A NOVEL TELEHEALTH PROGRAM FOR THE TREATMENT OF PEDIATRIC OVERWEIGHT AND OBESITY: A PROGRAM EVALUATION

by

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Abstract

Introduction: High rates of overweight and obesity among children in Canada have created the need for new and innovative strategies to treat the condition and address its underlying causes. Telehealth is an attractive option to reach children and families with barriers to accessing in-person treatment programs. The HealthLink BC Eating and Activity Program for Kids (the Program), a provincial telehealth program staffed by registered dietitians and a qualified exercise professional, was launched in Spring 2015 in British Columbia, Canada. A comprehensive program evaluation was implemented to assess its first 24-months of operation.

Purpose: The purpose of this program evaluation was to assess the effectiveness of a telephone-based childhood obesity treatment program in its initial implementation phase.

Methods: Participant data was obtained from physician referrals to the Program and/or information obtained at intake and upon follow-up (3 and 6 mo). Data includes the scores from a battery of questionnaires measuring: diet, eating behaviours, sleep, physical activity and sedentary behaviour, self-perception, and personal strengths and difficulties. Other data includes height, weight, body mass index (BMI), waist circumference, blood pressure, and the extent of contact with the Program. Baseline measurements were compared with follow-up data obtained after Program completion at 3 and 6 mo.

Results: A total of 55 participants consented to participating in the Program evaluation (25.5% of all referrals). Children in the evaluation generally adhered to the Program, with 56.4% of participants completing at least 70% (5 weekly calls) of the Program. At the 3-month follow-up: participants reduced their consumption of processed grain and meat products, boys increased their fruit and vegetable consumption, both boys and girls increased

total and moderate-to-vigorous physical activity, and reduced their time spent in sedentary pursuits. There were no changes observed in BMI. At 6-months post-intervention, some improvements in diet and physical activity had diminished. Results were impacted by small sample sizes and high variability across the sample.

Conclusion: The Program succeeded at attracting and retaining children and teens referred to its telehealth services. Like many other intervention programs, participants reported modest improvements immediately post-intervention, but generally did not report maintaining positive changes.

Lay Summary

High rates of overweight and obesity among children have spawned many lifestyle intervention programs, which are typically school- or clinic-based and often try to include the child and his or her family. These programs typically include counselling on improving diet, increasing physical activity, or a combination of the two. Right now, these types of programs are the preferred treatment option for children with overweight or obesity.

This thesis describes a first-of-its-kind behavioural intervention program for children, teens, and their families that was delivered almost entirely over the telephone. The goal of this work is to describe: how the novel telehealth program was developed and delivered, the characteristics of young people referred to the telehealth program before they received the intervention, how those young people may or may not have changed over the course of the intervention, and recommendations for this program moving forward.

Preface

The design of the program evaluation was initiated by Anne M. Lasinsky with the collaboration of colleagues at Dietitian Services at HealthLink BC, the Physical Activity Line, Dr. Tanis Mihalynuk, and Dr. Shannon Bredin. Ms. Lasinsky was also responsible for data cleaning and analysis. The entirety of this thesis was written by Ms. Lasinsky with feedback and guidance from the committee. Ms. Lasinsky wrote the text of the thesis and conducted the statistical analyses. Ms. Lasinsky also wrote the ethics for this program evaluation.

Participant recruitment and initial data collection was managed by Dietitian Services at HealthLink BC, as governed by the Information Sharing Agreement between the British Columbia Ministry of Health and the University of British Columbia.

Dr. Shannon Bredin is the Director of the Cognitive and Functional Learning Laboratory and Systematic Reviews Research Laboratory (UBC). She is responsible for overseeing all aspects of the Program Evaluation from its creation to knowledge translation of deliverables. This also includes significant input into the present thesis document and all publications that result from this dissertation. The Healthy Eating and Activity Program for Kids was conceptualized by Dr. Shannon Bredin, Barb Leslie (HealthLinkBC), and Dr. Tanis Mihalynuk (HealthLinkBC) beginning in November 2012 with advisory input from Lisa Forster-Coull (Ministry of Health) and Janice Linton (Childhood Obesity Foundation) throughout 2013. A feasibility report was also prepared by Zena Simces and Sue Ross (May 2013), and submitted to the Ministry of Health and the Childhood Obesity Foundation prior

to commencing implementation of the Program at HealthLinkBC. The program was a joint collaboration between Dietitian Services at HealthLinkBC and the Physical Activity Line at the Health and Fitness Society of BC.

Dr. Tanis Mihalynuk was responsible for providing input on the evaluation clinical, social, economic and behavioural variables, type, approach, ethics application and privacy impact assessment. Dr. Mihalynuk also helped to develop several key assessment tools, including the evaluation timeline, food intake and security measures, and demographic forms. She developed a new diet quality, quantity and patterns tool to support this novel program, evaluation and related dissertation needs. She was also instrumental in developing and coordinating the external data quality assurance processes at HealthLink BC. Dr. Mihalynuk has reviewed and edited all chapters of the thesis and provided substantive feedback. All versions of this work that have been submitted to HealthLink BC in the form of reports or presented as conference posters have also been reviewed and edited by Dr. Mihalynuk.

As the co-Director of the Physical Activity Line, Dr. Darren Warburton was responsible for the creation, implementation, and ongoing evaluation of the Physical Activity Line. He was also responsible for creating policies and procedures to ensure that all related research initiatives adhered to evidence-based best practice standards leading to tangible outcomes that can be effectively translated at the individual and population level. He also provided extensive training and support for qualified exercise professionals and other service providers/staff working at the Physical Activity Line. Dr. Warburton was responsible for overseeing and reviewing this research project, and ensured that staff working at the Physical

Activity adhered to the standards required for evidence-based best practice. Dr. Warburton has reviewed and edited chapters of the thesis.

Ethical approval for this program evaluation was obtained from the University of British Columbia Clinical Research Ethics board, under the approval certificate H14-01375.

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List of Abbreviations

Abbreviations

cm	centimeter – unit of length measurement
f	female
hr	hour
kg	kilogram – unit of mass measurement
kg/m^2	kilograms per meter squared – unit of measurement for body mass index
m	male
mg/dL	milligrams per decilitre
min	minute
mmHg	millimeters of mercury – unit of blood pressure measurement
mmol/L	millimoles per litre
mo	month
wk	week
y	year

Acronyms

BC	British Columbia
BMI	Body mass index
BMI-z	Body mass index z-score – a standardized measure of body mass
BP	Blood pressure
CBL	Child Behavior Checklist
CEP	Certified Exercise Physiologist
CFG	Canada's Food Guide
CHWII	Childhood Healthy Weights Intervention Initiative
DEBQ	Dutch Eating Behavior Questionnaire
DEBQ-C	Dutch Eating Behavior Questionnaire for Children
GSLTEQ	Godin Shephard Leisure Time Exercise Questionnaire
HDL-C	High-density lipoprotein cholesterol

HEAPK	HealthLink BC Eating and Activity Program for Kids
HSPP	Harter Self-Perception Profile
IDF	International Diabetes Federation
ISA	Information Sharing Agreement
LDL-C	Low-density lipoprotein cholesterol
LTST	Leisure time screen time
MEND	Mind, Exercise, Nutrition, Do It
MOH	Ministry of Health
MVPA	Moderate to vigorous physical activity
OGTT	Oral glucose tolerance test
PA	Physical activity
PIA	Privacy Impact Assessment
QEP	Qualified Exercise Professional
RD	Registered Dietitian
RDS	Recommended daily servings
SD	Standard deviation
SDQ	Strengths and Difficulties Questionnaire
SSB	Sugar-sweetened beverages
T2DM	Type 2 Diabetes Mellitus
UBC	University of British Columbia
WC	Waist circumference
WHtR	Waist to height ratio

Glossary

Accuracy: In reference to standards for program evaluation, meaning to reveal and convey technically accurate information.

Appointment Call: The first telephone contact made by Program staff to participants. Program staff will introduce themselves, confirm information provided on the referral form, and establish a date/time for the next telephone appointment.
[Approx. 15 minutes]

Assessment Call: The second telephone contact made by Program staff to participants, which includes a medical history review, clearance for engaging in physical activity (PAR-Q+), and a review of several screening questionnaires.
[Approx. 60 minutes]

70% Attendance of Sessions: Participants who completed at least 5 of the 7 weekly Program Calls.

Effectiveness: The ability to "measure the degree of beneficial effect under real world clinical settings".[1]

Efficacy: The ability to "determine whether an intervention produces the expected result under ideal circumstances."[2]

Feasibility: In reference to standards for program evaluation, meaning to be realistic, prudent, diplomatic, and frugal.

Follow-Up Calls: After completing the seven-weekly phone calls, participants received less frequent follow-up calls from program staff. The first follow-up call is received approximately 1-month after completing the

	weekly calls. Follow-up calls then occur at 3, 4, 5, 6, 9, 12, 18, and 24-months, after completing the weekly calls.
Follow-Up Packages:	Subsequent sets of written materials sent to program participants. The packages include some of the same written questionnaires that were sent in the Welcome Package and are used to assess any changes from the baseline tests. Follow-Up Packages are sent at 6-months after program initiation and again at 24-months after program initiation. All materials may be returned to HLBC using an enclosed self-addressed stamped envelope.
Program Staff:	Primarily referring to the Registered Dietitian and Qualified Exercise Professional, with whom program participants interact.
Initiated Contact:	The number of participants who complete the Appointment Call.
Obese:	In children, having a body mass index measurement above the 97th percentile for age, sex, and height.
Overweight:	In children, having a body mass index measurement between the 85th and 97th percentiles for age, sex, and height.
Participants:	The children/adolescents and their parents/guardians are collectively considered the program participants.

Primary Care Provider Follow-Up: Children and families who enroll in the program are encouraged to visit their primary care provider after completing the program calls (approx. 6-months after referral.) Measures taken upon referral to the program are repeated at this follow-up appointment. Another primary care provider follow-up is recommended one-year after that (approx. 18-months after referral.)

Primary Care Provider Referrals: Children and adolescents who have been referred by their primary care provider, family physician, pediatrician, specialist, and/or other allied health professional.

