Mentors in Motion:
A physical activity intervention for obese adolescents

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ABSTRACT

Childhood overweight and obesity has become a significant health concern worldwide. Obese youth are now being diagnosed with health complications and chronic diseases previously observed only among older adults. In order to improve their health and decrease their risk of premature mortality, secondary prevention is essential. To help guide development of an effective intervention program for obese youth referred to specialized clinical care, a chart review was conducted on adolescents seeking physician treatment for obesity. Data indicate that this patient population suffers from obesity-related health complications, faces social issues and exhibits lifestyle practices predisposing them to weight gain. Given that physical inactivity is one major risk factor for obesity in this population, a logic model and training module have been developed for a physical activity intervention program, with nutrition interventions to soon be incorporated. This program, called Mentors in Motion, provides mentoring to obese youth as a means of enabling positive changes in physical activity behaviors, mental well-being and overall health. A pilot study research protocol was also developed as part of the thesis activity to test the effectiveness of Mentors in Motion and to determine further program needs and enhancements. The pilot study has been funded by the Canadian Institutes for Health Research and is underway.

RÉSUMÉ

L'obésité familiale est devenue une préoccupation majeure à l'échelle mondaile. Les jeunes obèses sont maintenant diagnostiqués avec des maladies chroniques auparavant retrouvées seulement chez les adultes. Afin d'améliorer leur santé et de diminuer leurs risques de mortalité précoce, la prévention secondaire devient essentielle. Pour guider le développement d'un programme d'intervention efficace pour les jeunes obèses référés en cliniques de soins spécialisés, une revision de dossiers fût menée auprès d'adolescents bénéficiants de traitements pour l'obésité. Les données indiquent que cette population de patients souffre de complications de la santé reliées à l'obésité, fait face à des problèmes sociaux et pratique un style de vie prédisposant à la prise de poids. Étant donné que l'inactivité physique constitue un risque majeur pour l'obésité dans cette population, un modèle logique ainsi qu'un module d'entraînement ont été développés pour un programme d'intervention en activité physique, avec les interventions nutritionnelles seront incorporées dans le programme. Ce programme, Mentors en Mouvement, fourni un mentorat aux jeunes obèses dans le but de les amener à effectuer des changements positifs de leurs habitudes d'activité physique, ainsi qu'au niveau de leur bien-être et santé générale. Un protocole d'étude pilote a aussi été développé comme partie intégrante de l'élaboration d'une thèse, afin de tester l'efficacité de Mentors in Montion et de déterminer les besoins et amélorations éventuelles à apporter au programme. Cette étude pilote a été subventionné par l'Instituts de recherche en santé du Canada et est présentement en cours.

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PERSONAL CONTRIBUTIONS

Graduate student Carrie Markin's contribution to the development of the thesis represents a largely independent and self-directed project. Her contributions to the Mentors in Motion project include: conception of the program design and program name; initiation of the collaboration with Big Brothers Big Sisters of Greater Montreal; co-creation of the mentor training module; and with guidance from Dr. Egeland, development of a research protocol that was submitted to the Canadian Institutes for Health Research and awarded funding under the strategic initiative "Excellence, Innovation and Advancement in the Study of Obesity and Healthy Body Weight - Operating and Pilot Project Grants in Childhood Obesity ". Originally, data from the Mentors in Motion pilot study were to be available for analysis and interpretation for Ms. Markin's thesis. However, due to several delays in the Montreal Children's Hospital ethics review, as well as financial and logistical constraints, the study has not sufficiently progressed for results to be incorporated into the thesis. The research protocol now forms a chapter of the thesis, and the pilot study is currently underway (Refer to Appendices B-D).

OTHER CONTRIBUTIONS

The development, inception and research of Mentors in Motion would not have been possible without contributions from: Dr. Grace Egeland (collaboration and research protocol development); Dr. Laurent Legault (collaboration and research protocol development); Dr. Margaret Cargo (collaboration, program logic model and research protocol development); Diane Laforte (collaboration and research protocol development); and Ginette Sauvé & the staff at Grands Frères Grandes Soeurs du Grand Montréal (collaboration and development of the program logic model, mentor training module and seed funding).

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ABBREVIATIONS

AN	acanthosis nigricans
BBBSGM	Big Brothers Big Sisters of Greater Montreal
BG	blood glucose
BMI	body mass index
CDC	Centres for Disease Control and Prevention
CMA	census metropolitan area
DM	diabetes mellitus
HDL-C	high-density lipoprotein cholesterol
IOTF	International Obesity TaskForce
LDL-C	low-density lipoprotein cholesterol
MCH	Montreal Children's Hospital
MIM	Mentors in Motion
OGTT	oral glucose tolerance test
PA	physical activity
PCOS	polycystic ovary syndrome
SCT	social cognitive theory
SDT	social determination theory
SMART	specific, measurable, attainable, realistic, timely
TG	triglycerides
total-C	total cholesterol
US	United States
WHO	World Health Organization

1.0 INTRODUCTION

The prevalence of childhood overweight and obesity has reached significant proportions in Canada as in other countries worldwide. Secular trends suggest an increase in the prevalence of overweight/obesity in Canadian youth over the previous two decades (Tremblay & Willms, 2000), and most recent data indicate that nearly 20% of Canadian youth 11-16 years old are considered overweight or obese (Janssen *et al.*, 2004).

Childhood overweight/obesity is a health condition that arises from the interaction of genetic and environmental determinants (Davison & Birch, 2001; Lobstein *et al.*, 2004). While genetics may pre-determine the distribution and percent range of body fat for a child, social influences, such as food accessibility, quality of physical education programs and parent nutrition and physical activity habits, collectively affect the lifestyle practices and body weight of youth.

Overweight and obese youth not only face social derision but also health complications such as high blood pressure and impaired insulin response (McMurray *et al.*, 1995; Sinaiko *et al.*, 2001; Eisenberg & Neumark-Sztainer, 2003). They are also at high risk of remaining overweight into adulthood (Guo *et al.*, 1994), where they are likely to live in social isolation and poverty (Sarlio-Lahteenkorva & Lahelma, 1999) and develop long-term health complications, including type 2 diabetes mellitus (DM) and cardiovascular disease (Srinivasan *et al.*, 1996; Dietz, 1998; Rosenbloom *et al.*, 1999). It is apparent that secondary prevention is imperative to minimizing the current and future impact of obesity on the health and well-being of obese youth.

Obese adolescents and their families often seek treatment from a physician, yet despite counseling, these youth often struggle to successfully manage their weight (Yanovski & Yankovski, 2003; Saelens *et al.*, 2002). Adolescents referred to multidisciplinary obesity intervention programs have been successful in losing weight (Owens *et al.*, 1999; Braet *et al.*, 2003; Gately *et al.*, 2000); however, these programs require considerable financial and professional resources. In addition, these interventions have yet to prove long-term success in facilitating permanent improvements

in adiposity and related health risks factors (Ferguson *et al.*, 1999; Braet *et al.*, 2003; Gately *et al.*, 2000).

Numerous affordable and convenient weight management resources are available in the community; however, they may not address the social, skill and resource barriers experienced by obese adolescents (Zabinski *et al.*, 2003). They may also fail to ensure safe weight management in this high-risk population. If obese youth are to successfully manage their weight in the long term and decrease risk of health complications and premature mortality, the development of accessible, affordable and effective obesity intervention programs is essential.

2.0 LITERATURE REVIEW

2.1 Measuring Adiposity in Youth

The body composition of youth can be evaluated in several ways. Direct methods of assessment include magnetic resonance imaging, bioelectrical analysis, computerized tomography and dual-energy absorptiometry. However, in a clinic setting and for population studies, more convenient and less-invasive relative indices of adiposity are utilized. These measurements, including skin fold thickness, waist circumference, hip-to-waist ratio, weight, weight-for-height and body mass index (BMI), are then compared to classification criteria for overweight/obesity (Goran, 1998; Lobstein *et al.*, 2004).

2.2 Defining Childhood Overweight and Obesity

Of the relative indices for body fatness in youth, BMI, a measure of weight in kilograms divided by height in metres squared (kg/m^2), is the most widely used and accepted (Lobstein *et al.*, 2004). Several reference standards for BMI cut-offs for overweight and obesity in youth have been established. One such method is to classify BMI into percentiles for age and gender based on population-specific growth charts. A commonly used reference from the Centers for Disease Control and Prevention (CDC, 2005) consists of BMI percentile curves based on anthropometric measurements from a selected population of United States children. With this growth chart, youth are considered at-risk for overweight at the 85^{th} percentile, and overweight at the 95^{th} percentile. Alternatively, youth are categorized according to raw score gender-and-age specific BMI cut-offs developed by the International Obesity TaskForce (IOTF), for which childhood overweight and obese values were extrapolated from adult overweight and obese data points (Cole *et al.*, 2000). BMI z-scores, a dimensionless score representing the number of standard deviations a youth's BMI is from the population mean, can also be used to classify the adiposity of children and adolescents. A z-score of 0 represents the 50^{th} percentile, while values of –2.00 and +2.00 represent the lower 2^{nd}

percentile (underweight) and upper 98th percentile (overweight), respectively (Lobstein *et al.*, 2004).

2.3 Prevalence and Trends in Childhood Overweight and Obesity

In this era of technological convenience and food surplus, childhood overweight and obesity has progressed to become a global health concern. In westernized countries such as the United States and Great Britain, the rates of childhood obesity are disturbing. Based on the CDC criteria, 31% of American youth 6-19 years are classified as at-risk for overweight or overweight (Hedley *et al.*, 2004). In Great Britain, according to IOTF cut-offs, 15.4% and 4.0% of British youth aged 4-18 years are considered overweight or obese, respectively (Jebb *et al.*, 2004).

Secular trends for childhood overweight and obesity are also alarming. Over the past two decades, the United States has seen a 1.7-fold increase in childhood overweight (Wang et *al.*, 2002), while other countries such as Ireland and Australia have experienced a 1.3- and 2.0-fold increase in combined overweight/obesity, respectively (Watkins *et al.*, 2005, Booth *et al.*, 2003).

Once exclusive to industrialized nations, the rising prevalence and trends of childhood overweight/obesity has also extended into developing countries. For example, based on IOTF criteria, between 1974 and 1997 the rate of overweight in Brazilian children aged 6-18 years increased 3.4-fold from 4.1% to 13.9% (Wang *et al.*, 2002). Similar trends exist in other developing countries, such as Russia and India, where prevalence rates for combined overweight/obesity approximate 13% and 20% in urban adolescents, respectively (Wang, 2001; Ramachandran *et al.*, 2002).

In Canada, statistics on youth overweight/obesity point to a public health challenge. Latest data from 2002 indicate that 15.0% of adolescents aged 11-16 years are overweight and 4.6% are obese based on IOTF cut-offs (Janssen *et al.*, 2004). Obesity is also prevalent in pre-school children; one study found 25.6% of Newfoundland and Labrador children 3-5 years to be overweight or obese according to IOTF cut-offs (Canning *et al.*, 2004).

Geography, ethnicity and socio-economic status appear to have an impact upon

the severity of overweight and obesity in Canadian youth. Rates of overweight vary across provinces, with an increasing trend from west to east. In 1996, 26.6% of British Columbian youth aged 7-13 years were classified as overweight compared to 36.0% in Newfoundland and Labrador (Willms *et al.*, 2003). First Nations youth appear to be susceptible to gaining excess weight: the prevalence of overweight ranges from 28% in Dene/Metis and Yukon children aged 10-12 years (Nakano *et al.*, 2005), to 27.7% in boys and 33.7% in girls aged 2-19 years old in the Sandy Lake First Nation (Hanley *et al.*, 2000). Poverty may also affect the rates of overweight/obesity, as observed by O'Loughlin *et al.* (1998). In a study on inner-city, lower-income youth in Montreal, Quebec, 33% of girls and 25% of boys 9-12 years old were classified as overweight and 13% of girls and 15% of boys as obese.

Trends of overweight indicate a rise in overweight and obesity in Canadian youth over the previous two decades. Between 1981 and 1996, the prevalence of overweight in youth 7-13 years doubled from 13 to 27% in girls and tripled from 11 to 33% in boys, while the prevalence of obesity markedly increased from 2 to 9% in girls and 2 to 10% in boys (Tremblay & Willms, 2000). In comparing these data with the 2002 data from Janssen and colleagues (2004), there appears to be a decreasing trend in the prevalence of juvenile obesity. However, the authors contend that the lower prevalence may be conservative given that self-reported height and weight tend to be over- and under-reported, respectively. Nonetheless, these data taken collectively underscore the concerning issue of child and adolescent overweight/obesity in Canada and worldwide.

2.4 Causes of Childhood Obesity

2.4.1 Organic

Although childhood obesity is largely influenced by lifestyle and environmental factors, approximately 1-2% of cases are directly related to organic disease. Of the nearly thirty genetic disorders linked to childhood obesity, some of the more common clinically-featured conditions include Prader-Willi syndrome, Down syndrome and Duchenne muscular dystrophy. Though rare, endocrine and metabolic complications also exist, such

as Cushing's syndrome and leptin deficiency (Lobstein *et al.*, 2004).

2.4.2 At-Risk Populations

Certain health complications may predispose youth to weight gain. Children with disorders that impede movement, such as cerebral palsy, are at increased risk. Youth being treated with certain prescription drugs such as insulin, anti-convulsants and glucocorticoids are also more susceptible to excess weight gain. Juveniles with psychological or emotional issues that affect physical activity and nutrition habits are another at-risk group for obesity. Ethnicity appears to play a role, with youth of African-American, Hispanic, Native and Asian decent more susceptible to overweight/obesity (Lobstein *et al.*, 2004).

2.4.3 Environmental Risk

Certain environmental factors increase a child's likelihood of becoming overweight/obese. Children with overweight/obese parents are at high risk due to shared genetics and lifestyles (Simonen *et al.*, 2002). Fetal environmental factors, including maternal gestational diabetes and smoking during pregnancy, are known predictors for overweight (Dabelea *et al.*, 2000; Power & Jefferis, 2002). In relation, low birth weight, stunting in childhood and early adiposity rebound also increase a child's risk for excess weight gain (Whitaker & Dietz, 1998; Florencio *et al.*, 2001; Parsons *et al.*, 1999). Additional environmental determinants for childhood adiposity include socio-economic status and family/social support dynamics (Danielzik *et al.*, 2004; Lissau & Sorensen, 1994).

2.4.4 Lifestyle Risk Factors: Nutrition and Physical Activity

As outlined in a childhood obesity ecological model proposed by Davison & Birch (2001), juvenile obesity is a condition that arises from a multitude of social and environmental factors that influence the health behaviors, and ultimately, weight of a

child. As indicated in this model and elsewhere (Bar-Or *et al.*, 1998; Maffeis, 2000), nutritional and physical activity habits are central to weight management in youth. In fact, these two lifestyle factors may be interrelated, with less active youth also exhibiting eating behaviors that favor weight gain (Jebb & Moore, 1999).

Epidemiological and consumer data suggest that nutrition transition is in part to blame for the sharp increase in childhood overweight/obesity in recent decades. With a decreased reliance on traditional meals in favor of processed foods, the consumption of edible oils, sweeteners and animal source foods has increased in developed nations and is currently on the rise in developing countries (Popkin & Gordon-Larsen, 2004; Popkin, 2002; Popkin, 2001; Kosulwat, 2002). Trends on food consumption in the United States between 1970 and 1998 indicate that per capita energy availability increased 15%, and in concomitance, preparation of home meals decreased, while the consumption of larger-portion convenience foods increased (Harnack *et al.*, 2000). For American youth aged 4-19 years old, it has been reported that nearly one-third eat fast-food on a given day, and that calorie intake is higher and diet quality poorer for those who frequently eat out (Bowman *et al.*, 2004). In fact, between 1977 and 1996, fast food consumption increased nearly 300% among American youth (St-Onge *et al.*, 2003).

Research linking dietary habits to adiposity is conflicting. In a cohort of 9- and 10-year-old children, Tucker *et al.* (1997) found that adiposity was positively related to fat intake and negatively associated to carbohydrate and protein intake. McGloin and colleagues (2002) also observed similar results in children, where level of body fatness increased across quartiles of fat intake. Also linked to overweight in youth are specific nutrition habits such as consuming soft drinks and skipping breakfast (Ludwig *et al.*, 2001; Siega-Riz *et al.*, 1998).

Conversely, several studies have failed to associate dietary intake to adiposity. In the Belgian Luxembourg Study IV (Guillaume *et al.*, 1998), total fat intake was associated with BMI and skinfold thickness only in boys aged 6-12 years-old, whereas total energy intake was not related to anthropometric measurements. In the longitudinal Bogalusa Heart Study (Nicklas *et al.*, 2004), macronutrient and caloric intake were not associated with fatness level in youth. Other investigations have also failed to find any

significant associations between excess weight gain and energy or macronutrient intake in youth (Maffeis *et al.*, 1998; Magarey *et al.*, 2001).

Limited data on the nutritional habits of Canadian youth are conflicting. As analyzed by Phillips and colleagues (2004), dietary intake of convenience foods including salty snacks, cakes/cookies/pastries and carbonated beverages contributed significantly to the calorie, fat and other nutrition intake in a sample of youth 13-17 years. Meanwhile, Janssen *et al.* (2004) found a positive relationship between soft drink consumption and BMI, but an inverse relationship between the intake of other convenience foods and adiposity. However, as suggested by the authors, these data may be confounded by underreporting of dietary intake and lack of statistical adjustment for portion sizes. Furthermore, other lifestyle factors, particularly physical activity, may confound results of these and other studies evaluating the dietary correlates of adiposity.

Data tracking secular trends of physical activity in youth are lacking (Goran *et al.*, 1999). However, it is plausible that sedentary habits have increased and physical activity levels have decreased over recent decades in concomitance with technological advancements (Haskell, 1996). Interestingly, secular trends on dietary intake in youth 2-19 years between the 1970's and mid-1990's indicate a minimal change in caloric intake (Troiano *et al.*, 2000), leading these and other authors (Bar-Or *et al.*, 1998) to conclude that the increase prevalence of childhood overweight and obesity is largely due to a decrease in physical activity levels.

Several studies have examined the relationship between physical activity and body fat in youth. Researchers have observed that obese children are significantly less active than their lean counterparts, with both frequency and intensity of exercise inversely related to adiposity levels (Page *et al.*, 2005; Abbott & Davies, 2004; Dionne *et al.*, 2000). Similarly, longitudinal studies investigating changes in activity habits over time have demonstrated increases in physical activity levels to be associated with decreases in measures of body fatness (Berkey *et al.*, 2003).

