includes characteristics inherent to the individual such as sex and age. The microsystem includes a person’s immediate situation (that is, other persons with whom he/she interacts in a face to face manner), the connections between other persons within the setting, the nature of

Figure 3: Bronfenbrenner’s ecological theory of development.



these connections, and the influence of all these (direct or indirect) on the person at hand (McLaren and Hawe, 2005). The mesosystem refers to linkages or overlap between settings; these include, for example, parent-teacher interviews, which link the school and family microsystems (McLaren and Hawe, 2005). The exosystem refers to linkages between settings that a person may or may not directly participate in, but that are none the less relevant because of their impact on his or her immediate environment. Examples include mass media and neighbours. The macrosystem is the most overarching concept and refers to the overall patterns of ideology and organisation that characterise a given society or social group (McLaren and Hawe, 2005). With reference to this model clearly these Calgarians were primarily concerned with the microsystem including the family and the individual however; they did also acknowledge broader influences including the exosystem (e.g., media, physical environment). Despite this emphasis on the family respondents seem not to acknowledge environmental constraints on families' capacity to be healthy. For example, respondents generally did not agree that cost and availability of healthy foods was an important causal factor in childhood obesity. Although these Calgarians do acknowledge the role of broader societal influences such as the media, portion sizes, fast-food, and technology they perhaps underestimate the importance of these trends as described in the review of the literature (e.g., Coon and Tucker, 2002; Knehans, 2002; St-Onge et al., 2002; Dietz et al., 2002).

In contrast to the focus on parents and family in terms of causes of childhood obesity, these same Calgarians supported some prevention efforts at a public/private policy level. At first glance this seems surprising: based on factor analysis of cause items it would appear that these Calgarians would support prevention efforts targeted at the family level. However, Calgarians' views on prevention were restricted by the items on the questionnaire - only one of which had to do with the home environment. Calgarians also supported prevention strategies involved with children's health promotion activities such as more healthy food choices in schools, compulsory daily physical education classes, and the promotion of healthy eating by children's television. The public support for these health promotion strategies will provide policy makers with a starting point from which to address childhood obesity issues in home and school settings, that is

relatively less controversial based on the views of participants in this study. Respondents opposed the single item regarding putting an additional 5% tax on high fat foods. Although this is only a single finding, it makes sense as Alberta is a politically conservative province which strongly opposes government involvement in business or personal decisions.

Next I will discuss differences in factor scores, resulting from the cause items, between sociodemographic categories. On two of the cause factors 'Over consumption and media promotion of unhealthy foods' and 'Physical activity environment' women scored significantly higher than men. The finding that women ranked 'Over consumption and media promotion of unhealthy foods' more importantly than men may reflect attitudinal differences in the way men and women view nutrition. Women may be more likely to be diet conscious than men and may tend to be more aware of the influences of media on health choices. Research strongly indicates that a thin ideal of beauty is promoted by the print media, particularly magazines aimed at teenage girls and adult women (Thompson and Heinberg, 1999). Furthermore, a *Psychology Today* survey indicates the significant impact the mass media has in promoting the cultural ideal of thinness and beauty, at least for women (Thompson and Heinberg, 1999). Of 3,452 women responding, 23% indicated that movie or television celebrities influenced their body image when they were young, and 22% reported the influence of fashion magazine models. In contrast only 13% and 6% of men respectively reported an influence of movie/television celebrities or fashion magazine models (Thompson and Heinberg, 1999). This finding is further supported by Green and Pritchard (2003) who also found that adult women report a significant level of media influence. It is therefore conceivable that a lot of women are aware of the influence of mass media and are reflecting this in their rankings. It is also possible that women watch more television with their young children as they are more likely to be at home than fathers. As a result, women may be more tuned into the advertisements that are bombarding children. Women also ranked 'Physical activity environment' more importantly than men. 'Physical activity environment' had two items loading on it regarding the lack of safe facilities for walking and cycling. Women are more likely to strongly agree that concerns of safety keep them

from walking or bicycling (Canadian Fitness and Lifestyle Research Institute, 1999), and this increased concern is likely being projected onto children.

There were no significant differences between parents and non-parents on any of the factors. Theoretically, differences between these two groups are the result of parents having additional insight into causes of childhood obesity. But, perhaps non-parenting Calgarians are very in tune with what may be causing childhood obesity and thus parenting Calgarians are not unique. Childhood obesity is very topical in Calgary recently (newspaper articles discussing childhood obesity and news specials) and this may have helped increase awareness in non parenting Calgarians. Additionally, as all Calgarians become more aware of obesity in general, they are more likely to reflect on what they feel are potential causes for recent trends, and transfer these concerns to children.

There were no significant differences between any of the education categories for any of the factors. Again, childhood obesity is increasingly on the minds of Calgarians because they have been exposed to media coverage on the issue. As a result, persons of all educational categories may have similar opinions on childhood obesity. Calgary is also a city where the boom in the oil and gas industry likely resulted in many persons without post secondary education working their way up in companies and acquiring higher salary and prestige that accompanies a respectable occupation. With increased socioeconomic status often comes more awareness and knowledge of various health issues. So perhaps here in Calgary persons with post secondary education and those without are not that different. Perhaps if we had used a different indicator of socioeconomic status, such as income, we would have obtained different results.

Calgarians who were classified as obese scored higher on 'Misuse/Overuse of modern technology' than those who were classified as under/normal weight. Obese persons may have additional insight into what caused their obesity and can reflect these opinions in their rankings. As mentioned in the review of the literature use of technology has increased throughout the population in recent years (CIHI, 2004) however it could be that obese persons are more aware of this because they have experienced potential consequences of this societal trend. In other words, perhaps obese individuals might tend

to think that ‘Misuse/Overuse of modern technology’ was an important cause of their own obesity and are transferring this to what they feel are important factors in childhood obesity.

The finding that there were no significant differences between men and women, parents and non-parents, and the varying education levels for any of the prevention factors indicates that these different groups of people share common views about prevention of childhood obesity. The only significant prevention finding was that persons classified as obese ranked ‘Healthy public/private policy’ more important than those who were under/normal weight. Again, this finding may reflect the additional insight of those persons who are obese. This demographic difference suggests that perhaps being obese makes people more aware of the need for policy action to combat the problem. Alternatively, this result may support the finding that obese individuals are more externally oriented than non-obese persons (Adolfsson, Andersson, Elofsson, Rossner, and Unden, 2004). The concept “locus of control” refers to the belief individuals have in the amount of control they have over their lives (Adolfsson et al., 2004). An external locus of control orientation indicates that goal attainment is attributed to external factors outside the control of the individual (Adolfsson et al., 2004). It is conceivable that the obese persons surveyed in this study are more externally oriented and this is being reflected by their ranking ‘Healthy public/private policy’, which is concerned with prevention strategies that are external to the individual, so importantly.

This study has shown that the Calgary public have a multifactorial view on the causes of childhood obesity. They support several prevention strategies and oppose others, thereby providing guidance for health promotion researchers and policy makers as to publicly acceptable intervention strategies.