Program Calls: A total of seven weekly phone calls made by Program staff to participants. Materials cover the topic-based curriculum developed by Program staff. [Approx. 60 minutes each]

Program Referrals: The total number of Primary Care Provider Referrals plus the total number of Self-Referrals to the program plus referrals received from the ShapedownBC and MEND programs.

Propriety: In reference to standards for program evaluation, meaning to behave legally, ethically, and with regard for the welfare of those involved and those affected.

Resource Package:	The second set of written materials mailed to program participants. After specific needs are identified in the assessment call, appropriate written information (e.g. tip sheets, guidelines, activity sheets, etc.) are sent to the family. Written materials can be used as a reference throughout the program.
Retention Rate:	Calculated as the number of participants who have not Withdrawn divided by the number of participants who Started Program.
Rural and Remote Areas:	Small towns, villages, and other populated areas with less than 1,000 individuals according to the current census.
Self-Referrals:	Children/adolescents and their parent/guardian who have contacted the program directly to seek counselling, without a formal referral.
Started Program:	The number of participants who complete the Appointment Call.
Telehealth/ Telemedicine:	Terms used interchangeably to describe clinical support designed to overcome geographic barriers between care providers and consumers in different locations. The purpose of telehealth and/or telemedicine is to improve health outcomes using varying communication technologies.

Utility: In reference to standards for program evaluation: meaning to serve the information needs of the intended users.

Welcome Package: The first set of written materials sent to program participants. The package includes several written questionnaires to be completed by the child and his or her parent/guardian. Written consent and assent to participate in the evaluation is also included. All materials may be returned to HLBC using the enclosed self-addressed stamped envelope.

Withdrawn: Participants who cease communication with the Program for any reason before completing the weekly Program Calls.

Acknowledgements

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Dedication

For my family.

Chapter 1: Introduction

Overweight and obesity among children have been a growing problem in North America for the past several decades[3]. Global rates of obesity among children across the globe are also prompting concern[4]. There are often numerous health-related issues that accompany overweight and obesity in children, and many children with excess weight in early life will remain overweight or obese throughout the lifespan[5,6,7]. The pace at which the prevalence of overweight and obesity has grown has created the need for accessible, evidence-based, intervention programs. While many interventions have been designed and implemented, barriers may still exist for families when trying to access these programs. For example, time commitments, cost, or geographic distance from services may prevent families from participating in intervention programs[8,9,10,11]. One strategy to address the accessibility of programs for children, teens, and parents has been to incorporate electronic forms of communication using telehealth. Telehealth has been integrated into programs in the form of supplemental support, monitoring, and/or content delivery[12–15]. By utilizing telehealth to provide such services, practitioners are able to expand their reach, potentially reduce their costs, and better monitor their clients and patients[16].

The effectiveness of in-person and telehealth interventions for obesity treatment in children is an area of significant research interest. The effectiveness of an intervention refers to one's ability to determine its impact under real world settings[1]. This contrasts with the term, 'efficacy', which refers to the assessment of an intervention under ideal conditions specific to the intervention or trial[17]. Recent recommendations from the Canadian Task Force on Preventive Health Care have argued that behavioural intervention programs are the preferred

course of treatment for children with overweight or obesity[18], so documenting and reporting their effectiveness is of great value. Systematic reviews of in-person treatment programs for overweight and obesity in children differ in their approaches. For example, some have explored diet versus diet plus physical activity approaches[19], while some have compared pharmacological versus behavioural interventions[20,21]. Across intervention types, some common themes have emerged. There are often modest improvements observed in the short-term (i.e., improvements in diet or physical activity, small to moderate reductions in BMI), with a likelihood that some or most of those improvements will wane with time[19,20,22]. While a systematic review of telehealth utilization in pediatric obesity treatment was conducted in 2012[23], synthesis of the information was largely focused on feasibility and lessons learned from early implementations of telehealth programs. A comprehensive summary of the effectiveness of telehealth in pediatric obesity treatment is still lacking, due to a paucity of outcomes data for these programs. The following thesis presents information on the development, implementation, and outcomes of an innovative and novel telehealth program for pediatric obesity, the HealthLink BC Eating and Activity Program for Kids.

As part of a larger family health initiative, the province of British Columbia (Canada) launched a behavioural lifestyle intervention program for children with overweight or obesity in the Spring of 2015. The HealthLink BC Eating and Activity Program for Kids (the Program) was unique in its ability to operate primarily from a telehealth platform. The Program began with a referral (from a physician, the family itself, or another obesity intervention program), proceeded with a telephone-based assessment to determine the client's needs, seven weekly phone calls to deliver healthy lifestyle counselling, and a

follow-up at Program completion. A postulated strength of the Program was that it is an interdisciplinary intervention employing a qualified exercise professional (QEP) and registered dietitians working together to assess children and teens, design and deliver individualized lifestyle programming, and track their progress. As part of implementing the Program, a comprehensive program evaluation was designed and integrated from its implementation. Because of the unique structure of the Program, a mixed model of evaluation was used. Some information was obtained through the objective reporting of referring physicians who could see patients in person, some from questions administered over the telephone, and some from paper questionnaires mailed back and forth between the Program and its participants. Information obtained from the Program in its pilot implementation phase included the demographic, anthropometric, health-related, and behavioural information from children, teens, and parents who enrolled in the Program and gave permission for their data to be used in the evaluation.

Specific measures included health information for the child, provided by the referring physician, partner program, or self-referred family. These measures included: health history, anthropometric measurements (height, weight, waist circumference), and blood pressure. Participating parents completed an internally-developed demographic questionnaire, assessing household income, geographic location, ethnicity of family members, parental education, and work status. The child and/or their parent also provided information on the self- or parent-reported quality, quantity, and patterns of the child's diet using an internally-developed dietary tool, and clinical eating behaviours, as assessed by the Dutch Eating Behavior Questionnaire or Dutch Eating Behavior Questionnaire for Children[24,25]. The

child's self- or parent-reported physical activity and sedentary habits were measured using the Godin-Shephard Leisure Time Exercise Questionnaire[26] and a series of individual questions asking participants to estimate their time spent in active versus sedentary pursuits. Self- or parent-reported sleep for the child was assessed using an internally-developed sleep questionnaire (adapted from the Pittsburgh Sleep Quality Index[27]). Measures of the child's self-perception and relative strengths and difficulties were measured using the Harter Self-Perception Profile[28] and Strengths and Difficulties Questionnaire[29], respectively.

Therefore, the purposes of this research were to first, describe the population of children and families referred to a novel telehealth program for obesity treatment, and second, to assess the effectiveness of that program in its ability to produce behavioural and clinical changes in participating children and families across the program's initial phase of implementation (~24 months). It was hypothesized that this program would: 1) receive referrals for children with complex healthcare needs, 2) improve access to healthcare services for individuals with barriers to receiving traditional in-person care, 3) improve participants' healthy lifestyle (i.e. diet and physical activity) behaviours, and 4) that if there were sustained improvements in participants' healthy lifestyle behaviours, there would be improvements in participants' clinical outcomes.

This research has a significant impact for practitioners in child obesity management, researchers in pediatric obesity and in telehealth, decision-makers at the healthcare administration level, and users of these healthcare services. The current and projected

prevalence of child obesity present major challenges to individuals and to healthcare providers and systems[4,7]. Evidence-based solutions are critical to begin addressing this issue.

1.1 Overview of Thesis

The thesis document consists of seven chapters. The contributors and outcomes associated with overweight or obesity in a pediatric population are discussed in Chapter 2 to provide background on the issue of overweight and obesity among children and youth. Chapter 3 provides a narrative summary of telehealth programs in the research literature addressing overweight and obesity in children at the time of Program implementation. This information was utilized during development and implementation of the Program evaluation. Details on the development and structure of the Program are presented in Chapter 4. The baseline characteristics generated from participants consenting to the Program evaluation are reported in Chapter 5 and describe demographic, anthropometric, and health-related characteristics of children and families prior to receiving the intervention. Outcomes for the children and teens enrolled in the Program evaluation are described in Chapter 6. This information is meant to reflect the effectiveness of the Program in achieving its intended goals of initiating and supporting healthy behaviour change. Based on the data reported in Chapter 6, a series of conclusions about the Program and suggestions for its future development and operation are detailed in Chapter 7.

Chapter 2: Overweight and Obesity in Children

This chapter provides an overview of the many contributors to and consequences of excess weight in early life. This information provides background information on the core issue of the thesis: overweight and obesity in a pediatric population. This chapter discusses causative and correlative factors related to overweight and obesity ranging from the intrauterine environment through childhood and adolescence. The outcomes of overweight or obesity during the early years of growth and development are also discussed.

2.1 The Issue of Overweight and Obesity in Children

Overweight and obesity in children has been referred to as an epidemic[30], pandemic[31], a moral crisis and a public health crisis[32]. It is estimated that more than 107 million children are now living with obesity worldwide, and are experiencing serious health consequences in childhood and risks to their future health and longevity[31]. The number of children with excess weight increases when children with overweight are included in these figures, and nearly one in three children in Canada right now has overweight or obesity[33]. The rates of obesity in children have been rising over the past several decades and are projected to continue rising in the coming decades[7]. In a recent statistical model of future obesity prevalence, researchers suggested that for children who are 2-years old now, nearly 60% will have obesity when they are adults and approximately half of those individuals will acquire obesity while they are still a child[7]. Considering that these projections exclude overweight, the future prevalence rates of overweight and obesity are cause for great concern.

Numerous treatment and intervention options have been implemented and studied, as healthcare providers, researchers, and many other stakeholders look for ways to curb a serious public health issue. In developing the intervention discussed herein, the many factors associated with and/or contributing to excess weight and childhood were reviewed and are discussed in the subsequent sections.

2.2 Defining Overweight and Obesity

There are varying standards for defining overweight and obesity in children and youth[34]. Across this thesis, overweight and obesity are defined using the World Health Organization's Growth Charts for Canada. Overweight is designated as a body mass index measurement between the 85th and 97th percentile for age, sex, and height. Obesity is classified as having a body mass index measurement above the 97th percentile[35]. As is the standard in this field, person-first language is also used throughout the thesis when discussing individuals with overweight or obesity. As an example, person-first language requires that the young people discussed herein are never described as "overweight children" or "obese youth", but rather "children with overweight" or "youth with obesity"[36].