In terms of daily energy expenditure, most studies indicate that, when corrected for fat-free mass, youth who are obese or at-risk for obesity have similar levels of energy expenditure compared to non-obese youth (Treuth *et al.*, 2000; Goran *et al.*, 1995; Goran

et al., 1998b; Treuth *et al.*, 1998). However, lower values for total daily expenditure among obese youth indicate they are less active (DeLany *et al.*, 1995).

Levels of sedentary habits may also predict excess weight gain in children and adolescents, although data are conflicting. Researchers Tremblay & Willms (2003), Gortmaker *et al.* (1996) and Proctor *et al.* (2003) have demonstrated a positive relationship between body fat levels and hours of television viewing or video game/computer use. Additional investigations indicate that levels of adiposity are higher among youth who watch more hours of television, with BMI values lower among youth who exercise more frequently at a vigorous intensity level (Eisenmann *et al.*, 2002). Conversely, other researchers have observed either weak effects or no relation of TV watching or media use on risk of overweight, indicating that a measure of media usage may not be a reliable single predictor of body fatness (Robinson *et al.*, 1993; DuRant *et al.*, 1994; Marshall *el al.*, 2004).

Overall, diet and physical activity habits appear to be associated with adiposity levels in youth. However, the extent to which each has an impact upon the severity of juvenile overweight/obesity is difficult to distinguish given the variations in study methodologies and response bias for dietary intake and activity levels (Jebb & Moore, 1999; Lichtman *et al.*, 1992; Prentice *et al.*, 1986).

2.5 Outcomes of Childhood Obesity

2.5.1 Physical Health Complications

Excess body weight places overweight/obese youth at risk for numerous health complications. Many obese youth are presenting with clinical signs of irregular hormonal homeostasis such as acanthosis nigricans, a skin condition indicating insulin resistance (Shalitin *et al.*, 2005). In addition, obese males are being diagnosed with gynecomastia (breast tissue enlargement) (Slyper, 1998), and female patients are presenting with cardinal signs and symptoms of polycystic ovary syndrome (PCOS) including menstruation abnormalities, acne and hirsutism (excess facial and body hair), (Huppert *et al.*, 2004; Hill, 2003).

Blood pressure in youth is also affected by body weight. BMI and body fat levels are consistently found to be positively related to systolic and diastolic blood pressure (Rosner *et al.*, 1993; He *et al.*, 2000; Paradis *et al.*, 2004), and when compared to normal-weight youth, obese youth are between two- to four-times more likely to develop juvenile hypertension (Freedman *et al.*, 1999; Rosner *et al.*, 1993; Sorof *et al.*, 2002).

Respiratory problems such as sleep dyspnea are more common among obese children and adolescents (Mallory *et al.*, 1989; Sulit *et al.*, 2005). Although research suggests they are also at higher risk for asthma, the relationship between excess body weight and airway inflammation remains unclear (Bibi *et al.*, 2004; Leung *et al.*, 2004). Conversely, some researchers have demonstrated no link between excess body weight and prevalence of asthma (To *et al.*, 2004), and instead contend that the shortness of breath is due to respiratory deconditioning and mechanical restrictions due to excess truncal adiposity (Gidding *et al.*, 2004).

Of course, blood cholesterol levels are influence by body fat levels, with obese youth presenting with elevated cholesterol levels and hypercholesterolemia (Quattrin *et al.*, 2005; Nawrot *et al.*, 2004; Tershakovec *et al.*, 2002). For example, Friedland *et al.* (2002) observed elevated serum cholesterol levels in 52% of obese adolescents compared to only 16% in non-obese control subjects.

Hyperinsulinemia and impaired glucose tolerance, metabolic manifestations of type 2 DM (Reinehr *et al.*, 2005a), are also common in juvenile obesity (Shalitin *et al.*, 2005; Reinehr *et al.*, 2005b; Viner *et al.*, 2005). In one US cohort of obese adolescents 11-18 years old, 21% had impaired glucose tolerance, and 4% were diagnosed with silent type 2 DM (Sinha *et al.*, 2002). In fact, BMI appears to be positively associated with the number of risk factors for insulin resistance syndrome (Lambert *et al.*, 2004), which include obesity, impaired glucose tolerance, dyslipidaemia and hypertension (Viner *et al.*, 2005). As suggested by one report from the Bogalusa Heart Study, upwards of 50% of overweight youth present with risk factors for syndrome X (Freedman *et al.*, 1999).

Overweight/obese children and adolescents are not only at risk for adult overweight/obesity but also its related chronic health conditions (Guo *et al.*, 1994; Srinivasan *et al.*, 1996). Excess weight in youth is associated with elevated cardiovascular risk in young adulthood (Sinaiko *et al.*, 1999) and type 2 DM and

cardiovascular disease in later adulthood (Colditz *et al.*, 1990; Chan *et al.*, 1994; Dagenais *et al.*, 2003; Rimm *et al.*, 1995; Dietz, 1999). As well, risk factors for insulin resistance syndrome appear to persist from childhood into young adulthood (Katzmarzyk *et al.*, 2001; Bao *et al.*, 1995). Co-morbidities including non-alcoholic fatty liver disease, type 2 DM, insulin resistance, hypercholesterolemia and hypertriglyceridemia are being diagnosed in this population prior to adulthood (Schwimmer *et al.*, 2005; Nanda, 2005; Chan *et al.*, 2004).

2.5.2 Psychosocial Consequences

Juvenile obesity is linked to numerous negative psychosocial outcomes. Most research indicates that overweight/obese youth often suffer from teasing, social isolation, and consequently, lower self-worth (Eisenburg & Neumark-Sztainer, 2003; Neumark-Sztainer *et al.*, 2002; Pesa *et al.*, 2000; Stradmeijer *et al.*, 2000). In fact, they are at-risk for living in social isolation and poverty if their obesity continues into adulthood (Sarlio-Lahteenkorva & Lahelma, 1999). There are a few studies, however, that demonstrate no differences in self-worth between obese and normal weight controls (Gortmaker, 1993; Rumpel & Harris, 1994), specifically when body image is controlled for (French *et al.*, 1995). Overall, the most consistent psychosocial finding among obese youth is a negative body image (Zametkin *et al.*, 2004).

Self-perceived health-related quality-of-life appears to also be affected by body weight in youth. Friedlander *et al.* (2003) demonstrated that overweight or at-risk for overweight youth were two-to-four times more likely to score significantly lower for self-worth, physical functioning and socioemotional health. A similar investigation found obese youth to rate their quality of life lower than that for children of normal weight diagnosed with cancer (Schwimmer *et al.*, 2003).

Psychosocial factors appear to be related to diet, physical activity habits and weight gain. As demonstrated by Morgan *et al.* (2002), overweight children with loss-of-control of eating habits were more significantly overweight and experienced greater levels of anxiety, depression and body dissatisfaction. With respect to physical activity, obese children tend to exhibit lower levels of self-efficacy and are less involved in

community programs (Trost *et al.*, 2001). They also experience numerous resource, social support and body-related barriers to being physically active (Zabinski *et al.*, 2003).

2.5.3 Financial Costs

The financial burden of juvenile and adult obesity is significant. In the United States between 1979 to 1999, annual hospital costs to treat childhood obesity-related conditions tripled from $35 million to $127 million (Wang & Dietz, 2002). In Canada in 2001, the cost of youth and adult obesity exceeded $4.3 billion or 2.2% of total healthcare costs (Katzmarzyk & Janssen, 2004). These estimates did not include costs required to treat obesity-related conditions, such as cardiovascular disease, which reached $18 billion in 1994 (Chan *et al.*, 1996).

2.6 Treatment of Childhood Obesity

2.6.1 Physical Activity Interventions

Decreases in body weight, total body fat and visceral fat have been observed in overweight and obese youth who were prescribed vigorous physical activity (Dionne *et al.*, 2000; Lazzer *et al.*, 2005; Owens *et al.*, 1999). Regular participation in physical activity has also been found to improve the aerobic capacity, submaximal exercising heart rate and resting blood pressure in obese youth (Gutin *et al.*, 1997; Eliakim *et al.*, 2002; Kang *et al.*, 2002). As well, favorable changes in metabolic profile have been demonstrated; fasting insulin, total cholesterol (total-C), low-density lipoprotein cholesterol (LDL-C) and triglyceride (TG) levels have been shown to decrease, while high-density lipoprotein cholesterol (HDL-C) levels have been shown to increase (Brown *et al.*, 2000; Epstein *et al.*, 1989; Sung *et al.*, 2002; Kang *et al.*, 2002; Ferguson *et al.*, 1999; Kelly *et al.*, 2004; Kirk *et al.*, 2005). As expected, benefits of aerobic activity are reversed when the youth return to sedentary habits (Ferguson *et al.*, 1999).

Although these data indicate that exercise may help to ameliorate the severity of obesity and its related health complications, dissemination of this information must be

cautioned. Exercise prescription for such studies is normally 3-5 days per week, 40-60 minutes in duration and at an intensity of up to 75% of maximal exercise capacity. This exercise prescription may not be realistic for obese youth exercising in an unsupervised environment.

No one type of exercise mode, such as cycling, walking or swimming, appears superior to another for effective weight loss (Epstein *et al.*, 1985). The type of exercise program, however, may predict long-term weight loss maintenance. For instance, lifestyle exercise was found to be more effective than aerobic exercise or calisthenics in maintaining weight loss in a two-year follow-up study (Epstein *et al.*, 1985). However, after ten years, researchers found no additional benefits of lifestyle exercise on weight loss or management (Epstein *et al.*, 1994). Although the effectiveness of weight training has yet to be established, it does appear to be of some benefit to program compliance and weight loss in obese youth (Sothern *et al.*, 2000). Also, safety recommendations for weight training in youth are currently available (American Academy of Pediatrics, 1990).

Data on the effects of exercise intensity on weight youth in youth are also conflicting. In comparing exercise intensities in youth, Gutin *et al.* (2002) found that, even though exercise resulted in favorable changes in total body and visceral fat, weight loss could not be predicted by exercise intensity. Conversely, Johnson *et al.* (2000) observed a significant negative relationship between adiposity and aerobic fitness in children, suggesting that exercise intensity can contribute to weight loss.

2.6.2 Nutrition Interventions

Several types of diets have been utilized to moderate energy intake in obese youth. Such regimes include a non-stringent calorie restriction based on the US Food Pyramid (Braet *et al.*, 2003); a low-energy, low-fat, high complex carbohydrate diet (Sung *et al.*, 2002); the "traffic light" diet, where foods are labeled with the colours red, yellow or green to indicate limited, moderate and free consumption, respectively (Epstein *et al.*, 1998); and a protein-sparing modified fast diet of 600-800 kcal and 2.0 g/kg/day of high-quality, lean protein (Lobstein *et al.*, 2004).

Overall, short-term studies on hypocaloric diets have proven some success in children and young adolescents (Epstein *et al.*, 1990; Epstein *et al.*, 1986), but data on long-term effectiveness are lacking (Yanovski, 2001; Figueros-Colon *et al.*, 1993). It is also unknown whether an optimal balance of macronutrients and/or distribution of meals throughout the day is required for effective weight loss, and whether certain diets are more effective than others in facilitating favorable and permanent changes in dietary practices (Hoppin, 2004; Hill, 2003; Epstein *et al.*, 1998).

In comparing nutrition and exercise therapies, energy restriction results in greater weight loss short-term (Figueroa-Colon *et al.*, 1993), but combination therapies result in greater benefits (Epstein *et al.*, 1985; Reybrouck *et al.*, 1990). In fact, the additional benefits of physical activity may not be through calorie expenditure and weight loss *per se*, but rather through improvement of health risk profile. As demonstrated by Rocchini and colleagues (1987, 1988), nutrition plus physical activity did not improve body fat levels better than nutrition alone; however, more favorable improvements in insulin levels and blood pressure were observed in youth who also exercised.

2.6.3 Behavior Modification Interventions

The effectiveness of behavior-based treatment for juvenile obesity is not known. A family-based behavior modification intervention by Epstein *et al.* (1990, 1994) demonstrated promising results for weight maintenance and additional weight loss after 10 years of follow-up. However, several of the youth in this study were at considerable risk for relapse. Also, significant financial and healthcare resources were required for treatment. Focusing on the same type of treatment, Levine *et al.* (2001) found that, in addition to weight loss, disordered eating habits and disposition improved in the youth. However, there was a significant drop-out rate, indicating a high-burden of treatment and questioning the effectiveness of less-intensive or non-supervised interventions. While some researchers contend that there may be no additional benefit of behavior-based interventions beyond education (Lansky & Brownell, 1982), others insist that such programs increase the likelihood of success, particularly when they are flexible, focus on

realistic lifestyle modifications and offer separate parent and youth counseling (Brownell *et al.*, 1983; Mellin *et al.*, 1987).

The multidisciplinary approach to weight management through diet, exercise and behavior modification is the recommended approach of many health professionals (Barloe & Dietz, 1998; Bar-Or *et al.*, 1998). While single counseling sessions have failed to assist overweight youth with weight management (Reinehr *et al.*, 2003), multi-component inpatient and outpatient programs have demonstrated short (less than six months) and intermediate (one to two years) term effectiveness in maintaining weight loss (Braet *et al.*, 2003; Reinehr *et al.*, 2003).

2.6.4 Pharmacological and Surgical Interventions

In their endless struggle to lose weight through diet and exercise, overweight and obese adults have resorted to surgical and medicinal alternatives, both of which are now being explored as treatments for obese youth. Studies on gastric bypass surgery in obese adolescents have demonstrated weight loss and amelioration of co-morbidities and socioemotional well-being (Inge *et al.*, 2004a; Widhalm *et al.*, 2004); however, it has not been clearly elucidated whether the youth are at nutritional risk or whether weight loss is sustainable long-term (Inge *et al.*, 2004c). Currently, guidelines for juvenile bariatric surgery, endorsed by the American Pediatric Surgical Association (Rodgers, 2004), are available (Inge *et al.*, 2004b). Although the use of drugs such as sibutramine, an appetite suppressant, and orlistat, an intestinal fat absorption blocker, have shown some success in combination with diet and exercise therapies, numerous side effects such as gastrointestinal distress and elevated blood pressure have been observed (Berkowitz *et al.*, 2003; Chanoine *et al.*, 2005). Nonetheless, these two drugs have recently been approved for use in adolescents in the United States by the Food and Drug Administration (Korner & Aronne, 2004).

Overall, bariatric surgery treatment and use of weight loss drugs is cautioned in obese youth until the safety and effectiveness have been established (Lobstein *et al.*, 2004; Yanovski & Yanovski, 2003; Berkowitz *et al.*, 2003).

2.6.5 Weight Management Guidelines and Research Recommendations

To date, there is no consensus on the most effective strategies for weight loss and weight management in obese youth (Dietz & Robinson, 2005; National Health and Medical Research Council (Australia), 2003). Published recommendations are non-specific but suggest that interventions combine nutrition, physical activity and behavior modification strategies (National Health and Medical Research Council (Australia), 2003; Canadian National Advisory Committee on Obesity, 2003).

The primary objective of any weight management program should be weight maintenance, and if required, a weight loss of approximately 450g monthly. Over the long-term, the goal should be to achieve a BMI below the 85th percentile for age and gender (Barlow & Dietz, 1998).

Physicians, dietitians, nurses and other health professionals are central in the tertiary treatment of childhood obesity. They help to identify youth who are overweight/obese and carefully screen them for health complications and exogenous causes of obesity (Barlow & Dietz, 1998). Clinicians are also integral to assisting with goal setting and advocating healthy nutrition and physical activity habits (Shephard, 2004; Dietz & Robinson, 2005).

Treatment of childhood overweight/obesity should consider the youth's and family's readiness for lifestyle modification. Changes should be gradually implemented, focusing on an increase in physical activity levels, a decrease in sedentary habits and a reduction in the consumption of calorie-dense foods. In addition, the provision of on-going family social support services is fundamental to helping youth effectively manage their weight (Barlow & Dietz, 1998). Behavior modification strategies, such as monitoring behavior, problem solving and rewarding change, are also recommended (Dietz & Robinson, 2005).

Expert committees have put forth several recommendations for future research on childhood obesity weight management (National Health and Medical Research Council (Australia), 2003; Canadian National Advisory Committee on Obesity, 2003). They suggest that all programs combine diet, physical activity and behavior modification components, and that the optimal prescription of each should be determined.

Furthermore, exercise and motivational strategies should be individualized to the needs and preferences of each youth. Researchers also contend that parental involvement is essential, but that effective parenting strategies for management of childhood obesity still need to be identified. Given the complex nature of childhood obesity interventions, it is suggested that management be long-term and that program outcomes be examined in a variety of settings. In particular, the development of school- and community-based programs requires further investigation, specifically to enhance the effectiveness, availability and accessibility to childhood obesity interventions.

2.7 Mentoring

While several definitions exist (Hall, 2003), mentoring can generally be described as "a dyadic psychosocial intervention in which an older individual is brought into a close relationship with a younger person in order to provide support, guidance, and opportunity for social and academic development" (Karcher *et al.*, 2005). In a dyad relationship, the mentor provides the protégé with social support to help enhance socioemotional well-being, decrease behavioral problems and improve relations and communication with others (Rhodes, 1994; Tierney & Grossman, 1995; Keating *et al.*, 2002). Four social support constructs central to mentoring include emotional, instrumental, informational and companion support (Wills & Shinar, 2000). With emotional support, the mentor is caring and sympathetic towards the youth to help foster confidence and self-worth while reducing anxiety and depression. The mentor also provides [instrumental] material aids and [informational] intellectual guidance to help the youth effectively problem solve and achieve tasks. As well, the mentor acts as a support companion and assists the protégé with social integration during participation in various activities.

Although many mentoring interventions have proven successful (Rhodes, 1994; LoSciuto *et al.*, 1996; McPartland & Nettles, 1991), not all programs have demonstrated positive outcomes (Beier *et al.*, 2000; Greenberger *et al.*, 1998; Rhodes *et al.*, 1994; Nelson & Valliant, 1993; Royse, 1998). The effect of mentoring on youth outcomes seems to be modified by youth risk status. The most comprehensive review of 55 mentoring programs by DuBois (2002) found a modest or small benefit of mentoring on

emotional well-being and social behaviors for the "average youth", with the most positive effects for youth at environmental risk alone or individual plus environmental risk. In particular, youth of a lower socioeconomic status, ethnic minority and/or single parent household are most likely to experience the greatest gains from mentoring (DuBois, 2002; Rhodes, 1994).