COMPARISONS TO AUSTRALIA

UNIVARIATE ANALYSIS – CAUSE ITEMS

In this section I will discuss substantial differences between the present study and that of Hardus (2003) on individual questionnaire items assessing causes of childhood obesity. Calgarians ranked over consumption of fast foods and media promotion of

unhealthy foods as more important causes of childhood obesity than those surveyed in Melbourne (Hardus et al., 2003). Initially, this difference was thought to perhaps reflect differences in the availability of fast foods in the two cities. However, Melbourne has an average density of 9553 persons per fast food outlet (Reidpath, Burns, Garrard, Mahoney, and Townsend, 2002) whereas Calgary has 10773 persons per fast-food outlet (McLaren, Bow, and Hawe, 2003). This finding suggests that Melbourne actually has a higher density of fast food outlets, however, differences in city zoning policies and which fast-food outlets were analyzed in each study may also be contributing to this finding. It is also important to realize that availability of fast-food outlets may not be a good indication of use. Perhaps Calgarians eat at fast-food restaurants more frequently than people in Melbourne. If respondents were more likely to use fast food restaurants themselves, they would likely reflect this in their rankings. Media promotion of unhealthy food is everywhere (television, radio, newspapers, and magazines) these days, and again the more prevalent the ads, the more likely people are to recognize the branding and conclude that it has influence on childhood obesity. Additionally, the Public Health Association of Australia was involved in very public lobbying to legislate a ban on all television food advertising at times when children comprise the majority of the viewing audience (http://www.phaa.net.au/policy/TVfood_advertisingF.htm). This debate has spilled over into the media in Australia, and has raised awareness of this issue. Perhaps because it has been publicly debated and legislated against, Australians may feel it no longer an important cause of childhood obesity.

Calgarians ranked items about parents not caring about physical activity or eating healthy more important in causing childhood obesity than those from Melbourne. This may be the result of differences in the way people in the two countries view the parents in their country. Perhaps Calgarians on a whole are more critical of parenting Calgarians. Childhood obesity is an issue continually on the rise in recent times. The issue is gaining national recognition and perhaps Calgarians view the epidemic as partially due to parents not caring enough about healthy eating or physical activity. Additionally, Calgary is much more politically conservative than Melbourne and this is often reflected in individual level blame as described previously. Due to the political climate in Calgary,

people may be more likely to place individual level blame as opposed to blaming environmental or social causes.

Calgarians also ranked genes as far more important than Australians. Almost twice as many Canadians (81%) ranked genes as either somewhat or very important compared to only 43% of Australians who ranked genes either very or extremely important. This may reflect the fact that in Australia there is more public awareness surrounding health issues. It is common to see media coverage on issues like genetics and obesity in their daily papers, whereas this is not as common in Calgary (P. Hawe, personal communication, May 3, 2005). Perhaps Australians are more health literate and are aware of the fact that genetics alone simply can not explain the recent trends in childhood obesity.

CALGARY – MELBOURNE DIFFERENCES IN CAUSE FACTOR SCORES

The results of the actual factor analyses were quite similar between the two studies. Factors 1, 4, and 5 were identical to one another. Factors 2 and 3 switched positions, but were still remarkably similar, differing in only one item.

In Melbourne, women placed greater importance than men on modern technology and media, and on having a safe environment for physical activity. In Calgary, women placed greater importance than men on over-consumption of unhealthy foods and media influence and on having a safe environment for physical activity. It makes sense that women in both countries would rank a safe environment for physical activity more important than men, as it is women who need to be concerned about their safety when doing outdoor activities like jogging. In other words concern for safety among women is a cross national issue. Because women have to be more concerned about their own safety it is likely that they project these concerns onto children as well. Sex differences on these other two factors (modern technology and media, and over-consumption of unhealthy foods and media influence) are more difficult to explain but may well have to do with the fact that these factors differed slightly in the two studies.

In Melbourne, parents scored higher than non-parents on ‘modern technology and media’, ‘physical activity environment’ and ‘lack of physical activity’, while in Calgary,

there were no significant differences between parents and non-parents. This could reflect the possibility that non-parenting Calgaryans are more aware of the potential causes of childhood obesity than those non-parenting Melbournes. Because of the current increasing awareness about childhood obesity in Canada, and its increasing presence in the media relative to Australia in which media coverage of the issue has been more consistent (P. Hawe, personal communication, May 3, 2005), perhaps everyone regardless of parental status is similarly aware of the potential causes of childhood obesity in Canada. Whereas in Australia, because of more consistent media coverage perhaps the interest level of non-parents has declined.

In Melbourne, respondents who were not tertiary educated scored higher on 'modern technology and media', whereas this difference was not found in Calgary. This difference may reflect the fact that those who are tertiary educated in Melbourne may be different than those tertiary educated residents of Calgary. It is possible that the university systems are very different in the two countries and university acceptance is much more competitive in Australia (P. Hawe, personal communication, May 3, 2005). From reviewing academic admission requirements for undergraduate studies in the two countries this explanation seems plausible. For example the University of Melbourne (<http://www.services.unimelb.edu.au/admissions/entrystandards/australian/scores/index.html>) requires an 86% average for entrance to their engineering program whereas the University of Calgary only requires a 78% average (http://www.ucalgary.ca/admissions/fall_2005_current_averages.html). Therefore, it is hard to determine whether tertiary (university degree or higher) and non-tertiary educated people from both countries are comparable at all.

UNIVARIATE ANALYSIS – PREVENTION FACTORS

In this section I will discuss substantial differences between the two studies in individual questionnaire items assessing prevention of childhood obesity. There was widespread consensus about the desirability of several prevention activities in both studies. Specifically, the promotion of healthy eating during children's television viewing; the provision of healthy food at school; obesity prevention strategies that target non obese as well as obese children; regular government-funded healthy eating

campaigns in the mass media; and the highlighting of the energy content of foods on their labels were endorsed by respondents in both studies. All of these prevention activities were even more highly supported by Calgarians. This may reflect differences in the way the scales for the surveys were done. Hardus et al. (2003) made use of a four point Likert scale including not; quite; very; and extremely, whereas the Calgary study used a four point Likert scale including not; not really; somewhat; and very. The slight increased support for the above prevention items may likely reflect such scale differences.

Compulsory daily physical education was not as heavily supported by respondents from Melbourne. This finding may reflect policy differences between the two countries. In Alberta, compulsory physical education became mandated as of January 2005 (CIHI, 2004). Due to this recent event and the media coverage surrounding it, perhaps Calgarians are more aware of the proposed benefits of daily physical education.

CANADA - MELBOURNE DIFFERENCES IN PREVENTION FACTOR SCORES

The factor analyses for prevention items resulted in two factors in each study. The first factors were identical with the exception of this study having one additional loading item. Factor 2 for both studies had to do with children's health promotion but did not have identical loadings.

In Melbourne, women had higher scores on 'Children's health promotion' than did men. In Calgary, there was no significant difference in men and women's rankings of a similar factor 'Media campaigns and compulsory physical education'. As this factor was different in the two studies, this finding may be an artefact of the differing factors. The items loading on Hardus factor 2 may be more heavily supported by women in Calgary as well, but we can't say this as our Factor 2 had different items loading on it.

LIMITATIONS AND RECOMMENDATIONS

This study contributes to the literature by providing a snapshot of views help by a sample of adult Calgarians regarding an important contemporary public health problem: childhood obesity. In this way these results provide guidance to health promotion practitioners and policy makers regarding publicly acceptable leverage points for intervention. However, there were some limitations to this study, which must be

acknowledged. Some study limitations resulted from the fact that the current study was a modified replication. For example, the survey instrument was not our own and was therefore missing some cause/prevention items from our review of the literature, as well as specific cause/prevention items local to Calgary or Canada. It therefore included a select sub set of cause/prevention items and was not necessarily comprehensive. Since the results of factor analysis are only as good as the data one starts with, this limited questionnaire content can obviously have important implications for the results. Additionally, the survey instrument has no reported psychometric properties, making it impossible to comment on the validity or reliability. We attempted to assess reliability with our limited sample (n=8) and found that only 10 of out 38 (26%) questionnaire items had test-retest correlations greater than 0.7. Our very limited assessment of this property indicated that reliability of the instrument may be a concern. The people surveyed represented a convenience (i.e. non probability) sample and therefore results may not be generalized because we do not know of what population this sample is representative. It is likely that respondents were a unique subset of the population characterized by an interest in the topic and who had the time to participate. Finally, the sample size of the study (n=264) did not meet our projected goal of 300, and therefore we may have had insufficient statistical power for some analysis based on factor analysis.