2.3 Contributing Factors

The following section describes a series of characteristics that have been shown to correlate with the presence of overweight or obesity or to have a causative effect in acquiring the medical condition. Some factors remain correlates rather than causative factors due to the

difficulty of conducting rigorous, controlled research in fetuses, newborns, and young children or of isolating factors like race or ethnicity into a single variable.

2.3.1 Birth Weight and Catch-Up Growth

Birth weight among newborns is often influenced by the intrauterine environment, and may reflect certain aspects of the mother's health during pregnancy. Low birth weight, meaning that a newborn is below the 10th percentile for weight, has been attributed to a number of factors, including but not limited to: maternal cigarette smoking, alcohol consumption, depression, or certain nutrient deficiencies during pregnancy[37,38]. Low birth weight has also been linked to a number of future health risks for newborns, like impaired growth, certain illnesses, and some neurodevelopmental issues[39]. Similarly, infants who are large for gestational age (LGA), or above the 90th percentile for weight, may also reflect aspects of the mother's health. For example, mothers with impaired glucose tolerance display an increased risk of having infants who are LGA [40]. Large for gestational age birth weight is also indicative of an increased risk for future health issues. Evidence shows that LGA infants who are born to mothers with gestational diabetes are at an increased risk of developing metabolic syndrome in childhood[41]. Infants who are LGA may also be at an increased risk for acquiring symptoms of metabolic syndrome when born to mothers with obesity who have impaired glucose tolerance (but do not necessarily meet the criteria for a diagnosis of diabetes). Other evidence has suggested that these infants may be at an increased risk for diabetes and obesity later in life, even when born to mothers with no complications[42]. In addition to the risks related to metabolic syndrome, atypical high birth weight is also independently linked to obesity at age seven[43].

It is important to note, however, that birth weight is not the only early anthropometric measure to consider in terms of future risk for overweight or obesity. There is a body of literature supporting the significance of "catch-up growth", a period of rapid growth in early life, which often occurs in response to a restrictive intrauterine environment or illness[44]. Children who display catch-up growth in the first two years of life have been shown to display higher body mass, body weight, and body fat at age 5 when compared to peers that do not exhibit rapid catch-up growth[44]. The mechanisms by which this period of rapid growth influences later health risks are unclear, but may be explained by the fetal origins hypothesis[45]. This hypothesis posits that many health conditions that appear later in life are resultant from an individual's time in utero, and in the nutritional environment that was present during gestation[46]. However, the fetal origins hypothesis is a matter of debate and is subject to many confounding variables that infants and children experience both pre- and postnatally[47].

2.3.2 Breastfeeding

One of the earliest correlates to the potential for overweight and obesity in childhood is the practice of breastfeeding. Large reviews of the literature indicate that breastfeeding infants creates a small, but consistent and significant protective factor against pediatric overweight and obesity[48]. This relationship also appears to display a dose-response relationship, wherein the longer an infant is breastfed through early life, the stronger the protective factor[49].

The mechanisms by which breastfeeding is thought to decrease the likelihood of early weight issues are not entirely clear, but several ideas have been proposed. Some literature suggests a "programming" effect on infant metabolism. Other researchers have proposed a behavioral mechanism, whereby parents and infants will rely more heavily on infants' satiety cues for initiation and cessation of breastfeeding. This contrasts with bottle-fed infants, who may be encouraged to eat past a point of satiety by parents who wish to achieve a certain number of ounces at each feeding. Overriding these innate feeding cues is thought to persist into childhood, potentially underpinning excess pediatric weight[50].

The uncertainty surrounding a potential causal relationship is largely due to a number of confounding factors, including: birth weight, parental weight, parental smoking, dietary factors, physical activity, and socioeconomic status[48]. There are also factors that influence a parent's decision to breastfeed, which may have an interaction with a child's weight trajectory. For example, working mothers who must return to work early are more likely to breastfeed for a shorter duration than women who are able to stay at home for longer periods of time. Mothers with higher levels of educational attainment are also more likely to breastfeed their children[51]. Maternal work and education status both have established relationships with pediatric weight[52,53]. Rates of breastfeeding also tend to differ among ethnic and racial minorities[54]. The inability to adequately control for a multitude of factors in infancy means that establishing a definitive causal relationship is unlikely.

2.3.3 Race and Ethnicity

Disparities in the prevalence of overweight and obesity are well established across ethnic and racial lines. Non-white populations in both the United States and Canada experience disproportionately high prevalence rates of pediatric overweight and obesity[55,56,57]. However, attributing these differences directly to race or ethnicity would be inappropriate, as race and ethnicity represent a complex interaction of social, economic, cultural, and genetic factors. While disparate prevalence rates have been established according to race or ethnicity, the drivers behind these disparities are more complicated to document.

The terms 'race' and 'ethnicity' often vary in meaning from study to study, based on how researchers have chosen to define and measure the concepts. Both race and ethnicity are fluid constructs, which continue to evolve as an increasing number of individuals define themselves as mixed race and as cultural practices evolve across generations[58]. Due to the complex and shifting nature of race and ethnicity, identifying the independent contribution of these factors to overweight or obesity becomes a difficult endeavour. This matter is further complicated by the tendency toward cross sectional designs in studies examining the relationship between race and pediatric weight[59–61]. There is an added layer of complexity when one considers the effects that historical and modern discrimination have had on ethnic and racial minorities.

Some of the disparities in prevalence of childhood overweight or obesity that emerge among different racial groups are attributed to higher prevalence rates of established risk factors. Compared to white counterparts in the United States, African American and Hispanic

mothers showed higher levels of maternal depression and lower frequency of breastfeeding[62]. Infants born to African American and Hispanic mothers also tended to exhibit higher rates of catch-up growth and daily sleep levels that did not meet current recommendations[62]. Other risk factors that emerge in early childhood which may contribute to disproportionate prevalence rates of childhood overweight and obesity among Hispanic and African American children include: higher consumption of sugar sweetened beverages, increased intake of fast food, and a higher frequency of televisions in the bedroom[63,64,65,66].

When examining the disparities in prevalence of childhood overweight and obesity among Aboriginal children in Canada, an ecological model has been proposed[67]. While research has established deficiencies in physical activity and dietary overconsumption as contributors to the issue[68,69], the ecological model also encompasses the historical, societal, environmental, and cultural influences on a child's health[70]. This model illustrates the historical factors that still influence Aboriginal children's opportunities for healthy foods, opportunities for physical activity, and available healthcare.

Examining ethnic and racial disparities in childhood overweight and obesity requires a multidisciplinary lens. While identifying risk factors that may contribute to the increased risk for pediatric weight issues is important in structuring prevention or intervention efforts, the larger historical context of these health inequities must be considered, as well.

2.3.4 Socioeconomic Status

Socioeconomic status (SES) typically represents a combination of income, occupation, and education. Socioeconomic status is often used to describe a person or group of people's social class or standing. While there are widely utilized tools for measuring SES, they most often rely on self-reported measures of household income and maternal education. Unfortunately, these measures do not account for important factors that would also contribute to a family's true socioeconomic situation. For example, existing wealth, material goods, access to resources, and support mechanisms are often unaccounted for in measuring SES. Nonetheless, low-SES is often cited as a risk factor for developing overweight or obesity in childhood[55,71].

The relationship between SES and pediatric overweight and obesity is complex, and is in fact a representation of the extent to which the SES of a child's family influences that child's weight status. In the United States, low-SES has often been linked to increased rates of childhood overweight and obesity. At one point, this relationship made the US a global anomaly in comparison to other developed nations where overweight and obesity were only observed among wealthier citizens[72]. The inverse relationship between SES and childhood weight in the US is often attributed to the low cost of high energy density foods, reduced availability of healthy foods, environmental limitations to physical activity, and restricted access to health care among the poor[73,74].

2.3.4.1 Income

Two aspects of SES that appear to exert a significant influence on pediatric weight status are family income and maternal work status. Large national data sets in the United States show that pediatric obesity rates are increasing among children of all income groups, but that the risk of becoming obese in childhood is significantly greater for children of low-income families[75]. Children from low-income households also experience higher prevalence rates of severe obesity[76]. In addition to the risks identified at the household level, community poverty rates may also influence a child's likelihood of becoming overweight[77]. The extent to which poverty correlates with pediatric overweight and obesity also differs when examined by race or ethnicity. Data from the US National Health and Nutrition Examination Survey (NHANES) (1999-2004) has shown an inverse trend between income and pediatric weight among White and Mexican-American children, but a reversal in the trend among African American girls, who tended to show higher levels of obesity with higher family income[78]. Newer NHANES data (2005-2008) showed no significant trends in prevalence of overweight or obesity and income among African-American or Mexican-American boys and girls, but a significant relationship between low-income and rising obesity rates among white boys and girls[79,56.]

The relationship between income-level and childhood overweight or obesity in Canadian children is often examined using a child's neighborhood as an indicator of income. Similar to findings in the US, Canadian children in low-income or average-income neighborhoods are more likely to be overweight or obese when compared with their peers who live in high-income neighborhoods[80, 81,82,83].

2.3.4.2 Maternal Work Status

Over the past several decades, employment status among mothers has changed significantly. There are a greater percentage of households with two working parents, and women have increased their presence in the workforce[84]. This shift in maternal work status has been cited as a potential contributor to the rise in overweight and obesity among children[85]. Research has documented a positive relationship between the number of hours worked by a mother and the likelihood that her child may become overweight or obese[86,87]. The effect seems to be especially powerful for women of a high SES[87].

The increase in a child's risk of acquiring overweight or obesity has been attributed to several unintentional consequences of mothers increasingly working outside the home. Children with working mothers tend to watch more television than children whose mothers are not employed outside the home[87]. Working mothers also tend to cook less at home, and children with working parents will tend to eat more prepared foods[52]. Children with working parents may also be at increased risk of overweight or obesity when they are placed into center-based care in comparison to children who are cared for by a relative or nanny[88].