While the variation in the outcome success of mentoring programs can partially be explained by youth risk status, other factors may impart an influence, including program design, the quality of the mentoring relationship and the personal traits of the mentor (DuBois & Neville, 1997; Karcher *et al.*, 2005; Hall, 2003). Features of program design, including provisions of ongoing training and monitoring, regular mentor contact and support, the organization of complementary structured activities and parental involvement, are integral to the success of any mentoring intervention (DuBois, 2002). With respect to mentoring relationship quality, emotional closeness of the dyad is associated with fewer symptoms of depression, improved life satisfaction and enhanced self-worth (Rhodes, 2003; Greenberger *et al.*, 1998). Frequency of contact and relationship duration also influence outcomes, with prematurely ending relationships often leaving the protégé in a worse emotional state (DuBois *et al.*, 2002; Parra *et al.*, 2002; Grossman & Rhodes, 2002). Mentor characteristics such as level of self-efficacy and experience as a counselor or educator appear to affect the quality of mentoring (DuBois & Silverthorn, 2005). Factors negatively associated with the mentoring relationship quality include insufficient mentor training, a lack of shared common values between the mentor and protégé and a mentoring style that is authoritative (Hall, 2003).

Given the relative success of mentoring at-risk youth and the association of low socioeconomic status, perceived lack of social support and low self-efficacy to low levels physical activity among obese youth (Danielzik *et al.*, 2004; Zabinski *et al.*, 2003; Trost *et al.*, 2001), mentoring may hold promise for promoting healthy body weight in obese adolescents. Although there is no one-on-one mentoring intervention for obese youth, *Go Girls! Healthy Bodies, Healthy Minds* (Ontario Physical and Health Education Association, 2003), a pilot group mentoring program for girls 12-14 years of age, educates youth at risk for overweight on a healthy body image, self-worth, relationships, nutrition habits and physical activity behaviors. Unpublished data indicate that mentoring,

in the short-term, is effective in enhancing the knowledge, skills, nutrition habits, physical activity levels and socioemotional well-being of the youth (Ontario Physical and Health Education Association, 2003). To date, it is not known whether mentoring can, in addition to the above aforementioned, assist overweight and obese youth achieve a healthy body weight.

2.8 Program Logic Models

A program logic model is a useful tool for the development, implementation and evaluation of a promotion or intervention program. A logic model is a diagrammatic representation of a program and how its elements relate to underlying psychosocial theories of the program and its expected outcomes (Renger & Titcomb, 2002). It is used as an administrative tool to aid practitioners with the planning, management, quality assurance and enhancement of a program (Millar *et al.*, 2001; McLaughlin & Jordan, 1999). Logic models have been applied to the evaluation of social welfare, agriculture and behavioral programs (University of Wisconsin-Extension, 2005), with more recent application to help secure funding for program initiatives (Kaplan & Garrett, 2005).

A program logic model provides many advantages to stakeholders. It clearly outlines the resources required, the target population involved and the internal/external influences that might affect program success (Schalock & Bonham, 2003). Key performance indicators are also outlined, making it easy to recognize and collect the data required for effectively evaluating program impact, identifying causal factors and making program revisions. A logic model also provides a means by which information on program performance measures and program values can be conveyed to stakeholders, agencies, employees and participants (McLaughlin & Jordan, 1999).

Prior to designing a logic model, it is essential to first define a program's situation priorities, needs and stakeholders, as well as its mission, mandates, resources and desired outcomes. Once these program aspects are determined, a multi-component model can then be devised (University of Wisconsin-Extension, 2003).

As reviewed by McLaughlin & Jordan (1999) and presented elsewhere (Schalock & Bonham, 2003; University of Wisconsin-Extension, 2003; The W.K. Kellogg Foundation,

2001), there are several components to a logic model (Figure 2-1). The first main consideration is program inputs; that is, the financial, staffing and information resources necessary to run the program. Program outputs are a second consideration and include the activities of the program, such as service delivery, training, counseling and program participants or customers. A third component is program outcomes. A logic model consists of short-term (6 months to one year) impacts, long-term (several years) outcomes, and occasionally, intermediate (one to two years) outcomes. A final but essential element to any logic model is external environmental influences. It is important to identify external factors that are not necessarily controllable but may influence program success, such as economy stability, resource availability or social trends. Collectively, these program components are then presented in a model with feedback loops indicating program flow and the interrelationships between the different program elements.

Through logic model development and implementation, practitioners in the health field are ultimately seeking to facilitate change in attitudes, beliefs and/or health-related behavior. These changes are often guided or informed by a variety of theoretical concepts and frameworks. With the movement towards the integration of theory into evaluation (Chen, 1990), these theoretical concepts represent an important aspect of the underlying logic of program evaluation models. While a review on such literature exceeds the scope of this thesis, certain theories will be discussed as they pertain to the program logic model presented in Section 9.0, which describes a mentoring intervention for obese youth.

3.0 STUDY RATIONALE

There is a need to further develop community-based childhood obesity intervention programs (Canadian National Advisory Committee on Obesity, 2003). One-on-one mentoring for obese youth may provide an affordable and accessible means by which treatment can be individualized to assist the youth with implementing permanent lifestyle changes to improve their health and successfully achieve a healthy body weight. In order to guide the development of an effective mentoring intervention program, it is necessary to assess the population the program will serve.

As such, the three objectives of this thesis include:

1. To conduct a retrospective chart review on an adolescent population seeking treatment for obesity at the Montreal Children's Hospital (MCH), whereby:
    a. demographic, anthropometric, biochemical and clinical data will be assessed for severity of obesity and overall health risk;
    b. contextual themes on predictors of weight management, including nutrition and physical activity habits and barriers to weight loss mentioned in chart records, will be presented and discussed;
    c. change in anthropometric data will be analyzed and discussed to determine weight loss/management following physician counseling and the need for complementary intervention services.
2. To design and present the program logic model for a mentoring childhood obesity intervention program called Mentors in Motion (MIM).
3. To design and present a research protocol for testing the effectiveness of MIM.

Originally, data from the MIM pilot study were to be available for analysis and interpretation for Ms. Markin's thesis. However, due to delays in forming a collaboration with Big Brothers Big Sisters of Greater Montreal (BBBSGM), designing the MIM program, obtaining ethics approval from the MCH Research Ethics Board and securing financial support, the study has not sufficiently progressed for results to be incorporated into the thesis. However, since the design of the MIM program and the research protocol

represent original and independent work of Ms. Markin, they are presented in Sections 9.0 and 10.0 of the thesis.

4.0 ETHICS

Approval for ethics was obtained from the Research Ethics Board at the MCH (Appendix A).

5.0 METHODS

5.1 Study Design and Patient Population

A retrospective chart review was conducted on youth seeking treatment for obesity at the MCH between April 2004 and March 2005. During this time, a total of 167 patients aged 8-18 years received counseling at the Weight Management Clinic. Chart review was limited to adolescents aged 12 to 18 years. Of a possible 127 charts meeting this age criteria, review was limited to 95 records, providing a sample size adequate for a descriptive overview of patient profiles. Also, review of additional charts required a fee. The records were pulled according to most recent chart number, which reflects the date of initial hospital visit; that is, patient chart numbers were assigned according to initial admission to the hospital for any health condition, which for most patients was several years prior to initial clinic visit. Dates of the clinic visits were reviewed and were found to be randomly distributed throughout the year, with no clustering on particular dates or months. In total, 89 charts were included for analyses; one chart review was a duplicate of the same patient, and five charts were excluded because further review indicated they did not meet the age criteria. There were no other exclusion criteria for chart review.

5.2 Data Collection

5.2.1 Methods

Data were recorded on a database and patients' identities were kept confidential, with only their initials and first three chart numbers recorded for cross-reference to the master patient list. Quantitative data were transferred to an Excel worksheet and qualitative information on health history and lifestyle habits was also recorded, with contextual themes highlighted for discussion on the overall health and well-being of the population.

5.2.2 Demographics

Gender and date of birth were recorded for each patient. Postal codes were collected from most recent visit and submitted to the Health Geography Lab at McGill University for demographic statistical analyses. Based on 2001 Census of Population data from Statistics Canada, median household income, average level of parent education, percent immigrant status and percent couple or lone-parent households were determined for the geographic areas in which each patient resided. These data were then averaged and compared to mean values for the metropolitan area of Montreal for descriptive, and not analytic, purposes. Because the most appropriate comparisons for the current patient population would be census data from Montreal households with children, and not all households, the available census data are limited. Nonetheless, the available Montreal data are presented as they may highlight socioeconomic features of the patient population important for program design. In addition, a geographical map of Montreal was created, marking the residing area of each patient.

5.2.3 Anthropometry

Height (cm) and weight (kg) were recorded to one decimal place for the initial and most recent clinic visits so that changes in body composition over time could be estimated. From these data, BMI (kg/m^2) was calculated. Additional anthropometry data were not available.

5.2.4 Biochemical and Clinical Data

Data were collected from most recent visit for fasting lipid values including total-C, LDL-C, HDL-C, and TG (mmol/L). Indices of impaired glucose tolerance and insulin resistance, including fasting insulin and fasting blood glucose (BG) were recorded. For patients (n=25) who underwent an oral glucose tolerance (OGTT) to screen for impaired glucose tolerance and type 2 DM, two fasting insulin and BG values were reported at 0 minutes and 120 minutes. Normal fasting BG levels were available on other youth (n=53)

and were also analyzed to determine average values for patients not considered at risk to undergo an OGTT. Data on alanine transferase (U/L), an indicator of compromised liver function, were collected. Markers of cardiovascular system function, including resting blood pressure (mmHg) and heart rate (bpm), were measured as well. For cases where biochemical data were not available for the most recent visit, data were recorded if analyzed within 18 months of the most recent visit. This method was required to obtain a more complete descriptive biochemical profile of the population.

Physician observations for the cinical signs acanthosis nigricans (AN), hirsutism and gynecomastia were recorded for most recent clinic visit. Clinical diagnoses of PCOS, sleep apnea, hypertension, type 2 DM, metabolic syndrome, dyslipidemia, asthma and hepatic steatosis were documented if the complication was present for the most recent clinic visit.

5.2.5 Qualitative Data

Cause for obesity was recorded, classified as either "no risk factors" or "risk factors". Risk factors included organic disease, drug interaction, and psychosocial disorders. Information on family history for diabetes mellitus, cardiovascular disease and overweight/obesity was also collected, as it was actively assessed and charted by the physician. Note that data on familial hypertension were not available.

Contextual themes pertinent to weight management were recorded verbatim. For each clinic visit, entries charted by the weight management physician and other clinicians were reviewed for information on nutritional intake, physical activity habits and barriers to successful weight management.

5.3 Statistical Analyses

Data were analyzed using SPSS Version 11.5 for Windows (SPSS, Chicago, IL 2001). All data are presented as the mean and standard deviation for all subjects and separately by gender. For all socio-demographic, biochemical and anthropometric data, comparisons for differences in means between males and females were evaluated using a

two-tailed independent student t-test (significance $p \leq 0.05$). Chi-square tests were conducted to test for differences in proportions between males and females with a positive history of clinical signs, health complications and family health complications. While the primary purpose of the analyses was to provide a descriptive overview of the patient population, differences between males and females were evaluated to help recognize any gender-specific health concerns that may need to be considered in designing an intervention program.

Using the epidemiological program Epi Info Version 3.2 (www.cdc.gov/epiinfo, 2003), percentiles and z-scores based on age and gender for height, weight and BMI were calculated based on the 2000 CDC growth reference data for age and gender (http://www.cdc.gov/epiinfo/). To further analyze the impact of physician counseling on weight management, mean change scores in anthropometry between initial and most recent visit were calculated. Linear regression analyses for BMI for age-and-gender percentiles and z-scores were calculated to evaluate the change in each anthropometric measurement for all subjects and by gender over years of follow-up. Multivariable linear regression models on these same two variables were also conducted to examine the impact of covariates including gender and age at initial visit.

6.0 RESULTS

6.1 Socio-Demographic Data

Of the 89 charts reviewed, 43 (48.3%) and 46 (51.7%) were for male and female patients, respectively. The average patient age was 14.1 years (SD=1.4), and the mean ages for males and females were not significantly different at 14.1 years (SD=1.4) and 14.2 (SD=1.4), respectively.

For demographic data based on postal codes, 84 records were successfully matched to six-digit postal code centroids in the Montreal census metropolitan area (CMA); four postal codes were illegitimate and one was outside the Montreal CMA. In total, there was a functioning set of 77 records, as seven postal codes fell in Census Tracts with no population data. Figure 6-1 is map of the Montreal CMA representing the geographic distribution of the 77 patients for whom census data were available.

In comparing patient data with that for the Montreal CMA, median household income was similar at $42 271 and $42 123, respectively. Level of parent education was slightly lower in the patient population, with 29.9% of parents with less than high school degree versus 26.3% for the Montreal CMA. Average immigrant status for the census areas of the obese youth was 22.0% versus 18.4% for the Montreal CMA. However, the percent of lone-parent households was higher in the patient population (28.7%) compared to the Montreal CMA (14.8%).

6.2 Anthropometric Data

Table 6-1 presents anthropometric data from the most recent clinic visit. The average weight, height and BMI were 95.7 kg (SD=24.6), 164.3 cm (SD=9.51) and 35.1 kg/m^2 (SD=6.8), respectively. Only BMI was statistically different between genders, with BMI being significantly higher in girls (36.8 vs. 33.3, $p<0.05$).

Data on CDC percentiles and z-scores are also presented in Table 6-1. Based on age and gender, average weight and BMI percentiles were at the 97.5 (SD=4.7) and 98.3 (SD=2.1) percentiles, respectively, with height at the 63.3 percentile (SD=29.9). Mean z-

score for weight-for-age was 2.44 (SD= 0.71); for BMI-for-age was 2.29 (SD=0.38); and for height-for-age was 0.45 (SD=1.12). There were no statistical differences between males and females for these data.

6.3 Biochemical and Clinical Data

Fasting lipid levels for total-C, LDL-C, HDL-C and TG are found in Table 6-2. The mean total-C, LDL-C and HDL-C values were 4.52 (SD=0.79), 2.72 (SD=0.70) and 1.19 mmol/L (SD=0.27), respectively. Average fasting level for TG (n=72) was 1.36 mmol/L (SD=0.75). Of these lipid values, only fasting HDL-C was significantly higher in females than males (1.26 vs. 1.12 mmol/L, p=0.03).

In addition to data on fasting BG and insulin, values from a 75-g OGTT were also available (Table 6-2). Mean BG levels at fasting, 0 min OGTT and 120 min OGTT were 4.89 (SD=0.53), 4.73 (SD=0.66) and 6.26 (SD=1.92) mmol/L, respectively. Corresponding values for insulin were 306.6 pmol/L (SD= 224.2), 249.3 pmol/L (SD=251.3) and 1208.0 pmol/L (SD=883.9). There was no significant effect of gender on fasting BG. However, mean fasting insulin was significantly higher in females (378.0 vs. 172.8, $p \leq 0.05$).

Of the 55 subjects screened for liver function, average alanine transferase was 37.27 U/L (SD=33.50), with no significant difference between males and females.

Average resting heart rate was 84.2 bpm (SD=11.5), while mean systolic and diastolic blood pressures were 128.4 (SD=14.0) and 67.4 (SD=10.8) mmHg, respectively (Table 6-3). Mean systolic blood pressure was significantly higher in males than females (132.8 vs. 124.2 mmHg, $p \leq 0.01$).

Data on clinical signs and health complications are found in Table 6-4. AN was present in 47% of patients, with no difference between genders. Hirsutism was documented for 23.9% of females, and 33% of males were diagnosed as having gynecomastia. PCOS was suspected or diagnosed in 40.0% females. Respiratory-related problems, including sleep apnea and asthma, were diagnosed in 5.6% and 14.6% of patients, respectively. Cardiovascular health was compromised in some adolescents, with

6.7% being hypertensive and 5.6% being dyslipidemic. Type 2 DM and metabolic syndrome were diagnosed in 1.1% and 2.2% of the youth, respectively.

Cause of obesity was classified into one of two categories: "no risk factors" and "risk factors". Risk factors for obesity included diagnosis of diseases or the use of drugs associated with excess weight gain, depression/related behaviour difficulties and Attention Deficit Hyperactivity Disorder/related behaviour problems. Nearly 80% of patients were classified as obese with no risk factors, while approximately 20% were categorized as obese with risk factors (data not presented in table format).

Familial risk for overweight/obesity, cardiovascular disease and diabetes mellitus was positive for 57.3%, 38.2% and 61.8% of youth, respectively (Table 6-5). There were no significant differences between genders for familial risk factors. Overall, 20.2% of patients had no positive family history of risk factors, while 25.8%, 30.3% and 23.6% of the youth had family history for one, two, or all three risk factors, respectively.

6.4 Change in Anthropometry Over Time

Of the 89 patients followed in the Weight Management Clinic between April 2004 and March 2005, 66 (74.2%) represented follow-up assessments. On average, the youth were followed for 1.96 years (SD=1.36), with an average of 3.1 (SD=2.0) clinic visits.

Mean change scores in anthropometry between baseline and most recent visit are presented in Table 6-6. Mean change scores for age-and-gender percentiles were -0.08 (SD=0.33) for weight and -0.04 (SD=0.22) for BMI. There were no statistical differences between genders in change scores. For z-score values, average weight and BMI change scores were -0.08 (SD=0.33) and -0.04 (SD=0.22), respectively. There was a statistically significant difference between genders for change in mean z-score for weight, with females experiencing a greater decrease (-0.16, SD=0.31) than males (0.33, SD=0.00, $p<0.05$).

Linear regression analyses to evaluate change in BMI percentiles and z-scores were conducted and there were no observed effects by number of years of follow-up on change in anthropometry (Table 6-7). The change in BMI percentiles over years of follow-up for all subjects is represented in Figure 6-2.

For multivariable linear regression analyses examining the effects of length of follow-up, gender and age at baseline, no significant effects were observed on change in BMI percentiles or z-scores (Table 6-7).

6.5 Contextual Themes on Weight Management

There were no standardized questionnaires or set of questions used by clinicians to collect information on the youth's nutrition habits, physical activity levels and barriers to achieving a healthy body weight; therefore, information recorded varied between charts. In fact, fourteen (15.7%) charts contained no information on the diet or exercise habits of the youth.

6.5.1 Nutritional Habits

One of the most frequently reported remarks on dietary intake of the youth was that they had large appetites (n=18). The same number of patients was reported to skip breakfast or lunch (n=18) in favor of frequent snacking (n=8), large dinner portion sizes (n=8) and second helpings (n=3). With respect to social environment, several youth were eating daily at the school cafeteria (n=8), with the same number being left home alone after school (n=8), resulting in unsupervised snacking. In a couple of instances (n=2), food intake was closely monitored and controlled by the parents. There was also indication of emotional [over]eating in this patient population (n=11).

It terms of actual foods consumed, the most commonly reported sources of excess energy intake were juice (n=15), pop (n=10) and convenience foods high in fat and sugar (n=16). Meanwhile, fruit and vegetable intake was reported to be low for several youth (n=18).