As for future research suggestions, a larger more comprehensive version of this study, which would include more cause/prevention items as to cover the entire spectrum of potential causes and prevention items would be valuable. As mentioned, results of this type of survey are constrained by the content included in the items. In order to get an accurate view of public perceptions, a more comprehensive instrument - with established psychometric properties - is needed. As the study can be easily replicated, it would also be valuable to have this study replicated in other cities across Canada, or perhaps engage a pilot project that addresses the most highly supported prevention items. Finally, it would be valuable to collect this data repeatedly, perhaps as part of a surveillance tool, in order to evaluate trends in public opinion over time.

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APPENDIX A: ETHICS APPROVAL



FACULTY OF MEDICINE | UNIVERSITY OF CALGARY

2004-12-08

Dr. A. Vollman
Department of Community Health Sciences
Calgary, Alberta

OFFICE OF MEDICAL BIOETHICS

Room 93, Heritage Medical Research Bldg
3330 Hospital Drive NW
Calgary, AB, Canada T2N 4N1
Telephone: (403) 220-7990
Fax: (403) 283-8524
Email: omb@ucalgary.ca

Dear Dr. Vollman:

RE: Childhood Obesity: Perceptions of the Calgary Public
Grant-ID: 18145
MSc Student: M. Potestio

The above-noted proposal, including the Information/Invitation Letter and Survey, have been submitted for Committee review and found to be ethically acceptable.

Please note that this approval is subject to the following conditions:

- (1) access to personal identifiable health information was not requested in this submission;
- (2) a copy of the informed consent form must have been given to each research subject, if required for this study;
- (3) a Progress Report must be submitted by 2005-12-08, containing the following information:
 - i. the number of subjects recruited;
 - ii. a description of any protocol modification;
 - iii. any unusual and/or severe complications, adverse events or unanticipated problems involving risks to subjects or others, withdrawal of subjects from the research, or complaints about the research;
 - iv. a summary of any recent literature, finding, or other relevant information, especially information about risks associated with the research;
 - v. a copy of the current informed consent form;
 - vi. the expected date of termination of this project.
- (4) a Final Report must be submitted at the termination of the project.

Please note that you have been named as a principal collaborator on this study because students are not permitted to serve as principal investigators. Please accept the Board's best wishes for success in your research.

Yours sincerely,

Christopher J. Doig, MD, MSc, FRCPC

Chair, Conjoint Health Research Ethics Board

CJD/km

c.c. Adult Health Research Committee Dr. T. Noseworthy (information) Research Services Ms. M. Potestio (MSc Student)
Information and Privacy Office

APPENDIX B: PERMSSION TO REPLICATE THE STUDY

Melissa,

I've attached a copy of the brief survey we developed. The final make-up and format of the instrument (i.e. 4 point scale) was based on quite a bit of field pilot test work that was conducted. Our aim was to develop an easy to answer questionnaire that could be completed in about 5 minutes. We ran the study in a shopping mall using a convenience sample, mostly because we had no money to do this particular study. Essentially we were aiming to get hold of a large group of people of mixed backgrounds quickly and cheaply (we ran the study for about \$300) and the shopping mall approach served our purpose. A random population survey (postally administered) would have been ideal to make the findings more population representative, but that is usually a more expensive option. In replicating this work you might want to ensure that you ask about potential prevention strategies that have been mooted in your part of the world. Apart from that, I would not change much about the study.

Best of luck with your study. Tony and I would be interested to see your results.

Cheers

David

Sept 17, 2004

At 11:17 AM 16/09/2004 -0700, you wrote:

>Dr. Crawford,
>
>
>Hi my name is Melissa Potestio and I am graduate student in the Department
>of Community Health Sciences in the Faculty of Medicine at the
>University of Calgary in Alberta, Canada. I am in the process of writing my
>master's proposal and hope to do a modified replication of one your very
>innovative studies. Among all the papers I have read on the topic of
>childhood obesity I found this paper to be of particular interest.
>
>"Public perceptions of the causes and prevention of obesity among primary
>school children"
>
>International Journal of Obesity (2003) 27, 1465-1471
>

>I was hoping you would be able to discuss some of the details of your study
>with me. For example I am interested in why the use of a four point likert
>scale was chosen over a five point scale, or why the use of a mall as
>opposed to another venue. Additionally, I would like to get a copy of the
>original survey instrument that was used in the study.

>

>I would also be very interested in hearing about any limitations in the
>study, or if you would do anything differently if you replicated the study.

>

>I would really appreciate any time you may have to correspond with me.
>Please note I did try and contact Dr. Worsely who was listed the person to
>correspond with, but I got a return email saying he is away until February
>2005.

>

>Thank you for your time,

>

>Sincerely

>

>Melissa Potestio

APPENDIX C: SURVEY COVER LETTER

TITLE: Childhood Obesity: Perceptions of the Calgary Public

WHAT IS THE PURPOSE OF THE STUDY?

This study is going to help researchers answer the question: What are the public perceptions among Calgarians of the causes and consequences of obesity among children in grades K to 6? Participating in this study will help researchers canvass Calgary's views regarding the causes of childhood obesity and the most appropriate strategies for preventing it. An understanding of public views is important to determine the likely level of community support for preventive initiatives and to identify where there is a need to educate the public about childhood obesity. The identification of where Calgarians currently are on the issue of childhood obesity is a critical first step before any prevention or intervention strategies can be developed.

INVESTIGATORS:

Ardene Robinson Vollman, RN PhD, Adjunct Associate Professor
avollman@shaw.ca 239-3180

Lindsay McLaren, PhD, Centre for Health and Policy Studies

P.K. Doyle Baker, PhD, Department of Kinesiology

Melissa Potestio, MSc student, BSc (Kinesiology)

WHAT WOULD I HAVE TO DO?

Your participation will involve filling out the survey on the attached pages which will take approximately 3-5 minutes of your time.

WILL MY SURVEY BE KEPT PRIVATE?

The investigators listed above will be the only individuals who have access to information collected by the survey. In addition all information and/or data collected will not have your name attached. We will keep individual comments confidential and only report findings on an aggregated level.

Please note that by filling out and returning this survey you are giving consent for your participation. However, your participation in this survey is voluntary and you may withdraw at any time.

If you have any questions concerning your rights as a possible participant in this research, please contact Pat Evans, Associate Director, Internal Awards, Research Services, University of Calgary, at 220-3782

APPENDIX D: THE SURVEY

CHILDHOOD OBESITY – YOUR VIEWS?

In your view how important are each of the following as causes of obesity in children in grades K to 6.

HOW IMPORTANT?