2.3.5 Parental Weight Status

Parental weight status has been identified as a powerful indicator of a child's risk for becoming overweight or obese. In one often-cited study, researchers found that parental obesity more than doubles the risk of a child becoming overweight or obese, especially for children under age ten[6]. Researchers posited a combination of shared genetic and environmental factors as the driving forces, however the study was limited by its racial

homogeneity (the sample was predominantly white)[6]. Parental obesity also appeared to influence children's risk of becoming overweight or obese in longitudinal data obtained from a sample of Australian children and families[89]. A strong relationship between parents with high BMIs and children with high BMIs was also observed in a large cross-section of German children and families[90]. Cross-sectional data of a large Chinese sample showed similar trends, with children of two parents with obesity being more than three times as likely to become obese when compared to children of healthy weight parents[91].

2.3.6 Diet

2.3.6.1 Food Manufacturing and Marketing

Prevalence rates of childhood overweight and obesity have risen over the past several decades[3], and the food landscape has also been undergoing significant change. In the United States, changes in agricultural subsidies have shifted the costs of certain foods. Corn, wheat, and soy growers are subsidized by federal funds, which incentivize farmers to grow those crops. This keeps supply high and costs to consumers low. However, fruit and vegetable growers do not always receive the same financial incentives, and these crops become relatively less abundant and more expensive. In the United States, two-thirds of farmland is planted with corn, wheat, or soy; in contrast, less than five percent of farmlands are planted with fruits and vegetables (USDA Farm Services Agency, Published Data).

These government policies are among the drivers behind an inverse relationship between calorie density and calorie cost. This means that many processed food products which contain corn, wheat, and soy, have a relatively high energy content and low cost. These foods

have also been historically resistant to inflation[92]. Meanwhile, fresh fruits and vegetables are often of a lower energy content and higher cost. Foods in the lowest quintiles of energy density (mostly fruits and vegetables) have undergone drastic increases in cost across the past several decades, especially in comparison to the most energy dense foods, which are typically highly processed and often contain higher proportions of fat and sugar[92].

While the low cost of these energy rich foods is one driver behind their prevalence, another is the way in which they are marketed. In the absence of any regulation on marketing directly to children, food has become the most frequently advertised item during children's television programming[93]. The foods featured in these advertisements often tend to be foods with low nutritional value and high sugar content[93]. Evidence has shown that these advertisements do have an effect on children's preferences and food requests, as well as parents' purchases[94,95]. The American Psychological Association supports legislation restricting food marketing to children under 8 years of age, as young children lack the cognitive ability to appropriately understand an advertisement's persuasive intent. The Canadian government also announced a decision to restrict food marketing to children in 2016, but has since reevaluated its position[96]. In both the US and Canada, large food manufacturers and distributors have successfully prevented the implementation of these policies.

2.3.6.2 Meal Structure

In addition to the importance of a meal's dietary composition are the circumstances around which family meals are eaten. When parents are present for the evening meal, children tend to eat more fruits and vegetables, and consume fewer sugar-sweetened beverages[97,98].

However, many families now have two working parents and eating the evening meal as a family may be hindered by busy schedules[52]. Television-viewing habits during mealtime also have a relationship with diet choices. Families who typically watched television during their meals tended to eat more traditional 'junk foods' and fewer fruits and vegetables[99]. Television viewing during mealtime also resulted in overconsumption among children, due to a disruption in normal satiety cues[100].

Family meal structure appears to have shifted over the years. Evidence suggests that the amount of time spent on meal preparation has significantly declined across decades[101]. At the same time, consumption of pre-prepared meals and frequency of eating outside the home have increased[101]. Not only do ultra-processed foods and restaurant foods tend to be higher in salt, sugar, and fat and come in large serving sizes, families are also losing the physical activity that stems from shopping for, preparing, and cooking meals themselves[102]. This type of physical activity is referred to as non-exercise activity thermogenesis and is discussed in greater detail in Section 2.2.11.

2.3.6.3 Sugar-Sweetened Beverages

Children and adolescents view hundreds of television advertisements for sugary drinks each year[103]. Trends in consumption of sugar-sweetened beverages (SSB) have shifted upward in the past several decades. One study indicated that between the late 1970's and late 1990's, children had increased their SSB consumption by 48% and that mean intake of soft drinks had nearly doubled[65]. Other literature indicated that between 1989 and 2008, there was a 60%

increase in the number of calories from SSB consumed by children, and the number of children who consumed SSB also rose[104].

A prospective investigation of the interaction between SSB intake and BMI showed that both the baseline level of SSB consumption and the change in SSB consumption across the study were independently associated with high or rising BMI levels[105]. A large independent systematic review of SSB intake among children was conducted, which included cross-sectional, prospective cohort, and experimental studies. The findings suggested evidence of a positive relationship between SSB intake and BMI, and an independent contribution of SSB to weight gain[106]. The authors suggested that the combined evidence of SSB's influence on BMI warranted public health intervention. Conversely, there is a well-cited meta-analysis of SSB consumption using longitudinal or randomized controlled studies, which showed that the effect of SSB on BMI was negligible[107]. However, it is important to acknowledge that the research center producing this particular investigation had received funding from both the Coca-Cola Company™ and PepsiCo™, and that one author accepted a position at the American Beverage Association shortly after the paper's publication. In general, evidence suggests that reducing a child's intake of SSB is one method in assisting children who are overweight or obese better manage their body weight[104,108].

2.3.7 Physical Activity

There is a general consensus that children are not currently meeting guidelines for daily physical activity (PA)[109,110,111]. Some general news sources are also inclined to say that children are much less active now than previous generations[112]. While evidence supports that

low levels of physical activity are commonly observed among children, there are no adequate historical sources to provide evidence to support the notion of a drastic downward trend in physical activity among children.

In Canada, accelerometer-based PA data from a large national sample of Canadian children was collected and analyzed via The Canadian Health Measures Survey (2007-2009). While PA guidelines are subject to much debate among experts, outcomes data was analyzed in reference to national recommendations for at least 60-minutes of PA per day. When using these guidelines, only 7% of children met the recommended levels of PA. However, 44% of children met the criteria for being physically active on at least 3 days per week[109].A similar evaluation was done in the United States, wherein accelerometry data was analyzed in reference to recommendations that children achieve 60 minutes of PA on most days of the week[111]. Using this reference point, 42% of American children were considered to meet recommended levels of PA, achieving 60 minutes or more on at least 5 days each week. In both American and Canadian children, there are trends suggesting that children become less active as they progress into adolescence, and that boys tend to be more active than girls. Irrespective, low levels of PA seem to be especially prevalent among boys and girls with overweight or obesity[113]. In a large, international, systematic review of PA and diet measures, PA and sedentary behaviour were most strongly related to elevated BMI[114]. However, the relationship between BMI and physical activity levels is subject to many influential factors. In a review of physical activity correlates, a series of factors (see Table 1) were found to be significantly associated with children's levels of PA and may represent points of focus for prevention or intervention efforts.

Table 1. Correlates of Physical Activity in Children and Adolescents

Factor	Young Boys	Adolescent Boys	Young Girls	Adolescent Girls
Sex	x	x		
Ethnicity		x		x
Age		x*		x*
Perceived Athletic Confidence		x		x
Parental Overweight Status	x		x	
Physical Activity Preferences	x		x	
Intention to Be Active	x		x	
Perceived Barriers	x		x	
Intentions		x		x
Depression		x*		x*
Previous Physical Activity	x	x	x	x
Healthy Diet	x		x	
Program/Facility Access	x		x	
Time Spent Outdoors	x		x	
Community Sports	x	x	x	x
Sensation Seeking	x	x	x	x
Sedentary After School and on Weekends	x*	x*	x*	x*
Parent Support		x		x
Support from Others		x		x
Sibling Physical Activity		x		x
Direct Help from Parents		x		x
Opportunities to Exercise		x		x
**Indicates an inverse relationship*				
Table adapted from Trost et al.[113]				

One potential limitation in generating a knowledge base for childhood PA is the means by which PA is measured. Although accelerometry is becoming more available at the population level, some large data sets still rely on self-reports of PA. Self-reports for a number of health measures are subject to over- or under- reporting, and may be influenced by desires to meet expected norms[115]. Accelerometry has limitations too, which include variations due to placement area of the device, adherence to wearing the device, and the epoch length at which the device is collecting movement information[116]. Self-reports of PA and accelerometry data may also fail to account for certain types of activity. For example, small amounts of non-purposeful physical activity (sometimes referred to as non-exercise activity thermogenesis) may not be captured in a physical activity assessment tool.

Although data on non-exercise activity thermogenesis (NEAT) is scant among children, NEAT represents significant energy expenditure among adults. Even in active adults, NEAT often accounts for more daily energy expenditure than does purposeful physical activity (i.e., exercise)[117]. Non-exercise activity thermogenesis behaviors include all PA that is not eating, sleeping, or exercising, and may include active transportation, changes in body posture, and even fidgeting. It should be noted however, that equivalent activities could be either be considered NEAT or purposeful PA, based on the individual's intention. For example, an individual who bikes to work each day in order to improve their physical fitness or overall health would be engaging in purposeful PA, while an individual who bikes to work because it is their only mode of transportation, and is not biking with the intention to improve their health, is engaging in NEAT.

In one pilot study, NEAT behaviors were measured among children with overweight or obesity who were enrolled in a school-based physical activity program. Longitudinal data suggested that increasing purposeful PA through the program increased NEAT levels throughout the rest of the day, in the classroom, and at home (Unpublished data – Lasinsky MA thesis). This may be one yet unexplored benefit to increasing PA among children with elevated BMIs.

2.3.8 Sedentary Behaviour

Health promotion efforts for children have typically encouraged more active play and increased daily physical activity. Until recently, health promotion has often been silent on the importance of reducing sedentary time. Evidence now seems to point to the clear effects of sedentary time on health outcomes for children, likely through the role that sedentary time plays in displacing physical activity[118]. Sedentary behaviours represent a health risk to all populations regardless of physical fitness, and negative outcomes from sedentary behaviors are seen even in elite athletes[119]. Sedentary time is a necessary part of most individuals' daily schedule, but as sedentary behaviours become more routine a person moves toward becoming physically inactive. In 2010, the World Health Organization cited physical inactivity as the fourth leading risk factor for global mortality, which ranked even higher than obesity, which was ranked fifth[120].