6.5.2 Physical Activity Habits

Based on the chart entries, it appears that many of the youth were rarely or never physically active (n=26). For those who were active, common ways to exercise included

walking (n=16) and cycling (n=4) for leisure or travel to school, exercising on equipment at home or the gym (n=12) and participating on recreational sport teams (n=14). For several adolescents, physical education class was the only source of regular physical activity (n=11). With respect to sedentary habits, many of the youth were inactive several hours daily by watching television, playing video games and using the computer (n=16).

6.5.3 Barriers to Achieving a Healthy Body Weight

The charts contained several repeating themes on cognitive, social support and environmental barriers to adapting healthy nutrition and physical activity habits. Internal motivation to initiate change and/or maintain changes was one pertinent barrier for many patients (n=26). With respect to social support, physical education classes appeared to be the only source of structured physical activity for several youth (n=11). Many of the youth were also left home alone after school without support for attending extracurricular activities or for ensuring healthy eating habits (n=8). In addition, the family dynamics for several youth, including single parent households and low socioeconomic status, may have been negatively influencing weight management (n=13). One uncontrollable barrier to maintaining physical activity year round was weather, with many youth reporting no exercise during winter months (n=10).

7.0 DISCUSSION

7.1 Major Findings

7.1.1 Socio-Demographic Data

The demographic data from postal code linkage to census data suggest that level of parent education may be lower, immigrant status may be higher and percent of lone-parent households may be greater for the patient population. However, these values are proxy indicators as they are based on the mean values for all households in the postal code census areas and not on individual status for education, ethnicity and family dwelling. As it was not possible to extract comparison census data from households with children, comparisons with the Montreal data should be interpreted with caution. As such, it would be beneficial to collect this information directly from the patients' families so that more accurate demographic statistics are available to help guide the development of intervention strategies. In particular, given that mentoring appears to have a greater impact on at-risk youth of ethnic minorities and single-parent households, these youth may be a recognized at-risk population, further justifying the use of a mentoring intervention in this patient population.

The geographic map (Figure 6-1) provides an overview on the patient population's neighborhood of residence. The patients are widely spread throughout the Montreal CMA, with a few concentrated areas in lower socio-economic areas such as Verdun. While most patients live within close proximity of the MCH, several patients live in more distant communities and must travel one to three hours to the hospital for counseling.

These observations provide valuable information for program delivery. While counseling from the pediatric endocrinologist is valuable, it may be costly and cumbersome for the families who live a long distance away to travel into the city. In fact, this may deter some patients from seeking treatment. It may be beneficial to establish a network of physicians and dietitians specializing in treatment of childhood obesity in rural communities so that services are more conveniently available to patients from those

areas. In considering the delivery of adjunctive intervention therapies for weight management, program design will have to consider the wide geographic distribution of the patients. Offering an intervention at one central site may not be feasible; rather, an intervention should be accessible in several areas in Montreal. In addition, program design should consider the financial limitations and parental constraints of the families.

7.1.2 Anthropometric Data

An analysis of anthropometry confirms that these adolescents are of average height but significantly heavier than other youth of the same age and gender. Average weight-for-age and BMI-for-age values were above the 95th percentile, classifying this population as overweight according to CDC definitions. Mean z-scores for weight and BMI were greater than 2.00, a recognized cutoff for obesity (Lobstein, 2004).

7.1.3 Biochemical Data

Mean fasting blood lipids and alanine transferase levels fell within normal range as classified by MCH standards. As observed in other pediatric populations (Kim *et al.*, 2005), mean fasting HDL-C levels were significantly higher in females. Mean fasting BG levels remained within normal limits; however, fasting insulin levels were high. Although no standard upper limit value for fasting insulin levels in adolescents exists, 20 μIU/L (140 pmol/L) is an established WHO cut-off for hyperinsulinemia in adults (Alberti & Zimmet, 1998). Given that the mean fasting insulin levels at 0 minutes and 120 minutes of an OGTT were 249.3 and 1208.0 pmol/L, respectively, this population likely suffers from insulin resistance.

7.1.4 Clinical Observations

Mean systolic blood pressure was significantly higher in males than in females (132.8 mmHg vs. 124.2 mmHg). Given that systolic hypertension is diagnosed at 140

mmHg in adults (WHO, 1999), these males are at significant risk for early development of systolic hypertension (Sorof *et al.*, 2002).

AN was observed in an alarming 47% of youth, providing further evidence of insulin resistance in this population. The relatively high proportion of boys with gynecomastia and girls with PCOS and hirsutism is additional proof that obesity is affecting hormonal balances in these adolescents.

The prevalence of health complications in the patients was compared to rates reported for other obese adolescent populations and summarized by Lobstein (2004). While upwards of 30% of obese youth may suffer from hypertension, only 6.7% of youth in this patient population were diagnosed with the complication (Figueroa-Colon *et al.*, 1997). As well, respiratory-related sleeping problems were less prevalent in this study, where 5.6% where diagnosed with sleep apnea compared to rates between 33% and 94% reported elsewhere (Mallory *et al.*, 1989; Silvestri *et al.*, 1993). The prevalence type 2 DM has been reported at 4% in obese youth, a rate that is slightly greater than the prevalence of 1.1% reported here (Sinha *et al.*, 2002). Compared to a prevalence of 2.2%, the rates of metabolic syndrome among other obese youth have been found as high as 28.7% (Cook *et al.*, 2003). Lastly, hepatic steatosis was observed in only 1.1% of the patients, while up to 70% of obese youth have been diagnosed with liver-related complications in other studies (Kinugasa *et al.*, 1984; Rashid & Roberts, 2000). While it cannot be elucidated whether significant differences exist for prevalence rates of health complications, it does appear that the youth in this study are suffering from health problems that may predispose them to long-term morbidity in adulthood.

Twenty percent of youth had additional risk factors, including organic disease, drug interaction and psychosocial disorders, which may contribute to their weight gain. For such adolescents, design of obesity interventions may require special considerations to help ensure successful weight loss and maintenance.

As few differences in biochemical and health status were identified between males and females, an intervention program need not consider gender-specific health concerns. Rather, childhood obesity intervention programs should be developed with the flexibility to consider individual health concerns.

7.1.5 Changes in Anthropometry Over Time

Data on mean change scores in anthropometry indicate that weight remained relatively stable. While physician counseling may help to prevent further weight gain in obese youth, the data are compelling that physician counseling was not associated with subsequent weight loss.

7.1.6 Contextual Themes on Weight Management

The chart review of contextual chart themes revealed that these youth exhibit significant lifestyle risk factors for excess weight gain. One predictor for sedentary habits and overeating was staying home alone after school. To help prevent such habits, this population may benefit from after-school programs. As well, the only source of organized physical activity for several adolescents was physical education class. For those who participated in physical activities outside of school, activity levels decreased during winter months. With that said, the provision of structured, year-round physical activity services may help to increase physical activity levels. These youth may also benefit from nutrition education to help modify habits that pose challenge to weight loss, including low intake of fruits and vegetables, high frequency/volume of eating and excess intake of convenience foods.

Many of the adolescents may not have the social support required to help facilitate change in lifestyle habits. They may also lack internal motivation to become more physically active and eat a more healthy diet. As such, services that limit burden on the parent and offer psychosocial support to facilitate change in lifestyle habits may prove of benefit to this population.

7.2 Limitations

The largest limitation to any retrospective chart review is the accuracy of data. Because data collection was based on clinician-written chart entries, patient profiles may be incomplete due to missing or ineligible data. Chart entries may not accurately reflect

positive cases of clinical signs and family history due to underreporting. Information on nutrition, physical activity habits and environment risk factors may be not be accurate due to under- or over-reporting and reporting bias on part of the physician or patient. In addition, important documents may have been missing due to incomplete charts.

Chart reviews are limited by the nature of the data available. Demographic information on ethnicity or language was rarely recorded in the chart and semi-quantitative data on change in nutrition and physical activity habits over years of follow-up were not available. These data would have provided additional information to help assess the impact of physician counseling on changes in lifestyle practices. In addition, although general qualitative data were provided on nutrition and physical activity, there were no quantitative data available. These data could assist in setting specific goals for lifestyle change. As well, more complete information on nutrition and physical activity habits could to help guide program design with gender-specific considerations.

Data on the psychological well-being of the adolescents were also limited. Information on their attitudes towards weight management, as well as information on self-worth, body image and self-efficacy, would have provided a more complete psychosocial profile on this population.

Finally, the sample size was adequate for providing a descriptive overview of the patient population and for evaluating potential gender differences in mean values in the many biochemical parameters examined. However, the sample size provided inadequate power for detecting gender differences in the proportion with co-morbidities. Nonetheless, for most characteristics, the prevalence of health complications was very similar between boys and girls.

7.3 Recommendations

7.3.1 Intervention Programs

Despite physician counseling, this obese population did not lose weight. Given their physical activity and nutrition habits and barriers to adopting healthy lifestyle practices, adjunctive intervention services may help them achieve weight loss.

In considering program design, such interventions should be multifaceted. Physical activity services should be regularly scheduled, supervised and should consider seasonality to keep youth active year round. In addition, the youth should be educated on and encouraged to decrease sedentary habits, with a focus on discovering enjoyable activities the youth will enjoy long-term. Given that they are at risk for disordered eating, nutrition education should emphasize healthy eating through small, realistic changes rather than caloric restriction. Programming should also include a psychological component to help address the barriers experienced by the adolescents. In addition, data on psychosocial well-being, as well as physical activity and nutrition habits, should be collected at baseline to help guide individualized treatment and to determine the impact of the intervention at follow-up.

There are also other administrative aspects for program design to consider. Programs should be offered after school to help decrease overeating and sedentary habits. Since these adolescents come from a wide range of socioeconomic backgrounds and geographical locations, such programs will need to be accessible, affordable, individualized and should focus on the youth—rather than the caregiver—for implementing change. Since many of these youth have been obese for several years and may experience motivation and relapse issues, interventions should be long-term. Of course, the effectiveness of such interventions should be evaluated in order to enhance program design and to help ensure expected outcomes are achieved.

7.3.2 Future Research

Many of these obese youth have risk factors for obesity including psychological disorders and use of prescription drugs. Consequently, weight loss strategies and expected outcomes may be different for these special populations. This subpopulation of obese youth should be studied further to determine their unique needs for weight management.

While some of the barriers to weight management were identified from this chart review, additional research into levels of knowledge and skills and psychological factors

including self-worth, self-efficacy and state of readiness to change could help to further development of intervention programs.

Lastly, the postal code census data indicate that this patient population may be at additional risk due to a greater probability of immigrant status and coming from a lone-parent household. Because of this at-risk status, these obese youth may greatly benefit from mentoring. As such, the role of mentoring in enabling positive changes in lifestyle practices, body weight and well-being of obese youth should be explored.

8.0 CONCLUSION

A significant proportion of obese youth from this chart review presented with several indicators of long-term health complications including acanthosis nigricans, elevated insulin levels, elevated systolic blood pressure (in males) and positive family history for DM, cardiovascular disease and overweight/obesity. While physician counseling may help to prevent further weight gain in this population, weight loss is imperative to decreasing overall health risk for chronic disease. Given that these youth practice lifestyle habits that favor weight gain, providing adjunctive multidisciplinary services may help them to successfully lose weight. Such intervention programs should be accessible both geographically and financially, individualized to meet the unique needs of each youth and sustainable to help ensure permanent changes in lifestyle behaviors. One type of intervention that fulfills these criteria is mentoring. Given the youth's barriers to weight management and the potential for at-risk status of lone-parent household and/or immigrant, mentoring may be an effective alternative for treatment of childhood obesity and should be further explored.

BRIDGE

Based on information from the chart review, literature review and recommendations published elsewhere (National Health and Medical Research Council (Australia), 2003; Canadian National Advisory Committee on Obesity, 2003), an innovative youth obesity intervention was developed. This program, called MIM, was the inception of Ms. Markin, and the design of this intervention was independently directed. Section 9.0 of the thesis presents the program logic model for MIM and provides an ecological view on how the program will be administered and how it is expected to influence the physical health and mental well-being of obese adolescents.

9.0 PROGRAM LOGIC MODEL

9.1 Overview

In accordance with findings from the chart review and scientifically published recommendations (National Health and Medical Research Council (Australia), 2003; Canadian National Advisory Committee on Obesity, 2003), an innovative childhood obesity intervention has been developed. This program, called Mentors in Motion (MIM), utilizes one-on-one mentoring to help obese youth 13-18 years old achieve a healthy body weight by enabling permanent changes in healthy lifestyle behaviors and improvements in socioemotional well-being. In brief, the dyad meets weekly for at least one year to participate in physical activities of choice, where the mentor helps the protégé set realistic goals for lifestyle change and reinforces healthy behaviors. Integral to this model are complementary services provided by the physician at the MCH Weight Management Clinic. The physician, who is specialized in clinical care of obese youth, provides counseling on physical activity and nutrition to help the adolescents achieve a healthy body weight.

The MIM program is administered by BBBSGM in collaboration with the MCH Weight Management Clinic. McGill University is also a partner on the project and the mandates of the University are outlined in Section 10.0. BBBSGM is a well-established youth mentoring organization that has been serving the Montreal community since 1975. This non-profit organization matches adult volunteers with at-risk youth to help enable improvements in academic performance and socioemotional well-being. In addition to a traditional pairing, BBBSGM is also responsible for managing the Prometheus Project, a school-based mentoring program where dyads meet weekly in the school environment to participate in social activities.

As MIM is a new innovative pilot project, it is being developed in phases. The first phase focuses on modifying PA habits and improving various aspects of the youth's socioemotional well-being and development. Nutrition counseling provided by the physician is reinforced by the mentor. The second phase of MIM is currently under development and will integrate more comprehensive nutrition education/counseling and

parental support services. A research protocol was developed and has been implemented to test the effectiveness of mentoring on the first phase of MIM. More details on the research design are found in Section 10.0.

To outline the MIM program and to ensure coherence between its content, mission, goals and hypothesized impacts and outcomes, a program logic model was designed (Figure 9-1). This archetype follows the basic format of a logic model and was in part adapted from the Positive Action logic model which teaches about achieving success and happiness through positive actions (Positive Action, Inc., 2005). This model links psychosocial theories to changes in physical, intellectual and socioemotional outcomes—the primary objectives of the MIM logic model—and was therefore used as an archetype.

Overall, the first phase of the logic model for MIM consists of a mission statement and goals; a program philosophy linked to underlying psychosocial and child development theories; mentoring program administration components; short-term impacts and long-term outcomes of the program on the youth; and external influences. It is important to note that this logic model is not definitive and will be modified as the program is further developed.

9.2 Mission and Goals

The first component of the MIM model is its mission statement, which globally encompasses the main objectives of the program (Figure 9-1A). For MIM, its mission is to enhance the physical and mental well-being of obese youth by offering on-going guidance to the mentors who are integral in enabling lifestyle modifications in the youth. The program also seeks to provide continuity of care with healthcare services to help ensure delivery of safe, accessible and cost-effective resources.

Program goals are the next facet of the model, and they link the mission statement to the intermediate programs targets that influence change in the ultimate program target. For MIM, the target population is obese adolescents aged 13 to 18 years. These youth receive not only ongoing support from BBBSGM mentors but also counseling services provided by the physician. For the mentor, the goal is to provide training and on-going

support that is specific to enabling changes in lifestyle practices of obese adolescents. With healthcare services, the objective is for BBBSGM to liaise with community and physician services to help ensure continuity of care and accessibility to safe and cost-effective services. For the adolescent, the goal is to provide mentoring and physician support to create a social environment that enables the adoption of healthy lifestyle practices and enhancement of physical and mental well-being.

9.3 Philosophy, Youth Development and Psychosocial Links

The mission and goals of MIM are next linked to the philosophy and psychosocial/child development theories of the program (Figure 9-1B). The philosophy of MIM describes how mentoring is hypothesized to affect the youth's physical and socioemotional well-being. It is anticipated that mentoring will provide modeling, guidance and social support that is individualized to the needs of the youth to assist in the adoption of permanent lifestyle modifications to benefit his/her physical and mental well-being.

The MIM philosophy is supported by psychosocial and child development theories that help to explain expected changes in the adolescent. These psychosocial theories are linked to the outcome measures of the MIM intervention, as determined by self-report questionnaire, separate qualitative interviews with mentors and protégés and clinical body measurements.

The first theory of the model—the social cognitive theory (SCT)—was developed by Albert Bandura (1986) and encompasses emotional, cognitive and performance aspects to explain a change in behavior. There are several constructs to the SCT, and those of particular interest to MIM include observational learning, reinforcement, self-efficacy and behavioral capability. A mentor acts as a role model, and through mentoring, the protégé is able to observe the action and outcome of a behavior. Mentoring can also provide reinforcement to help the protégé increase or decrease the frequency of a behavior and to help promote self-directed changes in lifestyle habits. In addition, the youth's mastery of a skill and self-efficacy (self-confidence to perform a task or behavior) can be enhanced by working with a mentor on a weekly basis

(Baranowski *et al.*, 1997). It is hypothesized that the youth's perceived self-efficacy to engage in regular physical activity will be enhanced through participation in MIM. The 13-item measure developed by Sallis *et al.* (1987) will be administered to assess self-efficacy to be physically active. This questionnaire uses a 4-point response scale to assess an individual's confidence in their ability to stick to a physical activity regimen and make time for physical activity.

The second psychosocial link of the logic model is social support. As previously described, social support is a means by which a person can network with others to cope with a demanding situation (Bartholomew *et al.*, 2001). The four main social support constructs applicable to the MIM logic model include emotional, instrumental, informational and companion support (Wills & Shinar, 2000). With MIM, the protégé receives emotional empathy and trust; tangible aid and practical support to carry out an activity; expertise and constructive feedback to help address problems; and social integration during activities for a sense of social belonging. Social support for physical activity will be assessed through using a second 13-item measure of perceived support offered by family, friends and other adults (Sallis *et al.*, 1988). Note that there is some overlap of the constructs for social support and the SCT; therefore, measures from this questionnaire are also linked to the SCT. As well, in-depth qualitative interviews will be conducted with both the mentor and protégé to better understand the strength and weaknesses of the mentoring relationship, and to explore potential factors contributing to improvements in PA levels and health. This information will be used to refine the program and to develop future studies that will more closely examine interactions between the mentor-protégé pairs, such as provider effect.

Harter's developmental self-concept is a third youth development link in the model. It encompasses several psychosocial domains including social acceptance, athletic competence, physical appearance, behavioral conduct, scholastic competence and global self-worth (Harter, 1982). It is believed that mentoring for physical activity and other lifestyle habits will help to enhance self-rating of each of these domains and will be positively associated with the long-term outcome of socioemotional well-being. The scale of measure for Harter's youth development link measures global self-worth and self-perceived competence in youth, and a shorter version of the scale will be used for

MIM (Wichstrom, 1995). It is believed that mentoring for physical activity and other lifestyle habits will help to enhance self-rating of each of these domains and will be positively associated with the long-term outcome of socioemotional well-being.