(Circle one)

Genes.....	NOT	NOT REALLY	SOMEWHAT	VERY
Children don't know about the dangers of obesity.....	NOT	NOT REALLY	SOMEWHAT	VERY
Children don't care about eating healthy	NOT	NOT REALLY	SOMEWHAT	VERY
Children don't care about being physically active.....	NOT	NOT REALLY	SOMEWHAT	VERY
Parents aren't aware of the dangers of obesity	NOT	NOT REALLY	SOMEWHAT	VERY
Parents don't care about eating healthy	NOT	NOT REALLY	SOMEWHAT	VERY
Parents don't care about being physically active.....	NOT	NOT REALLY	SOMEWHAT	VERY
Parents don't know how to promote physical activity	NOT	NOT REALLY	SOMEWHAT	VERY
Parents don't know how to promote healthy eating	NOT	NOT REALLY	SOMEWHAT	VERY
Lack of physical activity at school.....	NOT	NOT REALLY	SOMEWHAT	VERY
Lack of physical activity outside school	NOT	NOT REALLY	SOMEWHAT	VERY
There is an over emphasis on academic work	NOT	NOT REALLY	SOMEWHAT	VERY
Eating too many high fat foods at school.....	NOT	NOT REALLY	SOMEWHAT	VERY
Eating too many high fat foods at home	NOT	NOT REALLY	SOMEWHAT	VERY
Children have too much money to spend on unhealthy food.....	NOT	NOT REALLY	SOMEWHAT	VERY
Eating over-sized servings of foods.....	NOT	NOT REALLY	SOMEWHAT	VERY
Over-consumption of fast foods.....	NOT	NOT REALLY	SOMEWHAT	VERY
Media promotion of unhealthy foods	NOT	NOT REALLY	SOMEWHAT	VERY
Eating in front of the TV.....	NOT	NOT REALLY	SOMEWHAT	VERY
Watching too much television.....	NOT	NOT REALLY	SOMEWHAT	VERY
Modern technology (e.g., cars, computers, video games).....	NOT	NOT REALLY	SOMEWHAT	VERY
Lack of safe cycling and walking paths.....	NOT	NOT REALLY	SOMEWHAT	VERY
Lack of other safe places to be physically active.....	NOT	NOT REALLY	SOMEWHAT	VERY
Healthy foods are expensive	NOT	NOT REALLY	SOMEWHAT	VERY
Healthy foods often aren't available	NOT	NOT REALLY	SOMEWHAT	VERY

In your view how important are these measures for the prevention of obesity in children in grades K to 6

Obesity prevention actions should be directed to all children.....	NOT	NOT REALLY	SOMEWHAT	VERY
Obesity prevention actions should only be directed to children who are overweight but not yet obese	NOT	NOT REALLY	SOMEWHAT	VERY
More healthy foods should be served in schools.....	NOT	NOT REALLY	SOMEWHAT	VERY
Daily physical education in school should be compulsory	NOT	NOT REALLY	SOMEWHAT	VERY
Healthy eating should be promoted on children's TV	NOT	NOT REALLY	SOMEWHAT	VERY
Advertising of high fat foods should be banned during children's viewing hours	NOT	NOT REALLY	SOMEWHAT	VERY
High fat foods should have an additional 5% tax.....	NOT	NOT REALLY	SOMEWHAT	VERY
Give 5% tax incentives to manufacturers of healthy food.....	NOT	NOT REALLY	SOMEWHAT	VERY
The government should build more safe cycling and walking tracks	NOT	NOT REALLY	SOMEWHAT	VERY
The food industry should reduce the portion sizes of take out foods.....	NOT	NOT REALLY	SOMEWHAT	VERY
Food labels should highlight the calorie/kilojoule content of foods	NOT	NOT REALLY	SOMEWHAT	VERY
Children should spend no more than 1 hour a day watching TV or playing computer games.....	NOT	NOT REALLY	SOMEWHAT	VERY
The government should run regular healthy eating and physical activity campaigns in the mass media	NOT	NOT REALLY	SOMEWHAT	VERY

Are you (circle): Male / Female

What is your age (circle one answer)

1. 18 – 30 years
2. 31 – 40 years
3. 41 – 50 years
4. 51 – 65 years
5. Over 65 years

What is your current height?

_____ Ft _____ inches

or _____ cm

Have you/Are you raising any children?

1. No
2. Yes

What is your current weight?

_____ Lbs or _____ Kg

What is your highest education level (circle one answer)?

1. Primary school
 2. Some high school
 3. Completed High school
 4. Some Technical or Trade School
 5. Some Community College
 6. Completed Technical or Trade School
 7. Completed Community College
 8. Some University
 9. Completed Bachelors Degree (BSc, BA, etc)
 10. Completed Post Graduate Master's, PhD, or Professional Degree
-

If you are willing to be contacted either by phone or email to take this survey again in two weeks, please provide us with a first name and contact information.

Name: _____ Phone Number _____ or Email _____

Thanks for helping!

APPENDIX E: ASSESSING ASSUMPTIONS

NORMALITY

Since PCA is used descriptively here as a convenient way to summarize relationships in a large set of observed variables, assumptions regarding the distributions of variables are not in force (Tabachnick and Fidell, 2001). If variables are normally distributed, the solution is enhanced. To the extent that normality fails, the solution is degraded but may still be worthwhile (Tabachnick and Fidell, 2001).

However, multivariate normality is assumed when statistical inference is used to determine the number of factors. Multivariate normality is the assumption that all variables, and all linear combinations of variables, are normally distributed. Although tests of multivariate normality are overly sensitive, normality among single variables is assessed by skewness and kurtosis (Tabachnick and Fidell, 2001). Skewness has to do with the symmetry of the distribution; a skewed variable is a variable whose mean is not the center of the distribution. Kurtosis has to do with the peakedness of a distribution; a distribution is either too peaked (with short, thick tails) or too flat (with long, thin tails) (Tabachnick and Fidell, 2001).

We assessed the normality of our continuous variable BMI by looking at a histogram and by examining significance tests for both skewness and kurtosis.

There are significance tests for both skewness and kurtosis that test the obtained value against null hypotheses of zero.

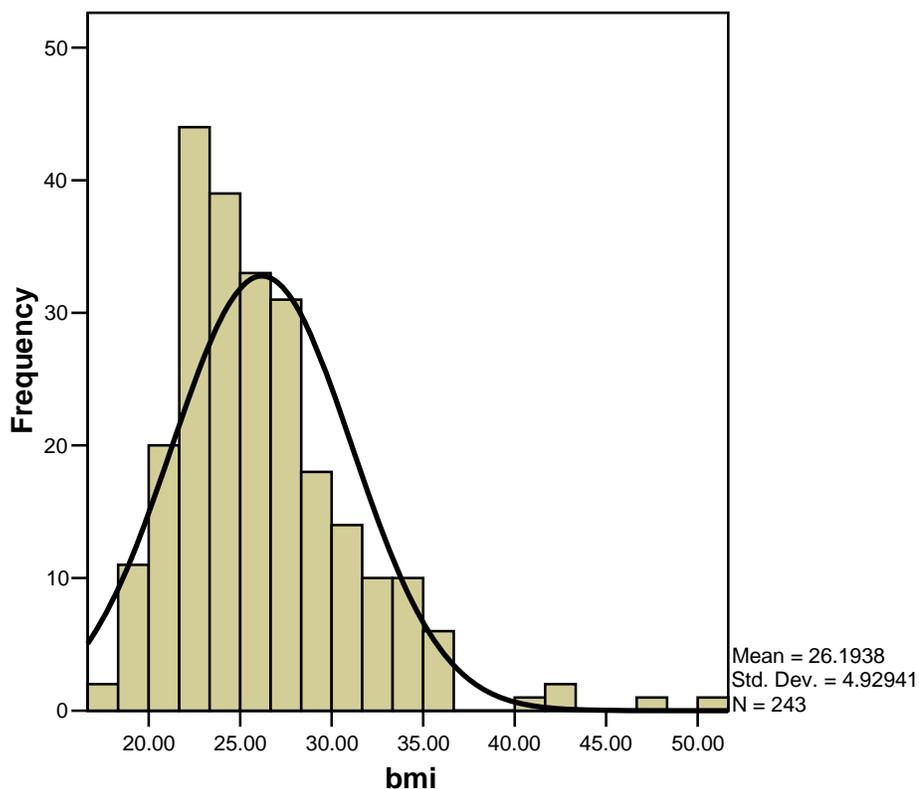
$$1. \text{ Skewness } Z = \frac{S-0}{S_s} \qquad 2. \text{ Kurtosis } Z = \frac{K-0}{S_k}$$

However, with large samples it is a good idea to look at the shape of the distribution instead of using formal inference tests. Because the standard error for both skewness and kurtosis decrease with larger N, the null hypothesis is likely rejected with large samples when there are only minor deviations from normality (Tabachnick and Fidell, 2001). In a

large sample, a variable with statistically significant skewness often does not deviate enough from normality to make a substantive difference in the analysis. In other words, with large samples, the significance level of skewness is not as important as its actual size (worse the farther from zero) and the visual appearance of the distribution. In a large sample, the impact of departure from zero kurtosis also diminishes. For example, underestimates of variance associated with positive kurtosis disappear with samples of 100 or more cases; with negative kurtosis, underestimation of variance disappears with samples of 200 or more (Tabachnick and Fidell, 2001).