Next to sleeping, the majority of sedentary time is spent watching television[109]. As such, the amount of time spent watching television is often used as a proxy measure of sedentary

behaviours. Previous literature has displayed a dose-response relationship between hours of television watching and likelihood of being overweight[121]. A large systematic review, which examined the role that sedentary time played in a child's health suggested that higher levels of sedentary time (most frequently assessed by hours spent watching television) were associated with: lower levels of physical fitness, higher levels of body fat, reduced self-esteem, and lower academic achievement[109]. However, these findings must be interpreted carefully as there are a number of other factors associated with pediatric overweight or obesity that may mediate the relationship between sedentary time and measures of self-esteem or academic achievement. In general, high quality evidence supports reductions in TV-watching as a means to improving health outcomes for children with overweight[122].

2.3.9 Sleep

The importance of adequate sleep in childhood has often been framed in terms of its relationship to appropriate growth and development. More recent literature has highlighted the interaction of children's sleep behaviors and body weight/composition. Overall, findings suggest that lower levels of sleep are correlated with higher BMI levels and higher adiposity in children[123,124], although the mechanisms underlying this relationship are still being investigated[125].

A large meta-analysis of cross-sectional studies confirmed a consistent relationship between lack of sleep and likelihood of a child acquiring overweight or obesity[126]. Because of the cross-sectional design of the included studies, examining causality is not possible, but there were several proposed mechanisms throughout the included literature. For example, a

hormonal response to shortened sleep has been proposed, wherein levels of leptin and ghrelin are affected by a child's sleep[127]. Alterations to leptin and ghrelin, the primary satiety and hunger hormones respectively, may cause increases in appetite and subsequent overeating. Other researchers have proposed an inflammatory mechanism driving the relationship between inadequate sleep and overweight or obesity[128]. Finally, one must consider whether or not poor sleep is an indicator of other unhealthy lifestyle habits, which may in fact better explain the demonstrated relationship between sleep and weight.

In addition to the relationship observed between sleep and body mass, is the relationship between sleep and physical activity. Literature shows that children who are more physically active during the day are likely to show better sleep patterns than children who spend more time in sedentary pursuits[129]. Similarly, children who exhibit more sedentary behaviours display lower levels of total sleep than children who achieve recommended levels of physical activity[130].

2.4 Comorbidities

The following is a list of established outcomes associated with acquiring overweight or obesity in early life. This list includes disruptions to metabolic health, as well as social-emotional indicators of health and wellbeing.

2.4.1 Metabolic Syndrome in Children

Initially, definitions of metabolic syndrome in children varied across the literature[131–135]. In 2007, the International Diabetes Foundation (IDF) convened an expert panel to develop a

uniform definition for metabolic syndrome in children[136]. The IDF describes metabolic syndrome as "a cluster of the most dangerous risk factors for type 2 diabetes and cardiovascular disease"[137]. Based on available evidence, a diagnosis of metabolic syndrome in childhood is only appropriate for children older than 6 and younger than 16. The essential component of metabolic syndrome among children is abdominal obesity (as determined by waist circumference), but a diagnosis involves other markers of metabolic health, as well. These criteria are outlined in Table 2 for children and adolescents as it relates to waist circumference, triglycerides, HDL-C, blood pressure, and glucose measures. While the IDF indicates a diagnosis of metabolic syndrome when a child between 6 and 16 displays abdominal obesity and at least two factors (Table 2), it is important to note that these clinical signs may occur independently in children with overweight or obesity, outside the context of metabolic syndrome. In a systematic review of the prevalence of metabolic syndrome in children, the cluster of risk factors was found in 3.3% of the total population of children, 11.9% of children designated as overweight, and in 29.2% of children classified as obese[138].

Table 2. International Diabetes Foundation Consensus Definition of Metabolic Syndrome in Children and Adolescents (Adapted from Zimmet et al., 2007)

The International Diabetes Foundation Consensus Definition of Metabolic Syndrome in Children and Adolescents					
Age Group (y)	**Obesity (WC)**	**Triglycerides**	**HDL-C**	**Blood Pressure**	**Glucose (mmol/L) or diagnosed T2DM**
6 to <10	$\geq$ 90th percentile	Metabolic syndrome cannot be diagnosed, but further measurements should be made if there is a family history of metabolic syndrome, T2DM, dyslipidemia, cardiovascular disease, hypertension, and/or obesity.			
10 to <16 Metabolic Syndrome	$\geq$ 90th percentile or adult cut-off if lower	$\geq$ 1.7 mmol/L or $\geq$ 150 mg/dL	<1.03 mmol/L or <40 mg/dL	Systolic $\geq$ 130 mmHg Diastolic $\geq$ 85 mmHg	$\geq$ 5.6 mmol/L or 100 mg/dL (If known T2DM or $\geq$ 5.6 mmol/L, recommend OGTT)
16+ Metabolic Syndrome	Use existing IDF criteria for adults, i.e.: Central obesity (defined as WC $\geq$ 94 cm for Europid men and $\geq$ 80 cm for Europid women, with ethnicity specific values for other groups), plus any two of the following four factors: • Raised TG: $\geq$ 1.7 mmol/L • Reduced HDL-C: < 1.03 mmol/L (<40 mg/dL) in males and < 1.29 mmol/L (<50 mg/dL) in females, or specific treatment for these lipid abnormalities • Elevated blood pressure: systolic BP $\geq$ 130 mmHg or diastolic BP $\geq$ 85 mmHg, or treatment of previously diagnosed hypertension • Impaired fasting glycemia: fasting plasma glucose = 5.6 mmol/L ($\geq$ 100 mg/dL), or previously diagnosed T2DM				

WC: waist circumference; HDL-C: high-density lipoprotein cholesterol; T2DM: type 2 diabetes mellitus; OGTT: oral glucose tolerance test; TG: triglycerides

2.4.1.1 Metabolic Syndrome: Abdominal Obesity

The International Diabetes Federation relies on abdominal obesity as the cornerstone of a pediatric diagnosis for metabolic syndrome. Abdominal obesity, a representation of excess visceral fat, is measured via waist circumference (WC). The WC percentiles used by the IDF have been developed by Fernandez and colleagues (2004) in a large multiethnic sample of children. The literature suggests that as percentile for WC increases, insulin levels increase and insulin sensitivity decreases[139]. A decision to use the 90th percentile as a cutoff point for determining abdominal obesity was based on the literature suggesting that children above the 90th percentile for WC had elevated risks for multiple symptoms of cardiovascular disease[140,141]. However, using the 90th percentile as a cutoff point is based on limited evidence, and the IDF has recognized the need to reevaluate as new literature emerges[136].

An elevated WC represents an independent health risk factor for children with excess weight. In studies comparing children with obesity who had similar BMIs, those with higher visceral fat mass showed poorer insulin sensitivity[142,143]. In a study examining young girls with obesity, it was visceral fat and not waist-to-hip ratio or subcutaneous fat, which was highly correlated with markers of insulin secretion and insulin resistance[144]. Some literature has suggested that using a combination of BMI and WC may improve the specificity and sensitivity of detecting cardiovascular risk among children with overweight or obesity [145]. Yet other evidence suggests that WC is the best predictor of all risks for cardiovascular disease in both boys and girls, followed by waist-to-hip ratio, and then BMI[146].

2.4.1.2 Metabolic Syndrome: Dyslipidemia

Whereas abnormal levels of lipids in the blood (dyslipidemia) was once only a condition observed in adults, children with obesity are now exhibiting signs of the disease. High levels of triglycerides and low-density lipoprotein cholesterol (LDL-C) and low levels of high-density lipoprotein cholesterol (HDL-C) have been observed in children with obesity[131,147]. A positive relationship between BMI and prevalence of dyslipidemia has been observed among children diagnosed as obese[131].

Among children and youth with overweight or obesity, dyslipidemia has a tendency to cluster with other risk factors for cardiovascular disease, including hypertension and hyperglycemia[148]. In combination with other risk factors for childhood MS, dyslipidemia has been associated with the extent of lesions in the aorta and coronary arteries and overall detriment to cardiovascular health in children with obesity[147] . Prevalence of abnormal triglycerides or cholesterol levels appeared to be significantly higher in overweight girls when compared to overweight boys in a large national sample of children[78].

2.4.1.3 Metabolic Syndrome: Hypertension

Evidence has repeatedly shown higher prevalence rates of hypertension among children with a BMI above the 85th percentile when compared to children with a BMI below the 85th percentile[78,149–151]. Children with overweight are roughly between 3 and 5 times more likely than their healthy-weight peers to exhibit signs of hypertension, and literature suggests a dose-response relationship between body mass and risk of hypertension[152]. Rosner and

colleagues (2000) have demonstrated that this relationship exists independently, even when race, gender, and age were considered[149].

There are several proposed mechanisms driving the relationship between hypertension and pediatric overweight/obesity. One commonly cited mechanism involves activation of the sympathetic nervous system, although insulin resistance and vascular changes have also been considered potential mediators. Hypertension is one of several symptoms that appear to cluster together and increase risk to cardiovascular health[148].

The literature has demonstrated the ability of physical activity to prevent and address hypertension in adults. Similar literature in children is less abundant, but there are several promising studies[153–155]. While there is little evidence suggesting that physical activity can prevent hypertension in children with elevated BMIs, there is sufficient evidence to suggest that a physical activity intervention can decrease elevated blood pressure in these children[154,156,153,155]. A review of this literature by Torrance and colleagues (2007) produced a recommendation of 40 minutes of physical activity on 3-5 days per week to achieve cardiovascular benefits from physical activity (conflicting with current Canadian recommendations for children's physical activity). While this literature has demonstrated the ability of physical activity to treat hypertension, it also shows that previous levels of hypertension are likely to return upon cessation of the activity intervention[157]. This highlights the importance of creating sustainable opportunities for children to be active and exploring non-exercise activities as means to achieving physical activity.

2.4.1.4 Metabolic Syndrome: Impaired Glucose Tolerance

Prevalence rates of type II diabetes (T2DM) among children have varied between less than 1% and more than 5% in certain subsets of the population[158]. This variation may reflect the disparities between different ethnic and racial groups. In North America, for example, there are disproportionately high rates for Native Americans and First Nations groups. Rates of impaired glucose tolerance, which does not yet meet the criteria for a diagnosis of T2DM, is more prevalent than T2DM itself among children and adolescents with obesity. Weiss et al. (2004) showed a relationship between BMI and markers of insulin resistance, where higher BMI in children correlated to higher prevalence of insulin resistance[131]. In a sample of children and adolescents with obesity, prevalence rates for impaired glucose tolerance of 25% and 21% respectively were observed[159]. The same study suggested that beta-cell function was still preserved in young people with obesity who have T2DM, and that impaired glucose tolerance was a result of reduced insulin sensitivity. Evidence supports increased physical activity and decreased sedentary time as means to improving glucose tolerance and reducing insulin insensitivity[158,160,161].