The theory of self-determination (SDT), developed by psychologists Ryan and Deci (2000), relates intrinsic motivation to social development and well-being. This theory identifies that people have an innate desire for competence, relatedness and autonomy, and these needs provide an intrinsic motivation—the inherent interest or enjoyment of an activity—for specific behaviors. To expand on theoretical terminology, competence is the act of showing physical and intellectual skill; autonomy is the power of self-direction and self-initiation independent of external factors; and relatedness is the perception of social connectedness (American Psychological Association, 2005). When these three internal needs are fulfilled, a person is intrinsically motivated to be actively engaged in a behavior. Conversely, external motivation, such as conditional rewards for performing a task, can decrease one's internal motivation to carry out a behavior (Deci & Ryan, 2000). It is hoped that mentoring will help to foster development of the youth's intrinsic motivation. The youth's level of internal motivation to be physically active is currently not being assessed to minimize response burden for the pilot study; however, SDT measurements will be integrated in the future. The youth's subjective perceptions of well-being, on the other hand, will be assessed using Weinberger's (1996) 7-item measure.

Goal setting is another important concept to the MIM intervention. This theory contends that a person will perform better and will more likely achieve a desired outcome if a goal is established (Bartholomew *et al.*, 2001). In setting a goal, it is recommended that the behavior, rather than the health outcome, is targeted. In addition, the goal should pose some challenge but still be feasible for the person to achieve. The SMART (specific, measurable, attainable, realistic, timely) method of goal setting (National Strength and Conditioning Association, 2004) is commonly used and is being applied in this program. Goals set for the youth will be precisely defined; will have concrete criteria for measuring progress; will pose some challenge but will still be attainable; will be realistic to the skills and motivation level of the youth; and will have a specific timeline for completion. Separate interviews with protégés and mentors will be used to identify the goals that were

set, the extent to which each goal was achieved and identify individual interpersonal and environmental barriers/facilitators to goal attainment. These interviews are conducted separately so that information provided by the protégés on the mentors remains candid.

One last theoretical consideration for the logic model is the transtheoretical model of behavioral change. This model consists of stages of change to help identify a person's internal motivation for modifying a behavior and to predict the success of changing a behavior (Bartholomew *et al.*, 2001). These stages include pre-contemplation (no thought to change a behavior within the past six months), contemplation (thought to change a behavior within the past six months), preparation (intention to make a change within 30 days), action (currently implementing the behavior for less than six months), maintenance (currently implementing the behavior for more than six months) and termination (the behavior is permanently adopted) (Prochaska & DiClemente, 1983). In order to arrive at the idyllic stage of termination, it is hypothesized that a person sequentially progresses through each stage. With participation in an intervention program, it is possible for a person to advance one or more stages. This, as well as a link between physical activity habits and self-perceived stage of change, will be assessed using the physical activity stage of change questionnaire by Marcus *et al.* (1992).

9.4 Program Development and Administration

9.4.1 Mentor Training Program

An essential component to MIM is the content of the mentor training program. The mentor works closely with the protégé, and as such, his/her knowledge and skills are central to the success of the intervention. Training will help to ensure the mentor establishes a mutually valuable relationship with the protégé, effectively disseminates knowledge and provides the support necessary to enable lifestyle change and improve the youth's physical health and mental well-being (Hall, 2003).

As observed in Figure 9-1C, the training curriculum consists of six different units. The mentor first receives an overview of the MIM program design, philosophies, collaborators, target population and scope of services. The mission and goals of MIM are

explained, with an emphasis on the specific mentoring requirements for the program. The mentor is also asked to sign a contract, affirming his/her commitment to fulfill the obligations of the program.

The second unit covers more specific details on the psychosocial facets of mentoring and predictors of a successful mentor-protégé relationship. The definition of mentoring is clearly explained, with an emphasis on the importance of trust and mutual respect to the health of the reciprocal relationship. The accountability of the mentor as an adult role model is reinforced, as is the responsibility to exchange valuable knowledge with the youth to help address socioemotional needs. The mentor is also presented with tips to help establish and preserve a positive mentoring relationship.

While the first two units provide basic training on mentoring, the next four components feature information unique to the MIM program. Promotion of a physically active lifestyle is one focus of MIM. For this component of training, the mentor is provided with safety information on exercise including an injury protocol, special considerations for youth who are obese and cautions on equipment use, unsafe activities and unfavorable weather conditions. Basic background knowledge on exercise physiology is reviewed, including exercise terminology, the components of physical fitness and the body systems used during movement. In orienting the mentor on the physical and mental benefits of physical activity, a "vitality" approach is emphasized; that is, the notion that exercise must be vigorous with a "no pain, no gain" approach is replaced with the view that physical activity comes in all forms of movement and can be incorporated it into daily life (Health Canada, 2000). The mentor is also informed on how to help the protégé enhance physical activity through three main approaches: to increase daily active living, to increase moderate-to-vigorous activity and to minimize non-active time. The MIM guidelines for progression follow the recommendations set by Public Health Agency of Canada (2002), but were slightly modified to meet what were considered more realistic goals for the protégé.

Another important lifestyle factor—nutrition—is also addressed by the program. As previously mentioned, this unit covers general principles of nutrition and is under revision for the next phase of the intervention. Promotion of healthy eating by the mentor is limited to reinforcement of general nutrition counseling provided by the physician and

to the use of Canada's Food Guide to Healthy Eating (Health Canada, 2005). As with physical activity, a vitality approach is taken to nutrition, where restrictive eating and dieting are discouraged. Instead, the youth is educated on balanced nutrition and is encouraged to consume a wide variety of nutritional foods in moderation. The mentor is also instructed on positive role modeling for healthy eating habits, such as bringing a fruit/vegetable snack to eat after a physical activity. In addition, the mentor is informed on nutrition quackery and is provided with answers to frequently asked nutrition questions, as well as a list of reputable nutrition resources. Because obese youth attempting to manage their weight are at risk for developing an eating disorder (Harter, 1982), the mentor is educated to recognize symptoms and to notify BBBSGM if disordered eating is suspected. Also, training of mentors will stress the need for positive messages around healthy food and eating habits. Additional nutrition interventions are planned and described in Section 9.6.

The next unit informs the mentor on background knowledge and strategies to help enable modifications of the youth's lifestyle behaviors. The mentor is educated on individual factors that may affect learning in youth and the use of SMART goal setting the help achieve incremental improvements in physical activity and nutrition habits. Tools including a monthly goal-setting form and a sample one-year program are provided to assist the dyad with program progression and goal attainment. The mentor is also presented with tips on maximizing success with the protégé and is informed on how to handle a behavior relapse, reinforce the achievement of a goal and progress to the maintenance stage of a lifestyle behavior.

The final section of the training module discusses various psychosocial domains, including body image, self-image, self-efficacy and self-esteem. Each term is defined, with a particular emphasis on how participation in physical activity can enhance mental well-being through skill mastery, goal achievement and social reinforcement. The mentor is also provided with tips on how to foster self-worth and self-image and with a list of motivational phrases to help the protégé become comfortable and confident with being physically active.

To help ensure the mentor is fully knowledgeable and confident in handling situations of conflict, mentoring scenarios were created for the mentor to role-play. In synthesizing information learned from all units, the mentor provides a response to the issue and receives appropriate constructive feedback.

9.4.2 Program Administration

After illustrating the curriculum for the mentoring intervention, the logic model transitions to the program administration (Figure 9-1D). For MIM, there are two areas of administration: the mentoring program and healthcare services.

The mentoring program involves management of the mentor and the protégé. Candidates for mentoring are recruited from the community and must pass a general screening to confirm their availability and interest in mentoring before receiving a systematic interview and full background check. Adults selected for mentoring then participate in an 8-hour training program delivered by qualified BBBSGM staff. The obese adolescent, on the other hand, is recruited by the hospital and referred to BBBSGM. Here, the protégé is profiled by a BBBSGM caseworker (a social worker or psychologist responsible for monitoring the dyad), and based on this information, the youth is matched to a same-gender mentor who shares similar interests and personality traits and lives in close proximity to the protégé.

Immediately prior to their first meeting, the mentor and protégé separately receive a safety program orientation that outlines appropriate adult conduct with youth. They are also debriefed on the profile of the other person and expectations for the initial meeting. Following the initial meeting, the dyad meet weekly for at least one year to participate in a variety of physical activities. These outings are self-directed and individualized according to the needs and preferences of the protégé. To help ensure successful pairing, BBBSGM regularly follows the pair, evaluates their progress and provides on-going support for the dyad.

As previously mentioned, healthcare, an integral component to program delivery, is presented as a complementary service in this logic model. In addition to screening and referring eligible youth to BBBSGM for MIM, the hospital physician also manages on-

going counseling and medical treatment of the youth. To help ensure continuity of care between MIM and the physician, BBBSGM and the hospital maintain regular communication about the progress of the mentoring pair.

9.5 Program Impacts and Outcomes

The final component of the MIM logic model outlines the projected end results of the intervention. The short-term impacts, long-term outcomes and socio-environmental determinants of success are presented is this diagrammatic summary (Figure 9-1E). For MIM, the mentor will assist the youth with progressive goal achievements to improve physical activity levels, nutrition habits and socioemotional well-being. With these incremental advancements, it is anticipated that the protégé will advance from achieving short-term impacts to maintaining long-term outcomes.

9.5.1 Social Environment and Program Content

The social environment and program content are central to the success of the intervention and are therefore presented in this component of the diagram. As a part of MIM, the protégé receives on-going care from a physician, and as required, access to other healthcare services. Of course, the mentor is an invaluable volunteer that fosters a relationship with the protégé and helps to enable lifestyle changes to help improve health and well-being. Nutritional counseling, although a future component of the social environment, is also included. As previously described, the MIM program content includes physical activity, nutrition, lifestyle change and youth development units.

9.5.2 Short-Term Impacts

The projected end-results of the program that are expected to occur within a relatively short period (approximately six months to one year) are considered the short-term impacts. These changes are specific, measurable and can be linked the underlying psychosocial theories of the logic model. In relation to the social support and social

cognitive theories, the mentor provides role modeling, reinforcement and knowledge exchange to assist the protégé with improving physical activity and nutrition habits. The theory of goal setting is also applied to help the youth progressively enhance lifestyle practices. Within this same time frame it is expected that mentoring will influence the protégé to advance at least one stage of change of the transtheoretical model. It is also perceived that the emotional support provided by the mentor will enable enhancements in social acceptance, athletic competence, physical appearance, behavioral conduct, scholastic competence and global self-worth. The achievement of these short-term impacts is required for the protégé to progress to more permanent, long-term changes.

9.5.3 Long-Term Outcomes

While the short-term impacts normally involve changes in behaviors and cognition, the long-term outcomes entail more global enhancements in health and well-being. In other words, the [long-term] end results arise from the [short-term] founding actions. The long-term outcomes are viewed as permanent, more global changes and often occur several years after initiation of the intervention.

It is hypothesized that by increasing physical activity levels, decreasing sedentary habits and improving nutrition habits, the protégé will improve his/her anthropometric and metabolic profiles. Over the long-term, this will lead to attainment of a healthy body weight and decreased health-risk profile. In addition, the short-term changes in socioemotional well-being (social and psychological needs of a person) and long-term changes in health will lead to enhanced perceived quality of life.

9.5.4 External Factors

Although the development of a comprehensive logic model can help to maximize the likelihood of achieving desired program outcomes, success is not guaranteed. Numerous factors external to the program may have a positive or negative impact on its direction. It is important to present and describe these socio-environmental influences so that program performance is accurately assessed and that any subsequent revisions to

MIM takes into account these external factors. For MIM, there are economic, social and environmental influences to consider.

BBBSGM, the administrator of MIM, is a non-profit organization. Since the organization relies exclusively on financial support from funding agencies and donors, the amount of financial assistance received will affect the level of service delivered. The financial stability of healthcare services (i.e. the MCH Weight Management Clinic), will also have an impact on the quality of care received by the protégé.

Childhood obesity has become a global health concern and there is currently a social movement to develop effective prevention and intervention strategies. The presence or absence of this social awareness may influence the level of funding received, the number of mentors available and consequently, the sustainability of the program.

MIM is a program that targets at-risk youth who are often from disadvantaged environments. Socio-environmental factors such as neighborhood safety, accessibility of recreation facilities and programs, financial resources, family dynamics, parenting style and level of family support to facilitate behavior change will influence the protégé's capability to increase physical activity levels and improve nutritional habits (Davison & Birch, 2001). Of course, the protégé's internal motivation and readiness to implement lifestyle change, which can be influenced but not controlled, will significantly predict outcome measures.

9.6 Future Directions for Nutrition Interventions

Currently, adolescents seeking treatment for obesity at the MCH Weight Management Clinic receive basic nutrition counseling from the physician. The physician educates the youth on how to follow the Canadian Food Guide for Healthy Eating and provides general tips such as replacing foods high in sugar and fat and low in fibre with fruits, vegetables and whole grains.

At this time, hospital budget constraints limit access to dietitians for one-on-one counseling. It can also be costly for the youth's family to seek advice from a private clinic dietitian. There is an obvious need to offer quality access to nutritional services that are affordable and minimize the use of hospital resources.

As such, the second phase of MIM, a unique collaboration with the School of Dietetics and Human Nutrition at McGill University will be explored: the involvement of dietetic stagiares to help disseminate nutrition education to the mentors, youth and their families. This collaboration provides mutual benefits to both MIM and the School of Dietetics and Human Nutrition; while MIM is able to offer affordable and quality nutrition services to the youth, the stagiares gain valuable community experience in working with a special population.

It is envisioned that the stagiares will help to assist with mentor training by providing accurate nutrition knowledge on healthy eating for adolescents trying to lose weight, as well as effective strategies to help foster changes in nutritional habits. The stagiares will offer group information sessions on healthy eating to the youth and their parents and take them on shopping tours for education on choosing nutritionally-balanced and affordable foods. Cooking classes may also be offered to teach the youth and their families how to prepare easy meals that are healthy and appetizing.

While the chart review on the patient population for this study provided general information on eating habits, it did not provide insight into the psychological issues of eating. In the second phase of the program, information on eating and psychology will be collected by the revised Three-Factor Eating Questionnaire, which addresses cognitive restraint, uncontrolled eating and emotional eating (de Lauzon *et al.*, 2004). Data from this questionnaire will help to guide development of effective nutrition counseling strategies and revisions to the MIM program logic model. In addition, the impact of social support, role modeling, reinforcement, goal setting, stages of behavioral change and internal motivation on nutritional habits will be explored.

9.7 Summary

The BBBSGM logic model for phase one of MIM visually describes a mentoring intervention for obese youth, and is believed to be the first of its kind. It links program components in a sequential manner and clearly elucidates how the program is administered and its expected outcomes. This model indicates that, with comprehensive training, the mentor will enable positive changes in the lifestyle practices of the obese

youth to improve overall quality of life. It is hypothesized that mentoring, in combination with physician counseling, will help the protégé improve physical activity levels, nutrition habits, socioemotional well-being and physical health.

The MIM logic model helps to ensure that appropriate outcomes are assessed and that program strengths, weaknesses and uncontrollable external influences are correctly identified. This, in turn, will help to guide program revisions and further enhance the impact of mentoring on the health and mental well-being of obese youth. A pilot study is currently under way to test the effectiveness of phase one of MIM, and the research protocol is presented in the following section. If successful, MIM will serve as a template for a larger-scale referral program—a program that will bridge affordable and accessible community services with professional care in the fight against juvenile obesity.

BRIDGE

To test the effectiveness of one-on-one mentoring on enabling lifestyle change and weight management in obese youth, a pilot study was developed. In October 2004 the research protocol was submitted to the Canadian Institutes for Health Research under the strategic initiative "Excellence, Innovation and Advancement in the Study of Obesity and Healthy Body Weight – Operating and Pilot Project Grants in Childhood Obesity". In April 2005, the application was approved and the study received funding for one year. The pilot study is currently underway (Refer to Appendices B-D) and its protocol, as submitted to the Institute, is described in Section 10.0. This protocol provides basic information on the project collaborators, study design, mentoring program design and project significance.

Originally, data from the MIM pilot study were to be available for analysis and interpretation for Ms. Markin's thesis. However, due to delays in forming a collaboration with BBBSGM, designing the MIM program, obtaining ethics approval for the MCH Review Ethics Board and securing financial support, the study has not sufficiently progressed for results to be incorporated into the thesis. However, since the design of the research protocol represents original and independent work of Ms. Markin, it is presented in Section 10.0 of the thesis.

10.0 RESEARCH DESIGN

10.1 Background

Childhood obesity has progressed to become a leading health condition in Canada. Obese children not only present with health risk factors such as high blood pressure and impaired insulin response (McMurray *et al.*, 1995; Sinaiko *et al.*, 2001) but must also contend with many psychosocial issues of overweight (Young-Hyman *et al.*, 2003; Stradmeijer *et al.*, 2000; Pesa, Syre & Jones, 2000). Given the marked prevalence of childhood overweight in Canada (Tremblay & Willms, 2000) and other countries, there is concern that chronic health complications, including cardiovascular disease and type 2 diabetes mellitus (DM), will present earlier in a larger proportion of the population, placing stress on social and healthcare delivery systems (Lobstein, Baur & Uauy, 2004). In 2001 alone, over 4.3 billion Canadian healthcare dollars were spent on treating obesity-related conditions (Katzmarzyk & Janssen, 2004). Obviously, interventions for treatment of childhood obesity are essential to the current and future socio-economic and health status of the population.

Physical activity (PA) level is an important determinant of weight status. In general, levels of PA decrease as children age, with the most significant decline occurring during transition from childhood to adolescence (Goran *et al.*, 1998a; Sallis, 1993). In fact, only 46% of Canadian youth 12 to 19 years meet the minimal guidelines for daily PA (Canadian Fitness and Lifestyle Research Institute, 2002). In addition, severity of overweight is inversely related to participation in structured or non-structured PA, with participation in sedentary activities a positive risk factor for overweight (Tremblay & Willms, 2003). As such, it is presumed that health promotion and intervention programs aimed at increasing levels of PA and decreasing levels of physical inactivity may help to curb the severity of overweight in obese adolescents.

Physicians play an integral role in the management of childhood obesity by advocating for healthy lifestyle changes and tracking changes in health (Shephard, 2004). Although physicians do counsel obese adolescents on the health benefits of PA, guidance usually ends there. Multidisciplinary programs that do involve professional care have helped to improve the weight and health status of obese adolescents (Owens *et al.*, 1999;

Braet *et al.*, 2003; Gately *et al.*, 2000); however, they require considerable financial and professional resources. Affordable PA programs such as recreational sport teams are readily available in the community, but they may not address the social, skill and resource barriers experienced by obese adolescents (Zabinski *et al.*, 2003; Trost *et al.*, 2001). They also may not consider safe health management of this high-risk population.