As a result of the above, we will interpret the significance tests for both skewness and kurtosis with caution, and will use the tests as only one criteria in judging any distributions throughout the analysis.

Histogram of Frequency of Respondents BMI



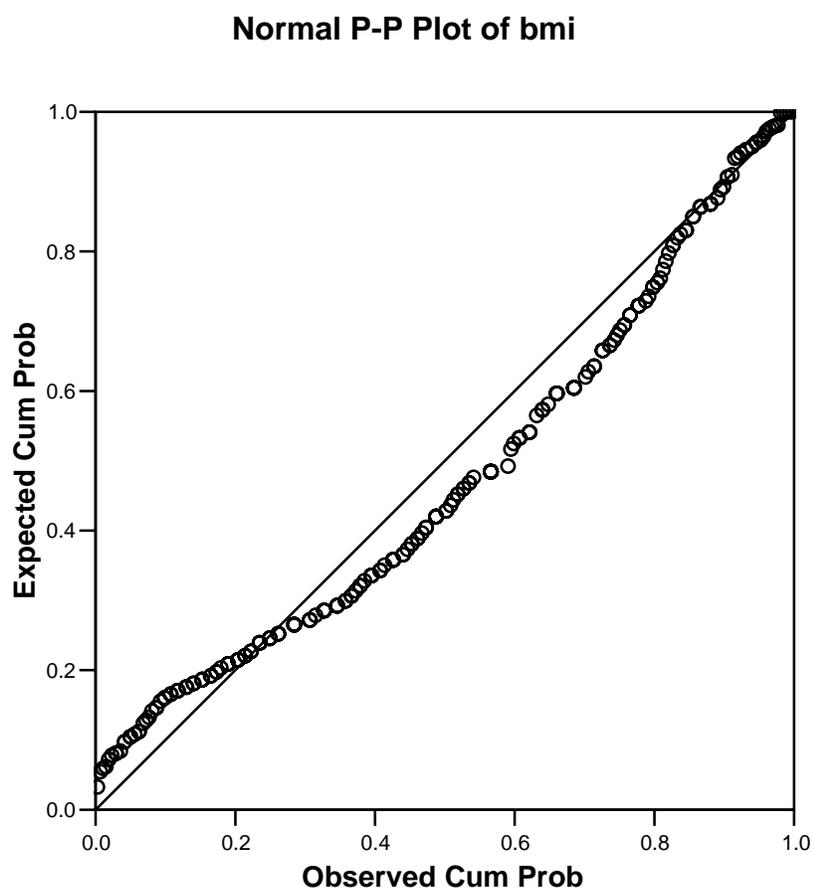
The distribution of BMI indicates that there is positive skewness, as there is a pileup of cases to the left and the right tail is quite long.

The corresponding skewness = 1.410 with a standard error of .156 and Kurtosis = 3.552 with a standard error = .311. Using equations 1 and 2 from above, the distribution does have statistically significant skewness ($z = 9.04$) and significant kurtosis ($z = 11.42$). However again, the way in which BMI was used as a categorical variable in the analysis negates any concern about the deviations from normality.

In addition to frequency histograms normal probability plots and de-trended expected normal probability plots can be used to assess normality. In these plots, the scores are ranked and sorted; then an expected normal value is computed and compared with the

actual normal value for each case. The expected normal value is the z-score that a case with that rank holds in a normal distribution; the normal value is the z-score it has in the actual distribution. If the actual distribution is normal, the points for the cases fall along the diagonal running from lower left to upper right, with some minor deviations due to random process. Deviations away from normality shift the points away from the diagonal (Tabachnick and Fidell, 2001).

The normal probability plot again indicated a slight positive skewness to the distribution



LINEARITY

The assumption of linearity is that there is a straight-line relationship between two variables (where one or both of the variables can be combinations of several variables). Linearity is important in a practical sense because Pearson's r only captures the linear relationship among variables; if there are substantial nonlinear relationships among variables, they are ignored (Tabachnick and Fidell, 2001). It is not necessary to assess linearity with this data, as we are working with categorical variables.

MULTICOLINEARITY AND SINGULARITY

Multicollinearity and singularity are problems with a correlation matrix that occur when variables are too highly correlated. With multicollinearity, the variables are very highly correlated; with singularity, the variables are redundant; one of the variables is a combination of two or more of the other variables (Tabachnick and Fidell, 2001). In PCA, multicollinearity and singularity are not a problem because there is no need to invert a matrix (Tabachnick and Fidell, 2001). However, for estimation of factor scores in any form of FA, singularity or extreme multicollinearity is a problem. To investigate further, we looked at SMCs for each variable where it serves as DV with all other variables as IVs. If any of the SMCs is one, singularity is present; if any of the SMCs is very large (near one), multicollinearity is present (Tabachnick and Fidell, 2001). There were no indications of multicollinearity or singularity.

HOMOSCEDASTICITY

For ungrouped data, the assumption of homoscedasticity is that the variability in scores for one continuous variable is roughly the same at all values of another continuous variable (Tabachnick and Fidell, 2001). Again, our data does not allow us to assess this assumption as it is categorical variables.