2.4.2 Liver Dysfunction

In some samples of children with obesity, increased liver enzymes may be observed. Elevated liver enzymes may indicate some type of liver dysfunction[162]. Papandreu and colleagues (2007, p. 410) have distinguished liver conditions, most often collectively referred to as non-alcoholic fatty liver disease (NAFLD) as: *"a wide spectrum of liver diseases ranging from the most common one, fatty liver (accumulation of fat in the liver, also known as steatosis), to non-alcoholic steatohepatitis (NASH, fat in the liver causing liver*

inflammation), to cirrhosis (irreversible, advanced scarring of the liver as a result of chronic inflammation of the liver).”[163] The designation of “non-alcoholic” is indicative of the fact that these types of changes to liver tissue were once only common among adults, often due to prolonged alcohol consumption. Today, similar changes are seen in some children with obesity, and those changes are often described as an outcome of increased fat mass and hyperinsulinemia[163,164]. However, incidence and prevalence rates of NAFLD in children are difficult to obtain, due to a lack of large population-based studies. True diagnosis of NAFLD requires a liver biopsy, which may also limit the availability of empirical evidence in children. Current treatment options for children often involve gradual weight loss and/or medication[163].

2.4.3 Bullying and Stigmatization

The deleterious effects of bullying have been the focus of increased media attention as of late. New forms of bullying have emerged with the widespread use of electronic communications and social media platforms among young people. Bullying can take a variety of forms, including: relational bullying (i.e., withdrawing friendship or spreading rumors), overt bullying (i.e., name-calling or physical violence), and cyber bullying (i.e., harassment via social media)[165]. Children with overweight or obesity appear to experience bullying behaviours to a greater extent than their typical weight peers. Increases in BMI correlate with an increased frequency of victimization through bullying behaviours[166,167]. Recent work has suggested a relationship between BMI and bullying, wherein the extent of victimization increased in a step-wise fashion with each point increase in BMI[168]. That same study suggested that children with obesity were also more likely to be perpetrators of

bullying behaviours, although other population-level research has refuted that idea[169]. Disproportionately high levels of teasing often involve weight- and appearance-related teasing among children with overweight or obesity, and these children tended to find teasing more upsetting than their typical weight peers[170].

In a large study of American third-graders, BMI remained a significant predictor of teasing and bullying victimization even when numerous potential confounders were accounted for[167]. After adjusting for socioeconomic and academic factors, race, gender, and perceived social skills, children with obesity still encountered disproportionate levels of teasing from their peers. The effects of bullying behaviours extend beyond the event itself. Children with overweight or obesity tend to internalize these insults, which may result in feelings of loneliness and poor self-perception[170]. Children with elevated BMIs who reported being teased also showed a preference for solitary/sedentary behaviours[170]. This may be a contributing factor in the high levels of sedentary time observed in this group.

Children may not only feel discriminated against by their peers, but by teachers and parents, as well. Parents may tease children about their weight and educators may show biases against their students with overweight or obesity[171]. Healthcare providers have also shown implicit and explicit biases toward individuals with overweight or obesity and display stigmatizing behaviors toward their patients with excess weight[172,173]. Despite efforts to educate practitioners, negative thoughts and feelings toward patients seem to persist throughout the medical community[174]. Recent work has found that children themselves seem to hold implicit biases involving other children with overweight and obesity[175].

2.4.4 Anxiety and Depression

Children considered overweight or obese are more likely to feel socially marginalized by their peers[176]. Feelings of isolation or marginalization may contribute to depressive symptoms in children. Studies among adolescents suggest that children display worsening depressive symptoms as BMI increases toward the uppermost percentiles[177]. A large prospective investigation of the relationship between BMI and depression in adolescents found that while BMI was not associated with depressive symptoms at baseline, an elevated BMI did increase the risk for developing symptoms of depression upon follow-up[178].

Evidence suggests that there may be gender differences, wherein young girls with elevated BMIs are more likely to experience depressive symptoms than boys[179]. These depressive symptoms were strongly associated with girls' concerns about their weight. The disproportionate effect on girls was shown elsewhere in longitudinal data, where girls experienced increases in symptoms of anxiety and depression as BMI increased across the investigation period[180]. One local obesity intervention program reported clinical levels of anxiety and depression in more than half of the children who were enrolled in the program (Unpublished data). This evidence suggests that programs aiming to treat children with overweight or obesity may require more than just diet and physical activity counseling, and should consider mental health needs, as well[181,182].

2.5 Conclusion

The potential causative factors and outcomes associated with pediatric overweight and obesity are extraordinarily complex and interrelated. A truly comprehensive discussion of the

topic would benefit from expert input from professionals in a variety of disciplines, including but not limited to: preventative medicine, obstetrics, pediatrics, mental health, psychology, economics, public and community health, sociocultural studies, diet, nutrition, and physical activity. While prevention remains the ideal solution for issues of pediatric overweight and obesity, treatment options at the individual, family, school, regional, national, and global level must continue to be explored.

Chapter 3: Telehealth and Telemedicine for the Treatment of Pediatric Overweight and Obesity

This chapter provides a review of the literature published on pediatric telehealth programming at the time of Program launch. The information collected through this review was used to inform the development and implementation of the Program Evaluation.

3.1 Introduction

The number of children who are classified as overweight or obese has increased dramatically over the past several decades[183]. Approximately 31.5% and 11.7% of Canadian children are considered overweight and obese, respectively[33]. A similar 32% of American children are overweight, with more than half of those children also considered obese[3]. Although extreme obesity (BMI >120% of the 95th percentile for age and sex) has recently declined in small segments of the population, overall prevalence of overweight and obesity are still alarmingly high and have proven difficult to decrease[3,184]. In 2015, the Canadian Task Force on Preventive Healthcare put forward new guidelines for the recognition and management of obesity among children[185]. The guidelines call for routine growth monitoring in the primary care setting, as well as the provision of referrals to appropriate behavioural interventions for children who have been identified as overweight or obese. The guidelines also suggest that, *"Where such interventions are not yet available, primary care practitioners and policy makers should consider their development a priority*" (p. 418). While many programs are documented throughout the academic literature, there are still gaps in service and areas where these programs may be difficult to access.

There are disparities in regional prevalence rates of obesity in North America. One group disproportionately affected is children in rural communities[186]. Whereas the physical activity requirements of living in a rural area were once a protective factor against excess weight gain, modernization has diminished many of those physical demands, and the protective aspect of rural residence has been mostly eliminated[187]. To compound the problem, rural and remote communities (i.e., small towns, villages and other populated places with a population less than 1,000 according to the current census[188]) are also likely to experience a shortage of healthcare providers, which is especially salient for specialty services including obesity-specific treatment[189].

Geographic barriers are not the only hindrance to accessing obesity-treatment services. Resource-based restrictions may also impede care delivery if parents are unable to attend in-person programming or appointments due to child-care needs for other children, work schedules, or transportation difficulties[9,10]. Therefore, even in areas where care is available, access is not necessarily feasible or guaranteed. Furthermore, families who wish to pursue structured intervention programming may be subject to specific inclusion and exclusion criteria, which may prohibit their participation. For example, some programs require a parent's participation at all group sessions or a child may have to reach a certain BMI percentile before they are eligible.

Another important consideration when examining barriers to healthcare access is a fear of feeling stigmatized or embarrassed by one's healthcare provider. Literature has shown a tendency for adults with overweight or obesity to avoid or delay physician interactions

because of concerns about being weighed or receiving unwanted advice to lose weight[190]. It is possible that some parents may share similar feelings or worries about their children who have overweight or obesity, as well. Among parents who do seek care for children with high BMIs, feelings of being dismissed, judged, or blamed have been reported in the literature[191]. When discussing matters of body weight, face-to-face interactions with physicians can present a level of stress for the patient, as well as feelings of stigmatization. Moreover, research has shown the occurrence of negative attitudes and biases from physicians towards their patients with overweight or obesity[174]. These collective barriers to accessing obesity treatment services have made providers rethink the ways in which they deliver care.

3.1.1 The Evidence for Telehealth

Most Canadians have regular access to the Internet and at least one telephone. Approximately 87% of households in Canada have a home connection to the internet[192], more than 85% of Canadians have a mobile telephone, and over 75% of Canadians have a wired home telephone[193]. However, many Canadians have comparably worse access to their healthcare providers. The 2016 Commonwealth Fund Survey found that Canadians had the longest wait times for primary, emergency, and specialist care among all the nations surveyed[194]. Extensive wait times and difficulty making an appointment with a healthcare provider were the two most common complaints among Canadians with challenges in accessing care in a 2016 report[195]. While satisfaction with care is good when users are able to see their healthcare providers, access remains an issue. The prevalence of communication technologies combined with the population of individuals living in rural and remote areas

throughout Canada (roughly 20% of the population)[196] and Canada's massive land area make it a prime location for utilization of telehealth.

The first research on telehealth (emerging in the early 1990s) focused on the technological feasibility of the practice. Researchers concentrated on the successful establishment of communications through electronic means and how often technological difficulties occurred[197,198]. Once technological feasibility had been well established, research focus shifted toward outcomes-based research[199]. Determining the overall effectiveness or success of telehealth, however, is a challenging task. Effectiveness or success depend on how those metrics are defined and often vary by study. Effectiveness may mean that a telehealth service has improved clinical outcomes, increased adherence to prescribed behaviours or medications, created cost-savings, reduced hospital utilization, or satisfied its users, among many other measures of success. In a 2010 systematic review of reviews examining the effectiveness of telehealth interventions, researchers found that roughly one-third of the reviews showed telehealth to be effective, one-third of reviews showed telehealth to be promising, and one-third or reviews found insufficient evidence to make a determination[200].