One innovative and affordable approach to PA behaviour modification is mentoring. Although outcomes of mentor programs are shown to vary according to program design and strength of mentor-protégé relationships, they have proved beneficial to youth, particularly those from lower socio-economic environments (Sipe, 2002; DuBois *et al.* 2002), in increasing self-worth and social skill attainment while diminishing high-risk behaviors (Moody, Childs & Sepples, 2003; King *et al.*, 2002). Successful mentoring programs promoting physical activity are known to exist, such as *Go Girls! Healthy Bodies, Healthy Minds* (Ontario Physical and Health Education Association, 2003); however, their accomplishments are based on advocacy rather than scientific investigation. In addition, the programming does not involve care from a primary healthcare provider. As such, a one-year, community-based pilot study has been devised where, in addition to physician care, obese adolescents will be referred to a PA mentoring program, called Mentors in Motion, to determine the impact of mentoring on PA habits and overall health.

10.2 Project Collaborators and Study Location

The three collaborators for this pilot study—McGill University, the MCH and BBBSGM—will be working cohesively on this project, with the scope of responsibilities outlined in a collaboration agreement. In brief, McGill University will be responsible for designing and administering the study, interpreting data results and acting as liaison between MCH and BBBSGM. MCH will provide the patient population for the study, location for data collection, primary physician care and will be held responsible for the welfare of study participants. BBBSGM will be responsible for the recruitment, screening, training and welfare of the mentors, as well as for

matching and following the mentoring pairs. McGill University will work in close collaboration with BBBSGM on all aspects of the mentoring program.

The three primary locations for this investigation include: 1) the MCH, which will provide patient consultation, initial evaluation and follow-up visits; 2) the BBBSGM office, where mentors will be screened/trained and adolescents will be interviewed by BBBSGM psychologists for appropriate matching to a mentor; and 3) recreation facilities and grounds in the greater Montreal area, where the mentoring pairs will exercise at their discretion and in group activities organized by BBBSGM.

10.3 The Research Team

Dr. Laurent Legault, MD, is principal investigator on this project. He is a pediatric endocrinologist with more than 10 years experience and expertise in the screening and prevention of chronic diseases related to obesity. Dr. Grace Egeland brings expertise in research design, statistical analysis and will ensure the scientific integrity of the project. Dr. Margaret Cargo brings experience on the evaluation of youth mentoring programs, diabetes prevention, qualitative data analysis and community-university partnerships. Carrie Markin, BSc, CFC, is a kinesiologist with over 6 years experience in health promotion, education and fitness program development for adults and youth. She will act as project coordinator and liaison between McGill University, MCH and BBBSGM.

10.4 Methods and Evaluation

10.4.1 Subjects

This pilot study plans to recruit forty adolescent females 14-16 years old from wait lists for treatment of obesity at the MCH Weight Management Clinic and the Adolescent Clinic. To be eligible for the study, subjects must be classified as obese with a body mass index-for-age above the 95^{th} percentile. Although the program will eventually be offered to adolescents of both genders 13 to 18 years, only females will be selected to simplify both the implementation of the new program and statistical analyses

of the data. In addition, a larger proportion of the physician's patient population is female, which will make for easier subject recruitment versus male subjects. A more narrow age range, between 14 to 16 years, will help to minimize the between-subject differences in psychological and physiological development.

Subjects with medical conditions contraindicative to physical activity (PA) or organic cause of obesity will be excluded from the study. Participants will also be ineligible if they are currently on an exercise/nutrition weight loss program or taking medication that interferes with weight maintenance, blood glucose and/or blood lipid metabolism.

Twenty same sex mentors will be recruited by BBBSGM from the local Montreal community via media exposure (i.e. newspaper, volunteer clubs, advertisements in fitness facilities). Mentors at least 20 years of age currently leading an active lifestyle, with knowledge on healthy living and experience working with adolescents will be recruited. Potential mentors will not be considered if they cannot commit to one year of mentoring or refuse to undergo a routine police background check.

10.4.2 Data Collection

Both qualitative and quantitative data will be collected from the study participants on four separate occasions: at baseline, three months, 6 months and one year. Figure 10-1 summarizes the timeline and progression of the study.

Various chronic disease risk factors, many of which have been shown to improve with PA training and/or weight loss in youth (Owens *et al.*, 1999; Gutin *et al.*, 1995; Kang *et al.*, 2002; Reinehr *et al.*, 2003), will be measured for this pilot study. A fasting blood sample will be collected to examine insulin, glucose, triglycerides, total cholesterol, low-density cholesterol (LDL-c), high-density cholesterol (HDL-c), and apolipoprotein-B (Apo-B) levels. Anthropometric measurements will include weight, height, body mass index (BMI) and waist circumference. Resting heart rate and blood pressure will be taken using a Dinamapmachine. Submaximal exercising heart rate will be calculated using a Polar heart-rate monitor immediately following a 3-minute aerobic step test adapted from the Canadian Society for Exercise Physiology protocol (CSEP, 1998). It involves

stepping up and down on a step of specified dimensions at a slower cadence of about 102 footplants/minute. Since patients will arrive at the clinic fasted, they will receive a juice and a healthy breakfast snack immediately after blood samples are taken and will wait at least 45 minutes before conducting the aerobic step test.

Changes in PA habits will be measured by the Modifiable Activity Questionnaire for Adolescents Questionnaire (Aaron, Kriska & Dearwater, 1993). This questionnaire provides a reasonably valid quantitative measurement of exercise within the past two weeks and past year (Aaron *et al.*, 1995), and can assess "light" activity, "vigorous" activity, sedentary habits and total activity levels in metabolic equivalent hours per week (MET-h/wk).

To objectively measure activity levels, participants will be asked to wear a pedometer (distributed at each clinic visit) and record their activity in a logbook for seven days. The logbook will not be used for statistical purposes, but as a tool to gather qualitative information on PA that cannot be collected by the pedometer (i.e. frequency, duration, intensity and type of activities). Although pedometers have research limitations, including the inability to detect magnitude and non-ambulatory movements, its affordability and small, lightweight size make it a convenient, objective tool for determining relative changes in movement over repeated measurements (Tudor-Locke *et al.*, 2002).

Changes in psychosocial determinants will be examined by questionnaire. Self-perception, including self-acceptance, athletic competence and physical appearance, will be measured using 3 subscales of 5 questions each from Harter's questionnaire on perceived competence (Harter, 1982).

Both PA and nutrition play an integral role in health and weight management; however, given the sensitivity and complexity surrounding disordered body image and disordered eating in overweight female adolescents, this pilot study will only attempt to modify PA habits. Nonetheless, dietary assessment tools will be administered at 3 months. The purpose is not to estimate dietary adequacy, but to characterize habitual dietary behaviors to learn more about the at-risk population to guide future intervention strategies. We will use a tool developed in Sweden that examines the timing of meals and snacks and the time interval between eating (Forslund *et al.*, 2002). Disordered eating

and emotional eating will be assessed, and questionnaire instruments are currently being evaluated for their appropriateness for the study (Popkess-Vawter & Owens, 1999; Lombardo *et al.*, 2004).

In-depth qualitative interviews with the mentors and the adolescents will be conducted at the end of the study to understand strengths and weaknesses of the mentoring relationships, and to explore potential factors contributing to improvements in PA levels and health. This information will be used to refine the program and to develop future studies that will more closely examine interactions between the mentor-protégé pairs, such as provider effect.

In addition to the above, a demographic questionnaire will be administered at baseline to the adolescents and mentors. Feedback questionnaires will be administered at each follow-up visit for the adolescent participants and via telephone to each mentor. This preliminary assessment of the pilot study will be important for any early-stage revisions.

10.4.3 Research Design

After obtaining informed consent from the adolescent subjects and parents, baseline measures will be taken and subjects will be randomized (block stratification) to one of two treatments: "usual care" (control group, n=20) or "usual care + mentoring" (intervention group, n=20), as outlined in Figure 10-1.

"Usual care" refers to obesity treatment practices of the study physician, which include discussion on the participant's current health status, benefits of healthy weight management and guidelines for healthy exercise and nutrition habits. During their initial clinic visit, the physician will offer identical nutritional advice and will provide and discuss Canada's Food Guide and a list of tips for healthy eating. Adolescents in this treatment group will be placed on a waiting list for the mentoring program and will have first priority to enrollment at the outset of the study.

"Usual care + mentoring" refers to physician intervention plus referral to MIM. BBBSGM normally receives the profile of a youth before allocating an appropriate mentor, and they normally train mentors in groups. Since recruitment of adolescent subjects is expected to be on-going, with 2-3 subjects recruited per week over the course

of at least 3 months, adolescents will likely have to be placed on a wait list for 1-2 months before appropriate mentors have been selected and trained. In this case, Day 1 of the intervention will commence on the first day of PA with the mentor. The variation in time-to-treatment between subjects will be controlled for in the statistical analyses.

Potential mentors will be screened, interviewed and selected by BBBSGM according to pre-determined criteria, and in agreement with McGill University. The mentors will also sign an informed consent, as demographic data and program feedback will be collected from them. During their training session, mentors will become familiarized with goals and objectives of a mentor-protégé relationship. They will also receive information on exercise physiology, safety, special considerations in working with adolescents who are obese, and will complete several role plays that deal with situations such as resistant behaviour and overtraining. Training will be conducted by a kinesiologist (McGill University) and BBBSGM psychologists and caseworkers.

The adolescents and their guardians will be interviewed by psychologists at BBBSGM for appropriate matching according to geographic location, personalities and common interests. The initial orientation between the mentoring pair will be facilitated by BBBSGM and the McGill University liaison. During this time, the adolescents and mentors will receive program manuals and will be asked to set goals and sign contracts of commitment. After this, the mentoring pair will meet over a one-year period for at least one hour weekly to participate in PA's of choice. These sessions will be self-directed with the pair deciding on time, location and type of activity. During this time, mentors will educate the adolescents on benefits of PA, as well as encourage them to increase PA habits on other days of the week. Mentors will also work with the youth to progressively improve their levels of physical fitness, with an emphasis on fun and variety of activities.

For the first month, emphasis will be placed on participating in fun activities to develop self-worth and self-efficacy: the primary goal is to get the adolescents moving and to familiarize them with various types of PA. The mentors will then continue to develop the fitness and skill levels of the adolescents for the activities they enjoy the most and feel they would like to participate in long-term. The mentors will also encourage the adolescents to be active on at least two other days of the week (a realistic goal for increasing levels of PA), as well as to decrease sedentary habits.

In addition, all study participants will receive PA incentives (e.g. facility passes, equipment rentals) for attending follow-up appointments.

10.5 Sample Size and Statistical Analyses

This intervention is designed to increase PA habits and improve physical fitness; therefore, submaximal exercising heart rate was a chosen primary outcome variable upon which to base sample size. The sample size needed to evaluate overall group differences between treatment and usual care groups was estimated to be 16 for each group (α=0.05, power = 0.90) and was calculated based on an effect size between two groups of 2.0 (SD=1.7) for submaximal heart rate. In considering the potential for a drop-out rate of 20%, the sample size was increased to 20 per treatment group (1/[1-0.2]=1.25, 1.25*32=40).

Student t-tests will be conducted to examine differences in baseline values of heart rate, BMI, waist circumference, lipids, and blood pressure between the treatment and usual care group. General linear models will further examine baseline differences in risk factors between the treatment and usual care group taking into account age (in months). Change scores will be calculated for each risk factor by subtracting the value measured at each follow-up from the baseline value and examined for normality. General linear models will be used to evaluate the change in each risk factor between the treatment and usual care group, adjusting for baseline age (months) and duration of follow-up (days). Given scheduling constraints for the follow-up, not all participants are expected to be re-tested at precisely 3, 6, and 12 months following the baseline measurements. Thus, duration of follow-up will be entered as a covariate in most analyses. Also, as change scores are known to be influenced by the extent of extremeness in baseline values, the baseline value of the risk factor being analyzed will also be entered into multivariable models. Because the patient population is a relatively homogeneous high-risk patient population, it is not anticipated that extreme values will be more prevalent in any one of the groups and bias the results. However, the data will be evaluated for this potential problem. At the end of the study, analyses of variance will be conducted to examine overall level of each risk factor at baseline, at 3, 6 and 12 months. An additional

multivariable general linear model approach will enable an examination of additional covariates such as baseline age (months) and duration of follow-up in analyses of risk factor changes between first and last visit and between the second/third and last visit. Changes scores for pedometer readings between baseline and each follow-up, as well as between follow-up visits, will also be analyzed.

10.6 Relevance, Innovation and Responsiveness

Childhood obesity is not only a concerning health problem but also a social issue that must be addressed at the level of the community. Mentors in Motion is an innovative intervention program that integrates accessible community services with physician care to help ensure safe, cost-effective and individualized health management of obese youth. It is believed that Mentors in Motion will help to increase PA habits, enhance mental well-being and favorably improve risk factors for chronic disease. This program also offers the opportunity to take a closer look at the PA and nutritional habits of adolescents who are obese. If successful, Mentors in Motion will expand further to explore nutrition interventions, and will serve as a template for a larger-scale referral program—a program that will bridge affordable and accessible community services with professional care in the fight against juvenile obesity.

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Table 6-1. Anthropometric Measurements For Most Recent Clinic Visit

	All Subjects (n=89) Mean (SD)	Male (n=43) Mean (SD)	Female (n=46) Mean (SD)
Age (y)	14.1 (1.37)	14.1 (1.35)	14.2 (1.4)
Weight (kg)	95.7 (24.6)	93.1 (26.9)	98.2 (22.3)
Height (cm)	164.3 (9.5)	165.8 (10.9)	162.9 (7.8)
BMI (kg/m^2)	35.1 (6.8)	33.3 (6.2)	36.8 (7.0) *
Percentiles-for-age			
Weight	97.5 (4.7)	97.5 (4.5)	97.5 (5.0)
Height	63.3 (29.9)	62.6 (28.5)	63.9 (31.4)
BMI	98.3 (2.1)	98.5 (1.2)	98.1 (2.7)
Z-scores			
Weight	2.44 (0.71)	2.46 (0.76)	2.42 (0.66)
Height	0.45 (1.12)	0.40 (0.99)	0.50 (1.24)
BMI	2.29 (0.38)	2.28 (0.34)	2.29 (0.43)

* Significant difference between males and females $p \leq 0.05$

Table 6-2. Biochemical Measurements For Most Recent Clinic Visit

	All Subjects		Male		Female	
	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)
Blood Glucose (mmol/L)						
Fasting	53	4.89 (0.53)	24	4.90 (0.39)	29	4.88 (0.63)
OGTT (0min)	25	4.73 (0.60)	11	4.66 (0.34)	14	4.79 (0.75)
OGTT (120 min)	25	6.26 (1.92)	11	5.94 (0.93)	14	6.51 (2.45)
Insulin (pmol/L)						
Fasting	23	306.6 (224.2)	8	172.8 (100.1)	15	378.0 (241.5) *
OGTT (0min)	21	249.3 (251.3)	8	325.1 (370.9)	13	202.6 (137.1)
OGTT (120 min)	21	1208.0 (883.9)	8	1416.4 (1073.1)	13	1079.7 (764.0)
ALT (U/L)	55	37.27 (33.50)	24	44.67 (44.94)	31	32.10 (20.58)
Lipid Levels (mmol/L)						
Total Cholesterol	72	4.52 (0.79)	36	4.52 (0.83)	36	4.51 (0.74)
LDL	67	2.72 (0.70)	34	2.73 (0.72)	33	2.72 (0.68)
HDL	68	1.19 (0.27)	35	1.12 (0.24)	33	1.26 (0.29) *
TG	72	1.36 (0.75)	36	1.49 (0.92)	36	1.22 (0.50)

* Significant difference between males and females $p \leq 0.05$

Table 6-3. Clinical Measurements For Most Recent Clinic Visit

	All Subjects		Male		Female	
	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)
Resting HR (bpm)	71	84.2 (11.5)	33	84.8 (12.5)	38	83.7 (10.7)
Blood Pressure (mmHg)						
Systolic	76	128.4 (14.0)	37	132.8 (12.5)	39	124.2 (14.3) **
Diastolic	76	67.4 (10.8)	37	68.7 (10.5)	39	66.2 (11.0)

* Significant difference between males and females $p \leq 0.05$

** Significant difference between males and females $p \leq 0.01$

Table 6-4. Proportion of Patients with Clinical Signs and Health Complications

	All Subjects (n=89) % (n)	Male (n=43) % (n)	Female (n=46) % (n)
Clinical Sign			
Acanthosis Nigricans	47.0 (42)	39.5 (17)	54.3 (25)
Hirsutism	---	---	23.9 (11)
Gynecomastia	---	30.3 (10)	---
Health Complications			
PCOS	---	---	40.0 (17)
Sleep Apnea	5.6 (5)	4.7 (2)	6.5 (3)
Asthma	14.6 (13)	18.6 (8)	10.9 (5)
Hypertension	6.7 (6)	7.0 (3)	6.5 (3)
Dyslipidemia	5.6 (5)	2.3 (1)	8.7 (4)
Hepatic Steatosis	1.1 (1)	2.3 (1)	0.0 (0)
Metabolic Syndrome	2.2 (2)	0.0 (0)	4.3 (2)
Type 2 Diabetes Mellitus	1.1 (1)	0.0 (0)	2.2 (1)

* $p \leq 0.05$, chi-square test for differences between males and females

Table 6-5. Proportion of Patients With Family History of Health Risk Factors

	All Subjects (n=89) % (n)	Male (n=43) % (n)	Female (n=46) % (n)
Risk Factor			
Overweight/Obesity	57.3 (51)	53.5 (23)	60.9 (28)
Cardiovascular Disease	38.2 (34)	46.5 (20)	30.4 (14)
Type 2 Diabetes Mellitus	61.8 (55)	55.8 (24)	67.4 (31)

* $p \leq 0.05$, chi-square test for differences between males and females

Table 6-6. Mean Change Scores in Anthropometry Between Baseline and Most Recent Clinic Visit

	All Subjects (n=66) Mean (SD)	Male (n=33) Mean (SD)	Female (n=33) Mean (SD)
△Weight (kg)	-0.64 (3.07)	-0.54 (2.18)	-0.73 (3.80)
△Height (cm)	7.27 (7.52)	9.06 (7.12)	5.48 (7.59)
△BMI (kg/m^2)	2.26 (4.18)	1.64 (3.37)	2.89 (4.83)
Percentiles-for-age			
△Weight	-0.64 (3.07)	-0.54 (2.18)	-0.73 (3.80)
△Height	-9.53 (14.80)	-8.79 (13.73)	-10.28 (15.99)
△BMI	-0.27 (1.48)	-0.18 (1.00)	-0.36 (1.84)
Z-scores			
△Weight	-0.08 (0.33)	0.00 (0.33)	-0.16 (0.31) *
△Height	-0.42 (0.53)	-0.37 (0.48)	-0.48 (0.57)
△BMI	-0.04 (0.22)	-0.01 (0.19)	-0.06 (0.23)