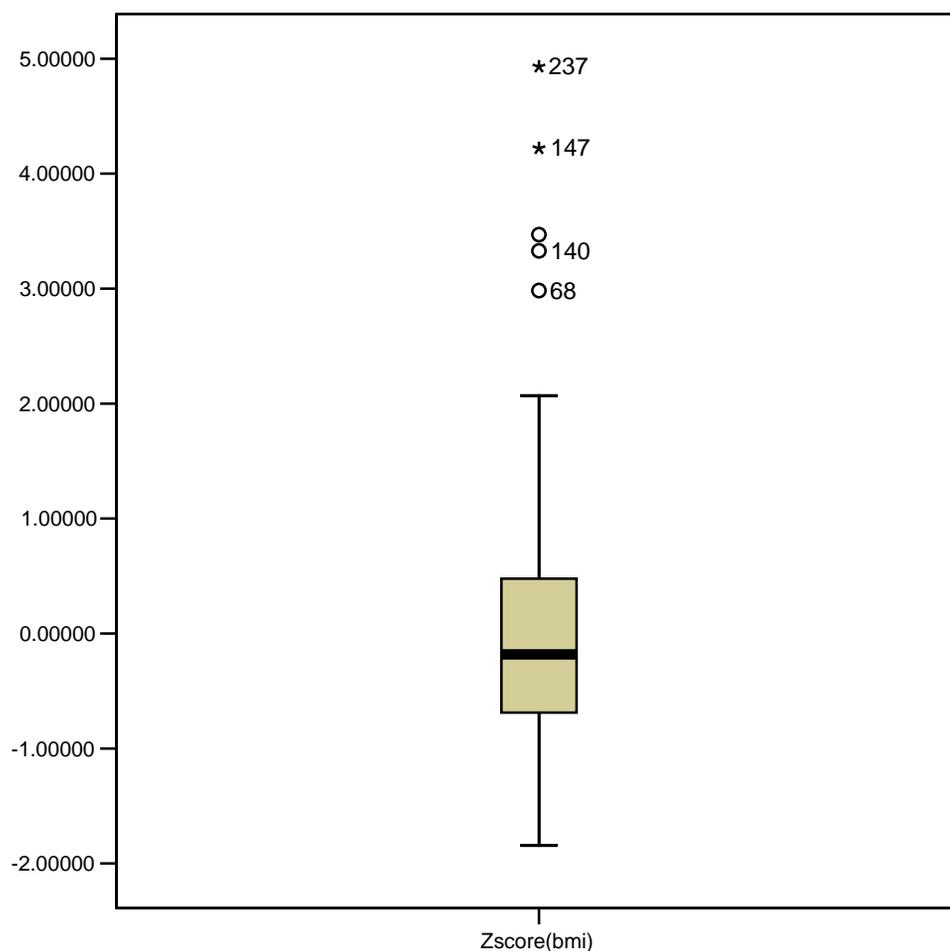
APPENDIX F: OUTLIERS

UNIVARIATE OUTLIERS

An outlier is a case with such an extreme value on one variable (a univariate outlier) or such a strange combination of scores on two or more variables (multivariate outlier) that they distort statistics (Tabachnick and Fidell, 2001).

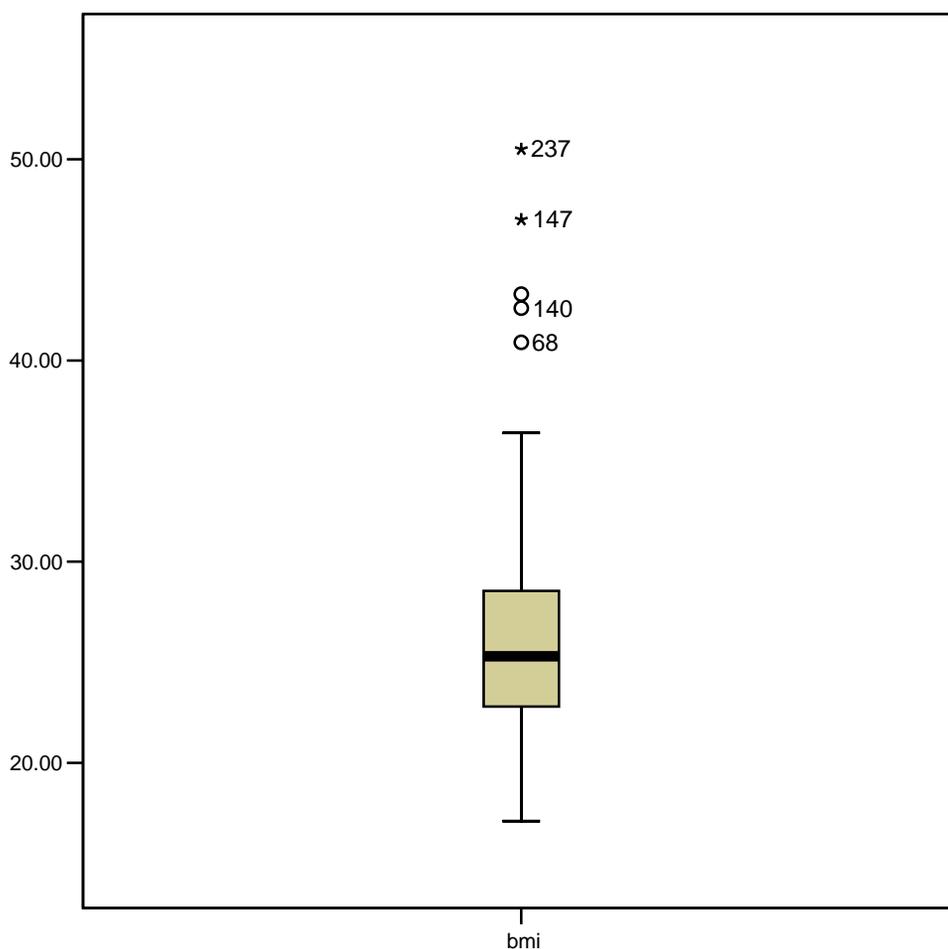
Among continuous variables, univariate outliers are cases with very large standardized scores, z scores, on one or more variables, that are disconnected from other z-scores. Cases with standardized scores in excess of 3.29 ($p < 0.001$, two-tailed test) are potential outliers (Tabachnick and Fidell, 2001).

The primary variable to be at risk for univariate outliers in the present study is BMI, since responses to all other questions was constrained by the categories provided. For example, respondents indicated their education level as falling into a particular category, so there was no opportunity for outlying values to be reported. To examine for potential univariate outliers in BMI standardized z-scores were calculated. Subsequently these z-scores were displayed in a box-plot.



The above box-plot of standardized z-scores for BMI indicates that there are four z-scores above 3.29 indicating potential outliers. Extreme outliers are indicated for two of the standardized z scores including respondent 147 with z-score = 4.22 and a corresponding BMI = 47.0 kg/m² and respondent 237 with a z-score = 4.93 and a BMI = 50.5 kg/m²

As an alternative or in addition to inspection of z-scores, there are graphical methods for finding univariate outliers. Below is a box-plot of BMI which indicated 5 outliers with 2 of these categorized as extreme.



The outliers were checked to make sure that they were accurately entered into the data file. These outliers were determined to be a legitimate part of the sample. If analyses were based on BMI as a continuous variable, then it might be warranted to delete or reduce the impact of these outliers. However, since BMI will be converted into a categorical variable for analysis these outliers will not distort the results of the analysis, as both large BMI's will be categorized as part of the obese category. Therefore we will leave these values as is.

All the other variables in this analysis are categorical and therefore a quick check of frequencies for each variable was done to ensure there were no outliers (which would probably reflect inaccurate data entry). No instances of outliers on these other variables were detected.

MULTIVARIATE OUTLIERS

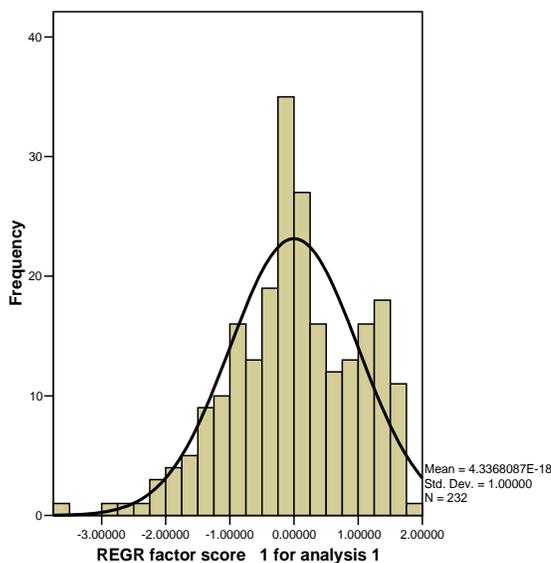
One statistic used to identify multivariate outliers is Mahalanobis distance. Mahalanobis distance is the distance of a case from the centroid of the remaining cases where the centroid is the point created at the intersections of the means of all variables (Tabachnick and Fidell, 2001). A very conservative probability estimate for a case being an outlier, say, $p < .001$ for the χ^2 value, is appropriate with Mahalanobis distance. Mahalanobis distance is evaluated as χ^2 with degrees of freedom equal to the number of variables, in this case 3. Any case with a Mahalanobis distance in Table 4.8 greater than $\chi^2(3) = 16.27$ (cf. Appendix C, Table C.4) then, is a multivariate outlier (Tabachnick and Fidell, 2001). Cases identified as multivariate outliers may or may not be considered univariate outliers.