In 2003, Jennett and colleagues systematically reviewed the socioeconomic impact of telehealth, with a subsection of the review discussing the use of telehealth for pediatric care. In the literature specific to telehealth for pediatric health issues, positive outcomes were observed for patients, families, healthcare providers, and the healthcare system in general. New mothers reported receiving educational and emotional support via telehealth, and experienced reductions in fatigue due to the telephone-based counselling they received[201].

Children with chronic illnesses showed improvements in their quality of care and quality of life using telehealth services[202], and in several ways utilization of hospital services by families was improved (fewer emergency visits, improved referral processes, etc.)[203–206]. Families, providers, and the larger healthcare system in the reviewed articles reported cost savings from the utilization of telehealth[16]. More recent assessments of the literature, however, have described the difficulty of assessing true cost savings in telehealth, due to the great variability in the ways telehealth is implemented and the conditions it aims to treat[207]. Despite potential difficulties in evaluation telehealth as a singular entity, its collective documented advantages present a promising opportunity to improve delivery of healthcare services to individuals, with at least a potential for cost savings and improved patient outcomes.

In 2007, Pare et al. conducted a systematic review to synthesize the evidence for telehealth and telephone-based home monitoring of chronic disease conditions, including: pulmonary disorders, cardiac disease, hypertension, and diabetes. The authors suggested that telehealth was a "promising patient management approach" that was able to empower patients and change their attitudes and behaviours. In this review, researchers again struggled to determine the effect that telehealth had on clinical measures of health among its users, due to the numerous metrics that can be used to assess health, and the heterogeneity of findings. While the evidence for telehealth's ability to improve clinical outcomes was mixed, the literature indicated strong positive potential for the use of telehealth[208]. This review focused on the use of telehealth for the management and/or treatment of chronic medical conditions

in the adult population, which represents a larger trend in literature, with comparatively less information on treating or addressing pediatric health issues, including obesity.

3.1.2 Telehealth in Pediatric Obesity Treatment

Using a telehealth approach as a strategy in the treatment of overweight and obesity has several strengths as an approach. Telehealth has the ability overcome geographic barriers to care, reduce time costs on patients and families, expand the reach of existing programs and services, potentially reduce feelings of anxiety or self-consciousness among users, and potentially produce cost savings for healthcare providers and consumers[16]. Individual components of physical activity counseling[209,210] and nutrition counseling[204,213,214] have been utilized previously in telehealth, although relatively fewer holistic interventions for obesity have been documented. In the telehealth programming that has been documented thus far in providing healthy lifestyle counselling to children and families, services have ranged from providing specialist services via videoconference to children in rural areas to providing follow-up care to children after an in-patient child obesity interventions[12–14,215,216].

The telehealth programs that exist are geographically and structurally diverse, which makes their direct comparison a challenge. Therefore, the purpose of this chapter was to collect all the available published information on these interventions, including individual program components like: satisfaction, feasibility, fidelity, baseline characteristics, and any available outcomes. This information was used in providing an evidence-base to inform the development and implementation of the evaluation for a novel telehealth program launched in 2015.

3.2 Identifying the Research

A rigorous approach was implemented to identify and examine the available evidence on telehealth support for pediatric obesity. Studies that were identified and examined were all: published in an academic journal before March 2014, available in English, and contained the key words of interest (telehealth or telemedicine; child, youth, or adolescents; overweight or obese; and intervention or program). Details of the literature search results are listed in Figure 1. After reviewing three databases (Medline, Embase, CINAHL), a total of 12 articles were found to report some aspect of a pediatric obesity intervention utilizing telehealth. The purpose of all programs examined was obesity intervention.

Overall, 5 unique telehealth programs were identified in the literature, which included 1,009 children, and reported on: feasibility of implementing a telehealth program (*n=4*), effectiveness of the program (*n=7*), participant/parent satisfaction with the program (*n=2*), participation rates (*n=1*), prevalence of overweight/obesity in an existing telemedicine psychiatry program (*n=1*), explanation of program protocols (*n=1*), and a description of baseline data for a pediatric telehealth program (*n=1*)

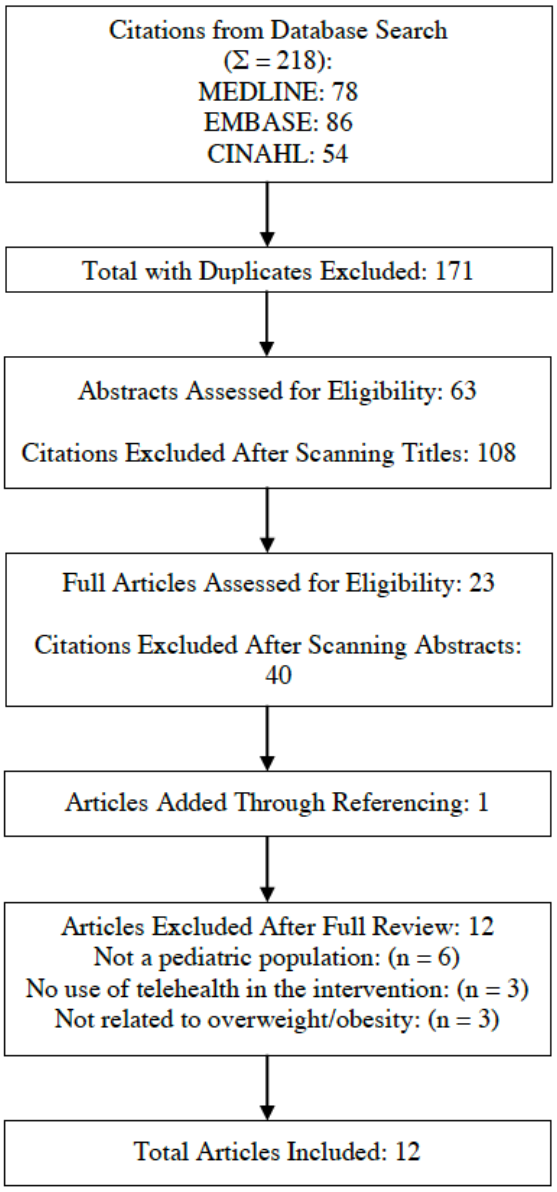

Figure 1. Results of Literature Search for Telehealth in Child Obesity Interventions

3.3 Telehealth Programs

There was marked telehealth program heterogeneity across the literature. Programs utilized telehealth in different ways and to differing degrees. For some programs, telehealth support was a supplement to a primarily in-person program and other programs operated using more

traditional forms of telehealth, where a specialist communicated with a healthcare worker and patient in a remote location. Since reporting metrics were so varied and program structures differed so greatly, the programs will be discussed individually.

3.3.1 The Loozit® Program

The Loozit® Program is a community-based, group weight management program for adolescents (age 13 to 16 years) with overweight or obesity in Australia. The evaluation of the program was designed as a two-arm randomized controlled trial, with both arms receiving an in-person intervention program, but only one group receiving telehealth support after the intervention[217]. Diet professionals facilitated the program, and utilized a cognitive behavioural approach in their counselling to encourage healthy lifestyle behaviour changes. As a group-based program, there were seven weekly in-person sessions, followed by five quarterly group meetings. The experimental group received telehealth follow-up support at the completion of in-person sessions in the form of motivational telephone coaching sessions, SMS text messaging, and e-mails. The effect of supplemental contact (referred to as 'additional therapeutic contact' (ATC)) was compared to a control group who received no ATC at follow-up. In total, three investigations have reported some aspect of the Loozit® program[12–14] and are described in Tables 3 and 4. The findings showed that children in the control group and experimental group showed similar outcomes and ATC did not provide a significant health benefit to children in the program[13].

The authors cite one potential limitation of the research in the Loozit® program which lacked a true control group, receiving no treatment. However, for the purposes of understanding the

effects of telehealth, this presents less of a problem. The Loozit® program also saw declines follow-up assessments, with fewer respondents arriving for anthropometric and health assessments as the length of time from the beginning of the intervention increased. While modest response rates from children were shown when they received follow-up text messages or e-mails, the authors suggested that perhaps the frequency of contact (once every two weeks) may not have been sufficient to support any additional clinical benefit[12]. Overall, while the Loozit® program did appear to create positive health benefits for the children in the intervention, providing additional support via telehealth did not seem to confer any additional benefits when compared to those participants receiving no follow-up communication via telehealth.

3.3.2 University of California Davis Pediatric Telemedicine Program

The University of California Davis (UC Davis) Pediatric Telemedicine Program has provided extensive insight into the field of pediatric telehealth. Telemedicine at UC Davis is primarily provided through direct video conferencing, where specialists at the main hospital in Sacramento, California communicate with patients and families in the offices of healthcare providers in rural and remote areas of the state[11].

Researchers followed the program from pre-implementation through its development and roll out. In 2004, Marcin and colleagues documented a needs assessment of parents throughout California who had children with special healthcare needs, including obesity[11]. Parents often cited time and geographic limitations (Table 5) as barriers to receiving healthcare for their children, and noted a lack of specialty care in their home areas. After introducing the

Pediatric Telemedicine Program in 2004, initial satisfaction among parents receiving telemedicine consultations was high[11] and remained high in later investigations (2011)[218]. Satisfaction scores were shown to be on par with those of parents receiving face-to-face specialty care for their children, however the authors cite that their sample size was small (n = 25) and potentially underpowered. The results may have also been skewed by only administering the tool in English in an area with a significant Spanish-speaking population[218].

Additional literature from the UC Davis Pediatric Telemedicine Program demonstrated the need for supplemental support in their telemedicine psychiatry program[219]. Since weight gain is a common side effect of psychiatric medications, the prevalence of overweight or obesity in this population is unsurprising[220]. Upon observing that 55% of children receiving psychiatry counselling had either overweight or obesity, researchers recognized the need to develop an integrated model of care[219]. By utilizing the telemedicine program to engage other obesity-related specialists, the feasibility of coordinating care would seem more probable than if families needed to schedule additional in-person appointments to address a child's diverse needs.

Table 3. The Loozit® Program

Publication	Study Design	Purpose	Metrics	Outcomes
Shrewsbury et al. (2009)[217]	Methods paper	To document the study protocol	--	--
Kornman et al. (2010)[12]	Data from a larger randomized controlled trial	To report participation in and satisfaction with electronic communications	Participant and facilitator participation in electronic communications (response rate); Participant satisfaction with communications (satisfaction questionnaire)	Overall response rate (adolescents) = 22%; response rate (facilitators) = 93%; Adolescent satisfaction with e-mail and SMS text were moderate
Nguyen et al. (2013)[13]	Randomized control trial	To describe program participant outcomes	BMI-z, waist-to-height ratio, diet, physical activity, psychosocial measures, lipid profile, blood pressure	See Table 4.