* Significant difference between males and females $p \leq 0.05$

Table 6-7. Linear Regression Beta (SE) Coefficients for Time, Age and Gender in Predicting Change in BMI-for-Age Percentiles and Z-scores

	Δ BMI-for-Age Percentile			Δ Z-score for BMI-for-Age		
	β	SE	p-value	β	SE	p-value
Model 1						
Intercept	-0.504	0.321	0.12	-0.072	0.047	0.13
Time	0.120	0.135	0.37	0.017	0.020	0.39
Model 2						
Intercept	2.023	1.935	0.30	0.265	0.283	0.35
Time	-0.010	0.175	0.96	0.002	0.026	0.93
Age	-0.162	0.133	0.23	-0.019	0.019	0.33
Gender	-0.190	0.365	0.61	-0.49	-0.114	0.37

FIGURES

Figure 2-1. Program Logic Model Diagram (Schalock & Bonham, 2003)

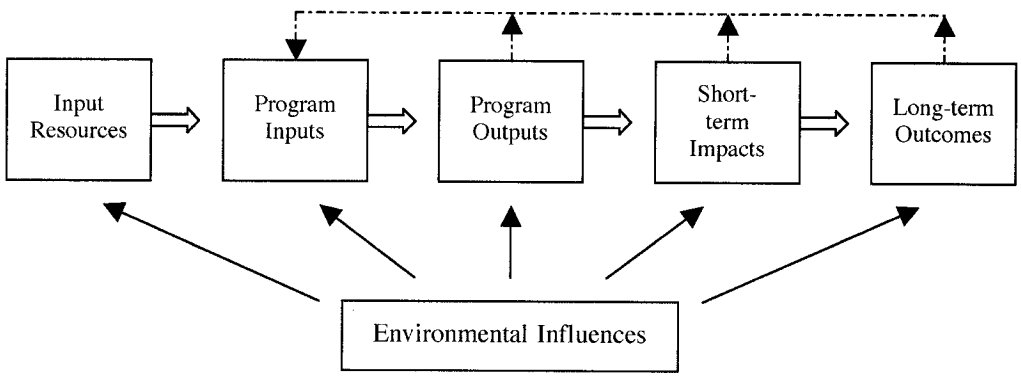


Figure 6-1. Montreal Metropolitan Area Map Indicating the Geographic Distribution of the Patients

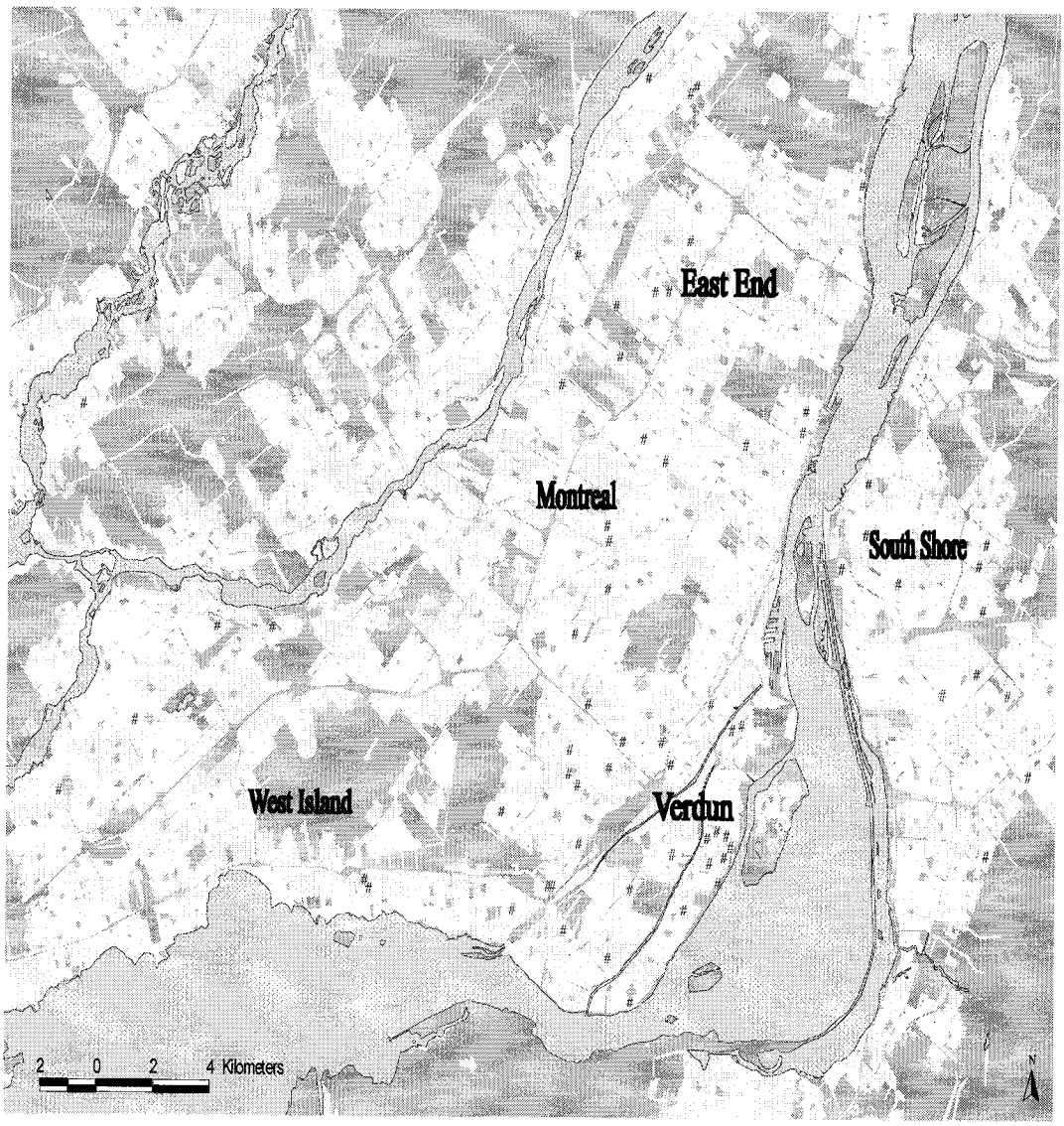


Figure 6-2. Change in BMI Percentile Over Years of Follow-Up For Males and Females