This resulted in two cases, 147 and 237, being identified as multivariate outliers. These were the same cases that were identified as univariate outliers. Again the data for the cases were checked to make sure they were accurately entered into the data file. The cases were identified as having very large BMI's but were properly part of the population from which we intended to sample. These cases had no pattern between them besides both having large BMIs. Again, since BMI was not used as a continuous variable, but rather, converted to a categorical variable, the influence of these two cases is already reduced, as they will simply become part of the obese weight category.

APPENDIX G: ASSESSING CAUSE FACTOR SCORE DISTRIBUTIONS

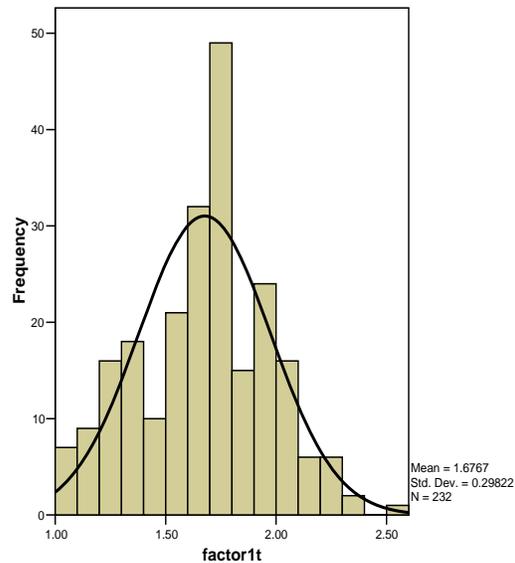
Factor 1

Histogram of untransformed Factor 1



Skewness: $z = -2.41$
Kurtosis: $z = 0.48$

Histogram of Transformed Factor 1

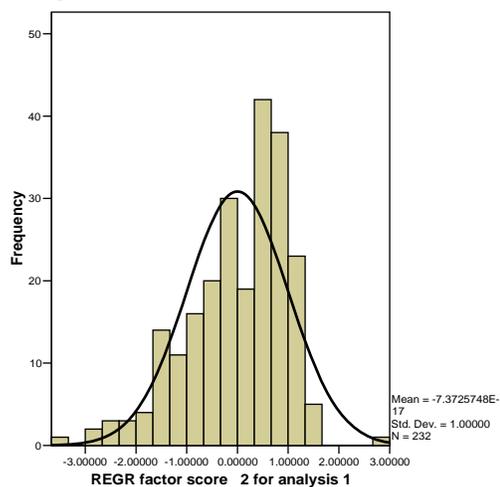


Skewness: $z = -0.47$
Kurtosis $z = -1.11$

The above calculation indicated that the factor 1 score distribution is significantly skewed. Although statistically significant, the degree of skewness is relatively small. However, a reflect and square root transformation was attempted with factor 1. The transformation did result in factor 1 scores having a normal distribution, and the rest of the analysis will make use of this new transformed variables.

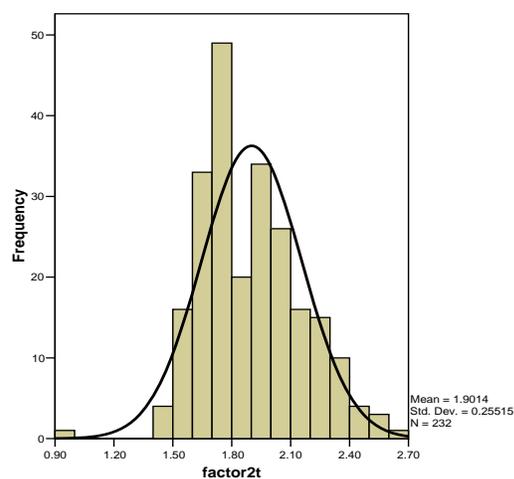
Factor 2

Histogram of untransformed Factor 2



Skewness: $z = -4.84$
Kurtosis: $z = 1.31$

Histogram of transformed Factor 2

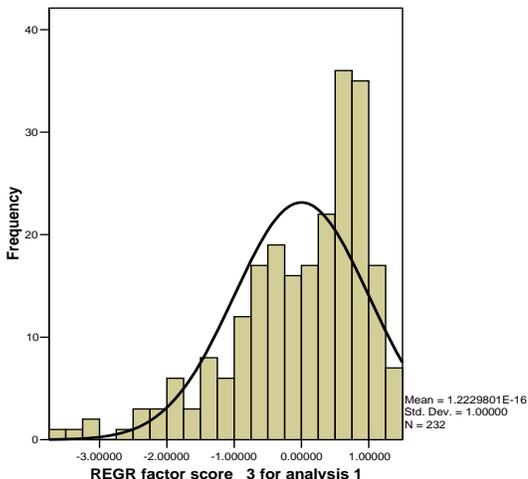


Skewness: $z = 2.46$
Kurtosis $z = 0.68$

The above calculation indicated that the factor 2 scores distribution is significantly skewed. Although statistically significant, the degree of skewness is relatively small. However, a reflect and square root transformation was attempted with factor 2. The transformation did not result in factor 2 scores having a normal distribution, and the rest of the analysis will make use of the untransformed variable.

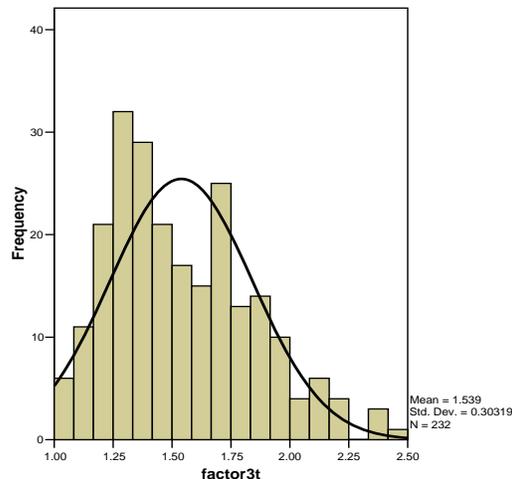
Factor 3

Histogram of untransformed Factor 3



Skewness: $z = -6.88$
 Kurtosis: $z = 3.42$

Histogram of transformed Factor 3

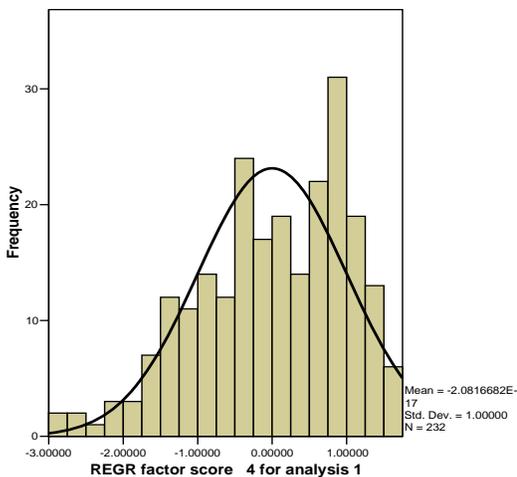


Skewness: $z = 4.14$
 Kurtosis $z = -0.10$

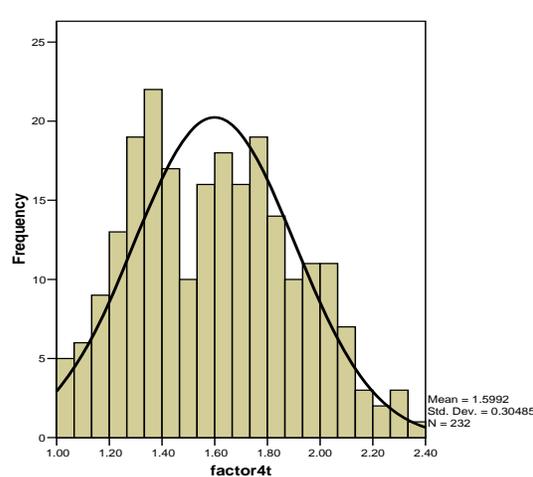
The above calculation indicated that the factor 3 scores distribution is significantly skewed. Although statistically significant, the degree of skewness is relatively small. However, a reflect and square root transformation was attempted with factor 3. The transformation did not result in factor 3 scores having a normal distribution, and the rest of the analysis will make use of the untransformed variable.