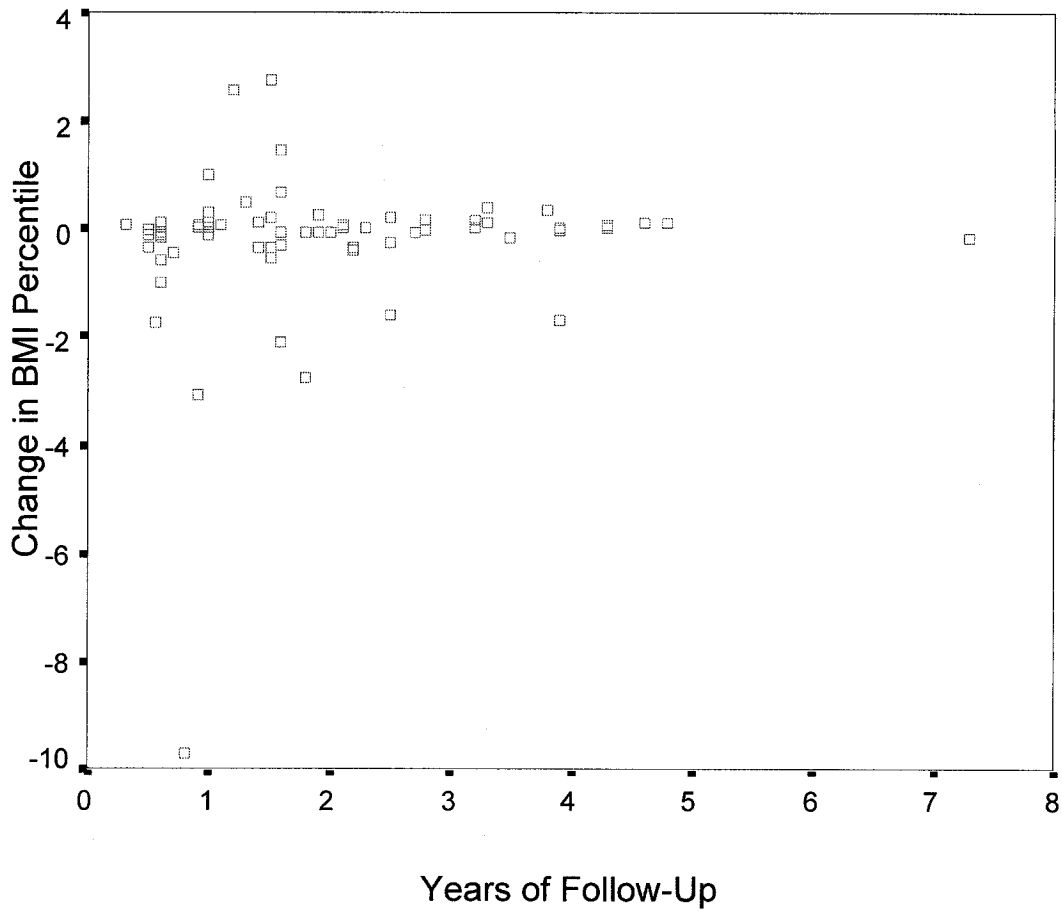


FIGURE 9-1A. Missions and Goals

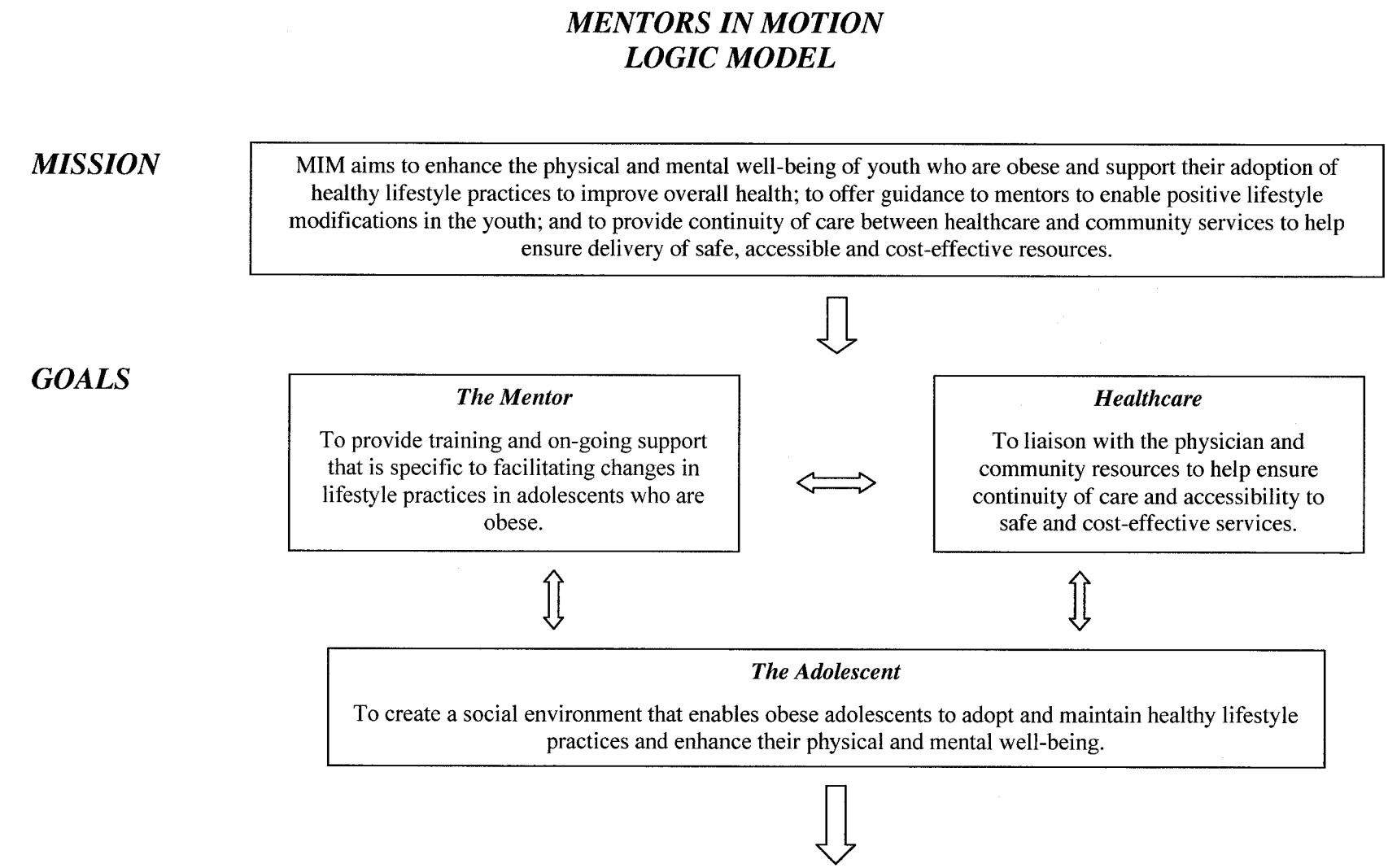


FIGURE 9-1B. Philosophy and Pyschosocial & Youth Development Links

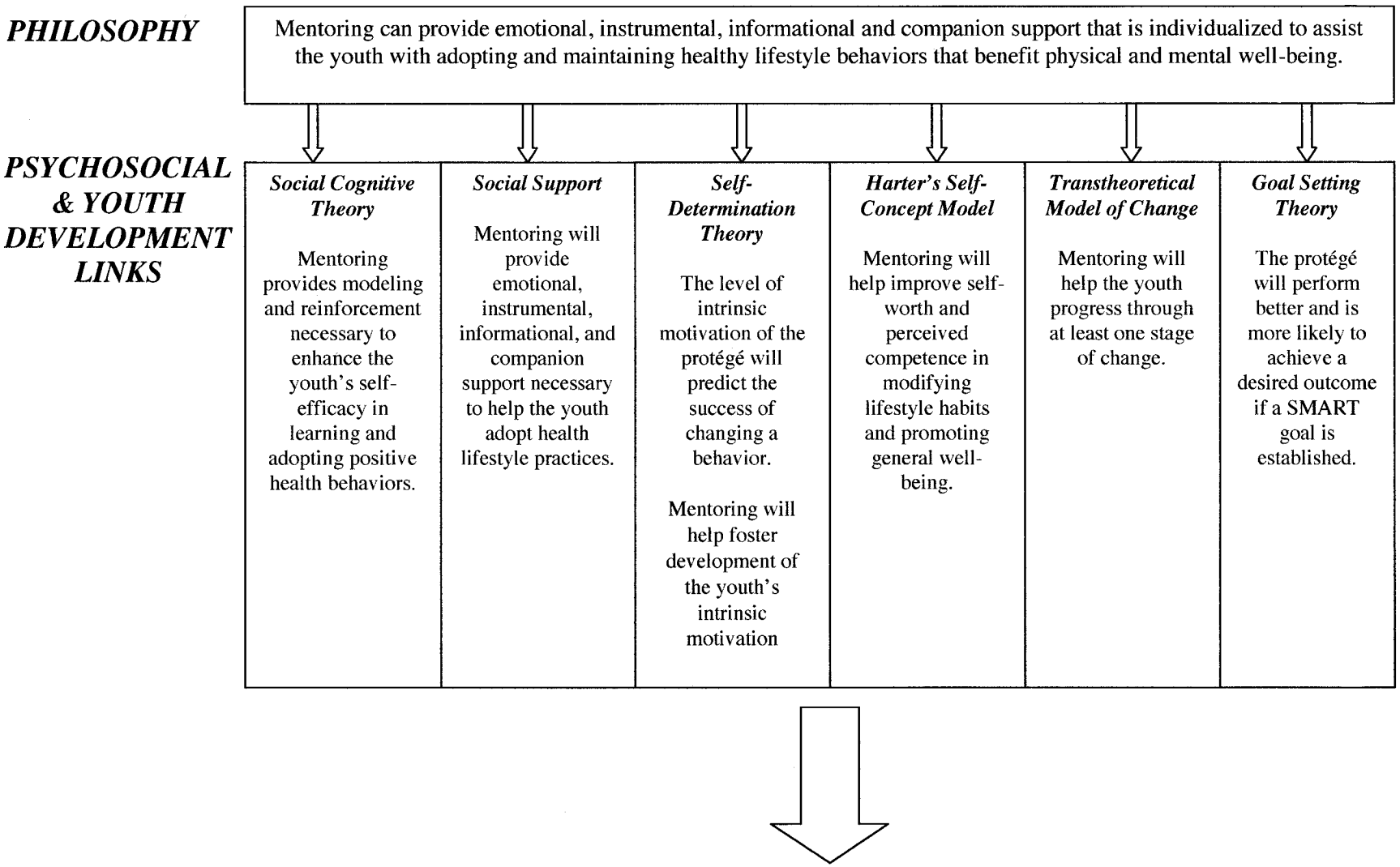


FIGURE 9-1C. MENTORING TRAINING PROGRAM

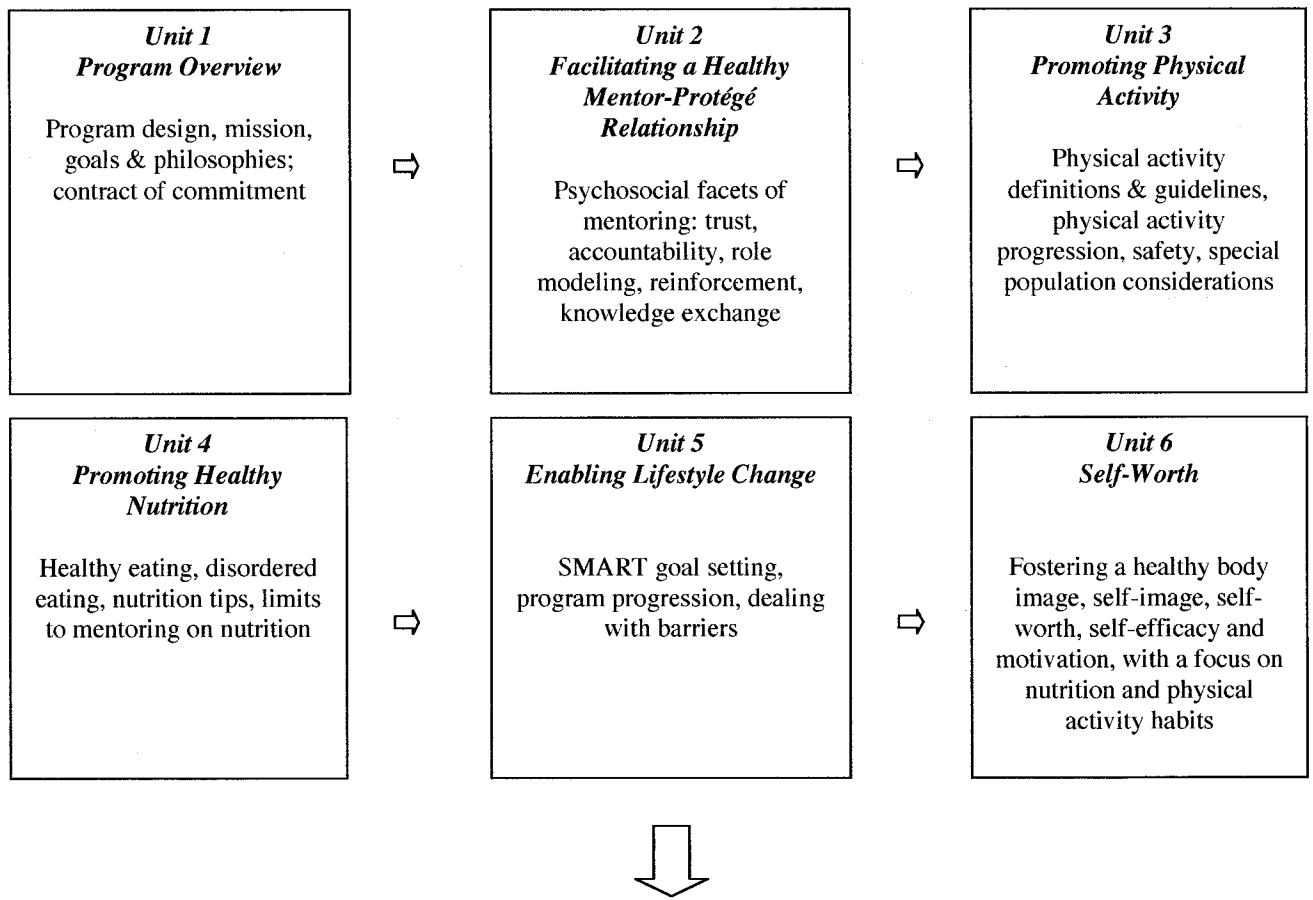


FIGURE 9-1D. Program Administration

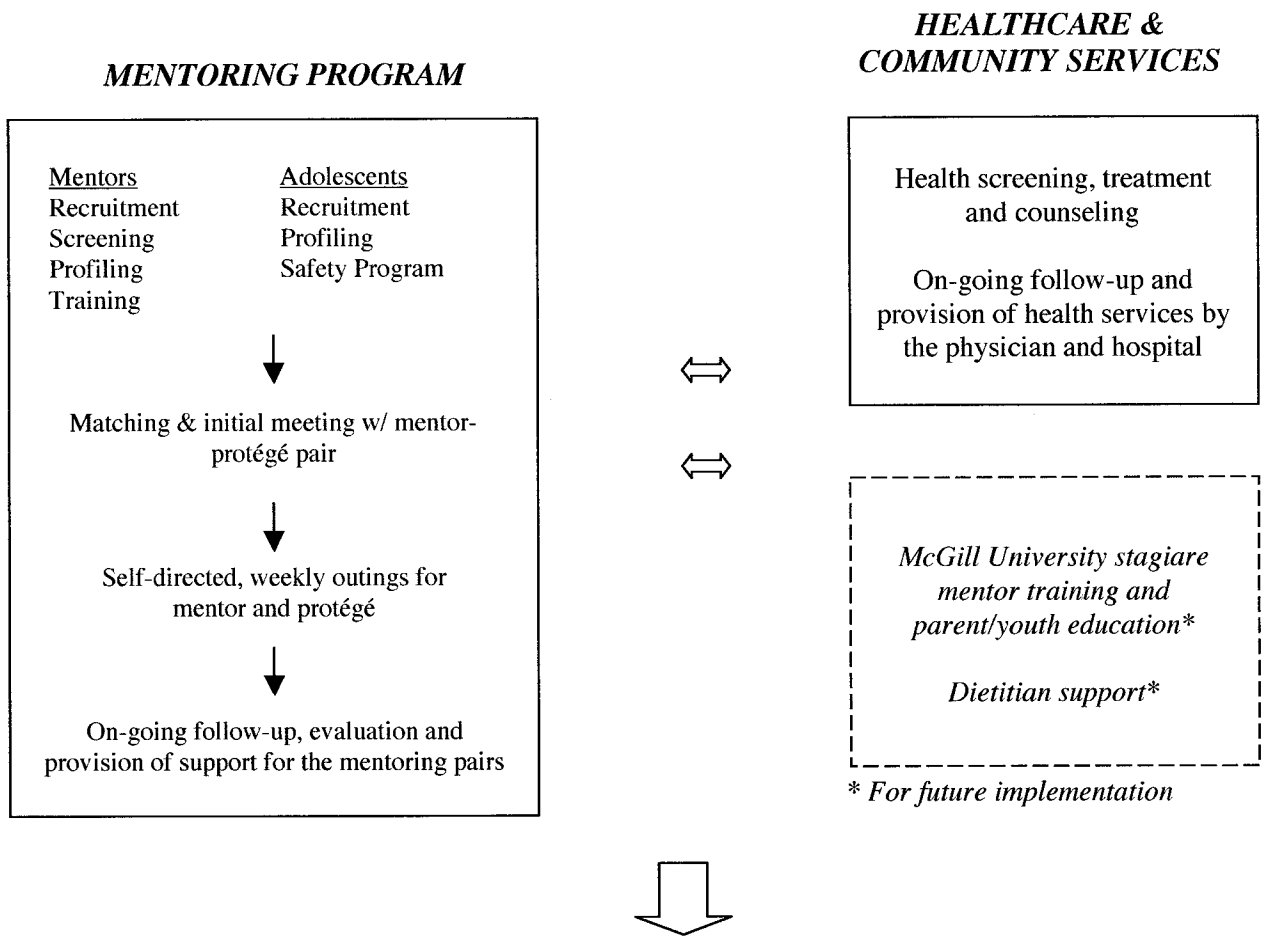


FIGURE 9-1E. Program Impacts and Outcomes

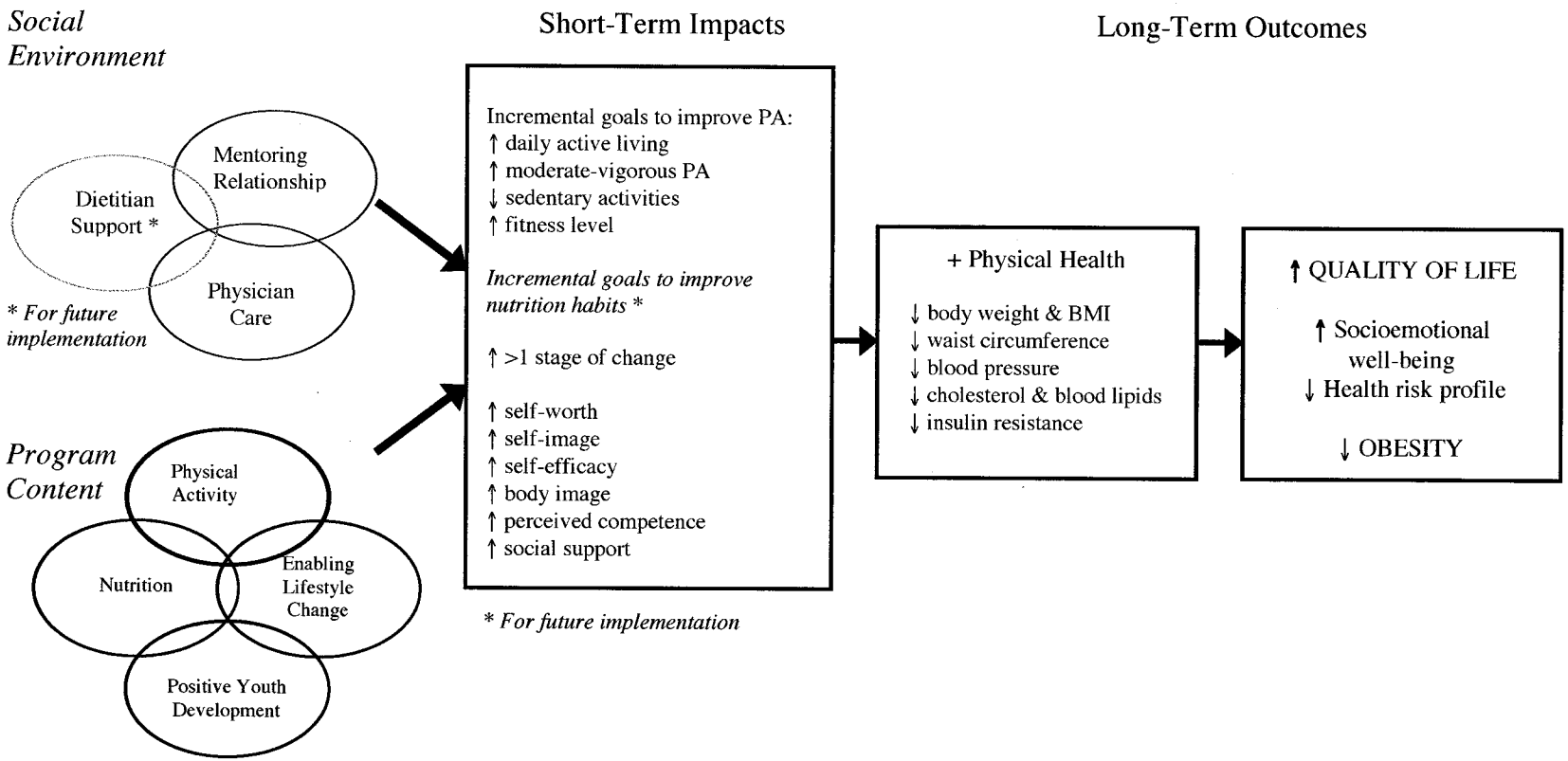
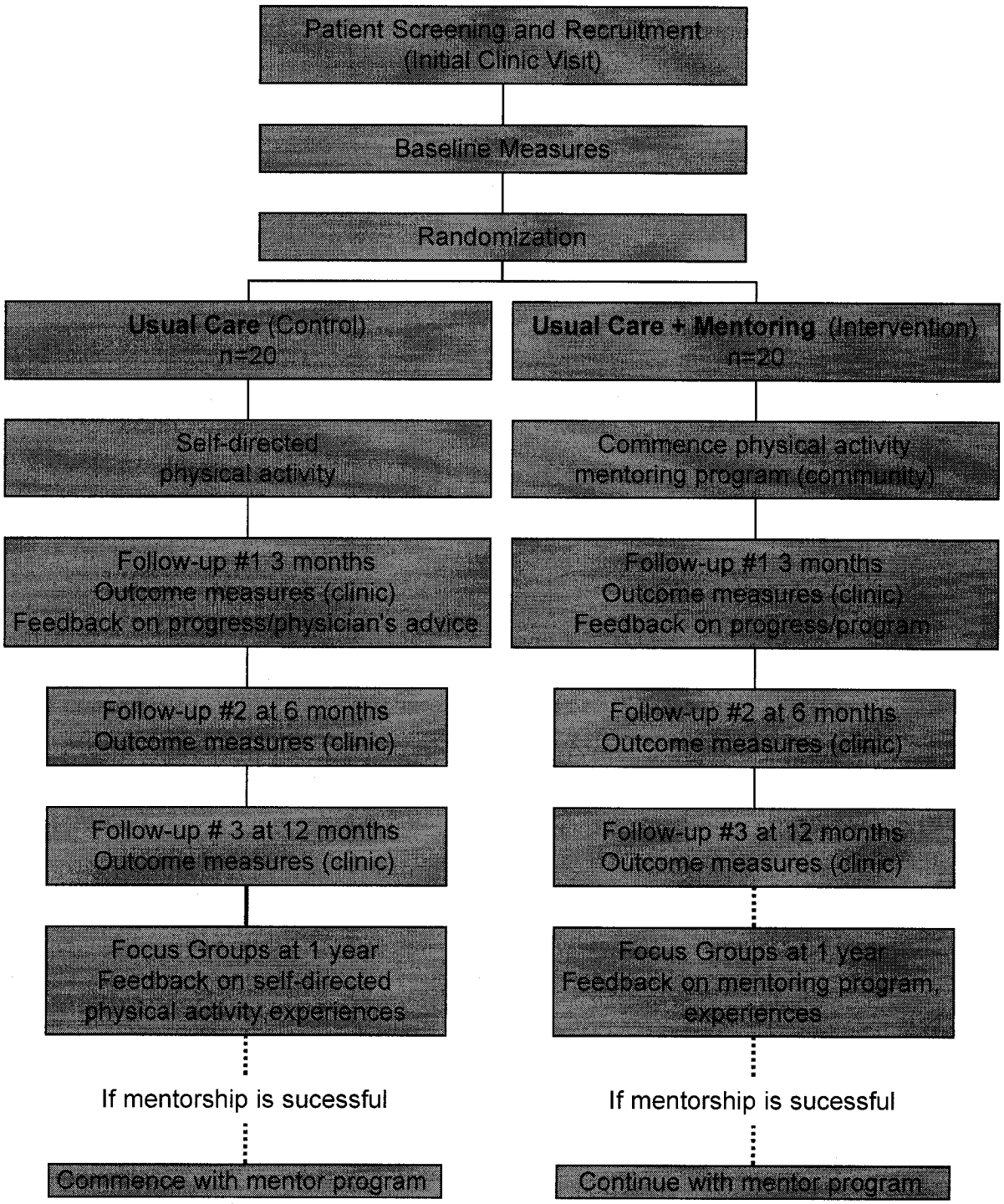


Figure 10-1. Mentors in Motion: One-year Timeline



Appendix B- CTV Internet News Clipping on Mentors in Motion

CTV.ca

Overweight teens to be given health mentors

About 15 per cent of Quebec teens are overweight or obese.

Dr. Laurent Legault is an endocrinologist for Montreal Children's Hospital.

CTV.ca News Staff

Updated: Wed. Jun. 15 2005 6:58 PM ET

In a new program called Mentors in Motion, researchers will observe 80 overweight Quebec teenagers for a year. Half of them will be paired with mentors from Big Brothers and Big Sisters of Canada, and encouraged to lead a healthier lifestyle. The other half will be left on their own.

"We're hoping that the results will be that the kids, after this is all said and done, will continue having good habits in terms of keeping active on a regular basis," says Dr. Laurent Legault, an endocrinologist for Montreal Children's Hospital.

Legault also hopes that the teens will be become fitter than when they were first assessed.

It is estimated that 15 per cent of Quebec youth are overweight or obese, and that the number is growing. Health risks can include high blood pressure and cholesterol levels.

Mentors in Motion was conceived by graduate nutrition student Carrie Marin, who believes the program will do more than help teens lose weight.

"Of course weight is a risk factor but the primary focus of the program is to help them adapt a healthy lifestyle," she says. "And develop a very healthy self-esteem about themselves."

Manuel Abdul-Rahman is a Big Brother who also studies phys-ed at the University of Montreal. "It's in my field, so if I can help kids while doing something I love, like sports and nutrition, well I guess that's my goal."

Vanessa Tardio is a Big Sister who mentors an overweight 15-year old girl. She wants to show her charge that "staying inside and playing on the internet isn't all there is to it."

Researchers will evaluate the teens every three months, with a final evaluation at the end of the year.

Big Brothers Big Sisters will be starting a similar program for overweight children in elementary and secondary schools in Montreal. It will begin this September.

With a report from Herb Luft, CFCF News

Appendix C- *The Gazette* News Clipping on Mentors in Motion

THE GAZETTE, MONTREAL, THURSDAY, JUNE 16, 2005

Mentors to get kids moving

There's big, and then there's really Big.

The Big Brothers and Big Sisters of Montreal are working with the Children's Hospital on an innovative program to help kids with weight problems. Mentors in Motion hooks up obese adolescents with Big surrogate sibs who turn the teens on to the virtues of good diet and exercise.

The program was developed by Carrie Markin, who is pursuing a master's degree in nutrition at McGill. Markin's commitment to good food and physical activity was forged during her youth. Because Markin's mother had been overweight as a child, she preached sensible eating to her daughter.

"My mother had gone through a lot of negative experiences," Markin said. "She worried about my overall well-being, so she put me in dance classes and tried to instill healthy eating habits – even though I had the worst sweet tooth in the world.

"There were always home meals and nutritious snacks in my lunch. She would sneak healthy food into my diet without me realizing it was healthy."

But what about kids who don't have sneaky parents?

Markin thought mentoring might help adolescents whom the Children's has diagnosed as obese. Doctors liked her idea, Big Brothers and Big Sisters came aboard, and Mentors in Motion got moving with 20 teens who will participate over the course of a year.

MIKE BOONE
ON YOUTH OBESITY

"At best shunned and, at worst, actively tormented, fat kids are not happy."

None too soon. Statistics cited during a news conference at the hospital yesterday indicate that obesity – an epidemic at every level (with the exception of Purina-gobbling seniors) of our supersized society – is a particular problem among young people.

In 1981, 10.6 per cent of boys between the ages of 7 and 13 were overweight. By 1996, the most recent year during which a survey was conducted, the percentage was 32.6. Percentages for girls were 13.1 and 26.6.

That was 10 years ago – before the Internet joined television to form a one-two punch seducing teens into chronic sedentarianism. Teens have increased access to passive entertainment, plus a wide choice of calorie-laden junk to ingest while engaged in what is known, without reference to the food group, as "vegging out."

At best shunned and, at worst, actively tormented by their peers, fat kids are not happy. Self-esteem plummets. Teens feel victimized, some sink into depression.

It's grim. And the situation will deteriorate as overweight teens become obese adults.

"Unhappily, the long-term price society pays will be very high," said Laurent Legault, who runs the weight-management clinic at the Children's. Canada's health system, strained by the demands of aging baby-boomers, will reap the whirlwind of adolescent obesity, as overweight kids become adults prone to diabetes, hypertension and cardiovascular disease.

Markin thinks positive role models can help young people grappling with weight problems. Mentors in Motion won't whisk obese kids off to ballet classes, but talking to a Big Brother or Big Sister about nutrition and exercise should be a step in the right direction.

To become a Mentors in Motion volunteer, phone (514) 842-9715 or go to www.gfgsmtl.qc.ca on the Web.

mboone@thegazette.canwest.com