Factor 4

Histogram of untransformed Factor 4



Histogram of transformed Factor 4

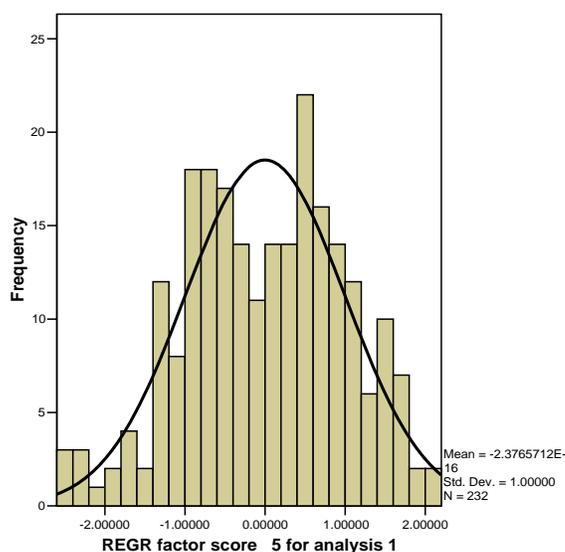


Skewness: $z = -3.51$
 Kurtosis: $z = -1.01$

Skewness: $z = 1.34$
 Kurtosis $z = -2.26$

The above calculation indicated that the factor 4 scores distribution is significantly skewed. Although statistically significant, the degree of skewness is relatively small. However, a reflect and square root transformation was attempted with factor 2. The transformation of factor 4 scores did not result in a normal distribution. The transformation did improve skewness but actually worsened kurtosis. As a result, the untransformed factor 4 scores will be used in further analysis.

Factor 5



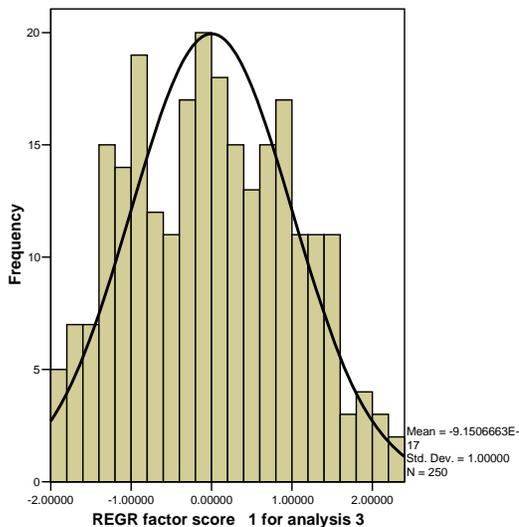
Skewness $z = -1.10$
 Kurtosis $z = -1.50$

Factor 5 scores were normally distributed as indicated by the values above. Therefore, the rest of the analysis will make use of the untransformed factor 5 scores.

APPENDIX H: ASSESSING PREVENTION FACTOR SCORE DISTRIBUTIONS

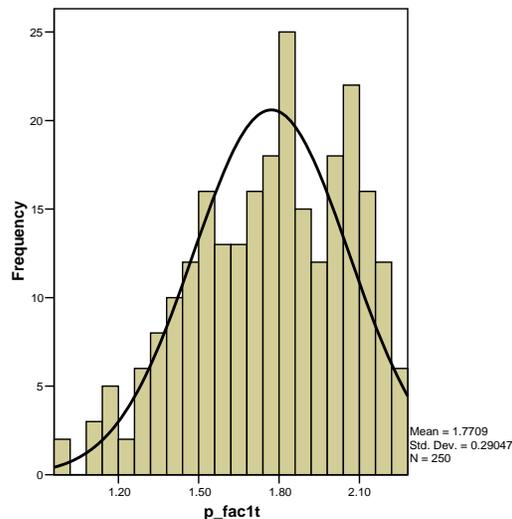
Prevention Factor 1

Histogram of Prevention Factor 1 scores



Skewness: $z = .526$
 Kurtosis: $z = -2.77$

Histogram of transformed Prevention Factor 1

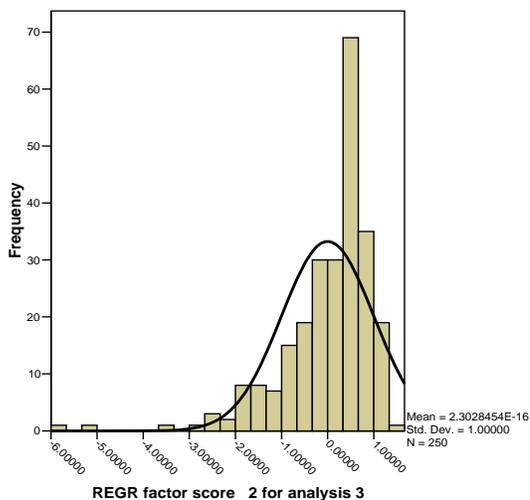


Skewness: $z = 2.59$
 Kurtosis $z = -1.73$

The above calculations indicated that the prevention factor 1 scores distribution has significant kurtosis. Although statistically significant, the degree of kurtosis is relatively small. However, a reflect and square root transformation was attempted with this variable. The transformation resulted did not improve the normality of the distribution and in fact made it worse. As a result, the variable was used in its untransformed state for the following comparisons

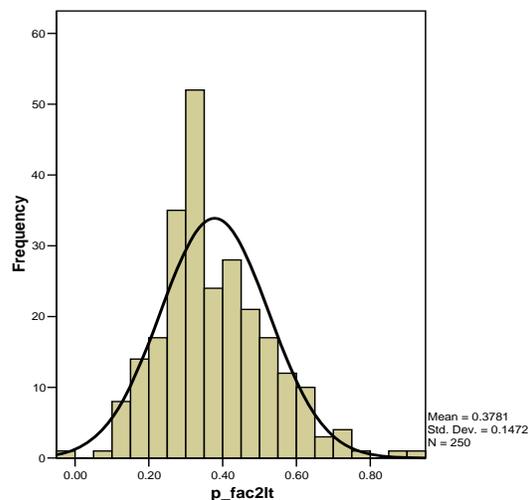
Prevention Factor 2

Histogram of Prevention Factor 2 scores



Skewness: $z = -13.68$
 Kurtosis: $z = 24.45$

Histogram of logarithmically transformed Prevention Factor 2 scores



Skewness: $z = 4.15$
 Kurtosis $z = 2.19$

The above calculations indicated that distribution of prevention factor 2 scores was significantly negatively skewed and also had significant kurtosis. Initially, a reflect and square root transformation was attempted (not shown) but resulted in no major improvements in the distribution. Secondly, a reflect and logarithmic transformation was performed and resulted in the above. The calculations above indicated that the reflect and logarithmically transformed variables still has significant positive skewness and significant kurtosis. Therefore, further analysis will make use of the untransformed variable.