Table 4. Outcomes of the Loozit® Program

Outcomes of the Loozit® Trial, Nguyen et al. 2013			
	Baseline	**12 Months (Δ from Baseline)**	**24 Months (Δ from Baseline)**
BMI-z	Control 2.02 ± 0.29, Experimental 2.03 ± 0.37	Control: -4.1%, Experimental: -3.1%	Control: -4.7%, Experimental: -10.4%
Waist-to-Height Ratio	Control 0.59 ± 0.06, Experimental 0.59 + 0.06	Control: -3.5%, Experimental: -1.0%	Control: -3.5%, Experimental: -1.0%
Total Cholesterol	Control 4.4 ± 0.9, Experimental 4.4 ± 0.7	Control: -2.3%, Experimental: 0%	Control: -4.8%, Experimental: -4.8%
HDL-C	Control 1.3 ± 0.3, Experimental 1.2 ± 0.4;	Control: -8.3%, Experimental: 0%	Control: -8.3%, Experimental: 0%
Triglycerides	Control 1.1 (0.7 - 1.9), Experimental 1.2 (0.7 - 2.1)	Control: -9.1%, Experimental: -9.1%	Control: -9.1%, Experimental: -8.3%
Systolic BP	Control 118 ± 12, Experimental 119 ± 13	Control: +0.8%, Experimental: +0.8%	Control: +1.7%, Experimental: +2.5%
Diastolic BP	Control 60 ± 9, Experimental 60 ± 9	Control: 0%, Experimental: +1.7%	Control: +3.3%, Experimental: +3.3%
Diet	More likely to report less frequent consumption of high-fat meat products (odds ratio: 0.22 (95% CI: 0.14, 0.36)) and lunch every day (0.49 (0.3, 0.82)); and more likely to report never/rarely consuming fruit juice (2.47 (1.59, 3.82))		
Physical Activity	Light-intensity physical activity reduced (mean - 0.80h (95% CI: -0.96, -0.64)); Total leisure activities increased (1.2h (1.0, 1.4)) including non-screen-based activities (1.4h (1.1, 1.7))		
Psychosocial	Improvements seen in: body shape satisfaction (mean: 0.43 (95% CI: 0.20, 0.65)), subjective social status (1.26 (0.86, 1.66)), and except for close friendship, all Harter self-perception measures including global self-worth (02.0 (0.09, 0.32))		
Conclusions	Additional telephone contact did not significantly improve outcomes compared to control group. Both groups showed 24-month reductions in BMIz, waist: height ratio, total cholesterol, HDL cholesterol and triglycerides; and increases in systolic and diastolic BP		

Perhaps the most extensive outcomes data from the UC Davis Pediatric Telemedicine Program comes from work by Shaikh et al. (2008), who were interested in documenting changes to care based on telemedicine consultations for children and adolescents with obesity. In this study, the records for 99 children who had received care for overweight or obesity management were reviewed[221]. Treatment protocols were changed in 86.9% of children who engaged with specialists via telemedicine, and 76.8% of children began behavioural modification programs (in accordance with current treatment recommendations[18]). In 28.3% of children, an additional consultation with a specialist was recommended. Parents and children both received educational materials through their telemedicine consultations, and 15% of children began a new medication[221].

In children who received two or more telemedicine consultations (n = 62), outcomes related to anthropometrics, diet, and physical activity were reviewed. While changes in body weight were typically modest, the majority of children with two or more telemedicine consultations showed improvements in diet (n = 50) and/or physical activity (n = 43). Slowed weight gain or weight maintenance was observed in 21.0% (n = 13) of children, and 22.6% (n = 14) of children showed a reduction in weight. While specific intervention strategies were not detailed, authors noted that diet and physical activity counseling was done by 'the consultant'. However, children may not have received the consultant's services and rather been referred to a specialist for additional care. Other limitations of this investigation include the likely variability of interventions that the children received, as well as the lack of any comparison group. Length of treatment also ranged from less than one week to nearly 18

months and did not include any long-term follow-up with the children included in the analyses.

Table 5. University of California Davis Pediatric Telemedicine Program

Author	Study Design	Purpose	Outcome Measures	Results
Marcin et al (2004)[11]	Survey of convenience sample	Needs assessment; program status report; participant satisfaction	Barriers to accessing care, satisfaction with telemedicine care	83% of parents/guardians reported > 1-hour travel time to hospital-based specialist; 40% of all parents and 96% of working parents missed work to attend hospital-based appointments; majority of parents reported reliance on emergency services or self-regulation to control children's medications. 86% of parents/guardians were likely or very likely to use telemedicine in the future.
Marks et al (2008)[219]	Retrospective review of records	Observation of weight issues among children undergoing psychiatric treatment	Prevalence of overweight or obesity	55% of children receiving telemedicine support for psychiatric care had overweight or obesity
Shaikh et al (2008)[221]	Retrospective review of records	Medical needs assessment; observation of behavioral change; parent/guardian/ provider satisfaction	Changes/additions to diagnoses, changes/additions to diagnostic evaluation; changes/additions to treatment, improvement in patient diet, activity, and weight status	86.9% (n=86) of children had a change in treatment; 15.2% (n=15) of parents received skills education; 15.2% (n=15) of children started a new medication; 76.8% (n=76) of children began behavior modification strategies; 63.6% (n=63) of parents received education material; 28.3% (n-28) had an additional consultation recommended; Of children who had two or more exposures (n=62): 80.6% showed an improvement in diet; 69.4% (n=43) showed improvement in activity level; 21% (n=13) slowed weight gain or showed weight maintenance; 22.6 (n=14) showed weight reduction
Mulgrew et al (2011)[218]	Cross-sectional survey	Participant satisfaction	Participant satisfaction	Parent satisfaction (Scored between 40 and 48): Telemedicine - Range 35-48, $\Sigma = 43.8 \pm 4.83$; Face-to-face - 38-48, $\Sigma = 44.5 \pm 3.85$ Telemedicine displayed satisfaction rates not statistically different than traditional in-person care, indicating it was acceptable to families.

3.3.3 University of Kansas Center for Telemedicine and Telehealth

The University of Kansas Center for Telemedicine and Telehealth created and evaluated a pediatric intervention program for children with overweight or obesity residing in the State of Kansas. Children were recruited through local elementary schools and randomized to receive either telemedicine counselling (n = 31) or counselling via standard physician visits (n = 27). Telemedicine programming was conducted by PhD level psychologists or similarly trained psychology professionals. Children participating in the telemedicine program received 8 weekly in-person group sessions, followed by 6 monthly sessions. Children's sessions were conducted at their school, while parents simultaneously but separately engaged in a telemedicine consultation on a similar topic. In order to match the content provided through the telemedicine program, physicians who participated in the physician-visit-arm of the study were given a list of topics to cover with the participating families.

Similar to the telemedicine literature from the University of California, research from the University of Kansas' Center for Telemedicine and Telehealth follows their pediatric programming from the initial feasibility phase through the completion of a randomized controlled trial. In the initial investigation, researchers failed to observe any significant changes in children over the course of the program[216]. A subsequent decision was made to lengthen the duration of the program to 8 months from an initial 4 sessions over 8 weeks. Lengthening the program improved the children's outcomes in both arms of the program. Children receiving the telemedicine arm and the physician arm of the intervention both showed similar improvements in BMIz, diet, and physical activity (Table 6), with no significant differences in treatment groups across any outcome measures.

Literature from the University of Kansas' program showed that telemedicine was a feasible, effective counselling strategy that could be implemented with fidelity[215], however the telehealth arm of the study did experience higher attrition than the in-person arm of the study. Throughout the course of the program, parents also reported satisfaction with the program and a reduction in travel burden by receiving their telehealth services at the school, rather than traveling to a physician's office[216].

Limitations of this investigation included a predominantly male sample (71%) and the lack of a true telehealth intervention for the children. While parents received counseling services over the telephone, children did not directly receive telehealth-based care. This program demonstrated the ability for an intervention utilizing telehealth to provide similar benefits to a traditional in-person, physician-based intervention.

3.3.4 TeleFIT

TeleFIT is a telehealth adaptation of the hospital-based pediatric obesity treatment program known as Brenner FIT. Brenner FIT is a "multidisciplinary, tertiary-care pediatric obesity clinic composed of a pediatrician, a dietitian, a family counselor, physical therapist, exercise physiologist, and social worker" (p. 247)[15]. The Brenner FIT program was tasked with serving families in a 19-county region of North Carolina, much of which is rural with underserved populations. Upon observing low enrollment and high attrition rates in the Brenner FIT program among families in rural areas, the TeleFIT program was implemented to address the issue.

Families enrolled in TeleFIT still needed to attend Brenner Hospital for one intake visit, but then received telehealth follow-ups every 2 to 4 weeks. Follow-up visits were conducted at one of four rural healthcare centers, where video monitors were set up to communicate with staff at Brenner Hospital. Check-ups with Brenner physicians occurred every 4 months in-person at Brenner Hospital. Whereas in-person treatment would have required 16-18 hospital visits per year, the TeleFIT program reduced the number to 4.

One noted strength of this study is its inclusion of the technology infrastructure used to deliver the telehealth program and the similarities between the BrennerFIT and TeleFIT samples of children. Although sample sizes were small for the telehealth arm of the study (n = 14 in year 1, n = 35 in year 2), the TeleFIT program represented a feasible, effective, sustainable means to adapting a clinical program to the telehealth setting. Prior to its implementation, only 4 rural families had been participating in the BrennerFIT program, and TeleFIT displayed an ability to increase enrollment among that population. Similar outcomes were seen between the Brenner FIT and TeleFIT programs, with no significant differences in the number of children who reduced their BMI or the magnitude of BMI reduction between groups. TeleFITshowed the ability to decrease attrition and increase enrollment among rural families in North Carolina (Table 7) and achieve similar benefits to an established hospital-based program.

Table 6. University of Kansas Center for Telemedicine and Telehealth

Author	Study Design	Purpose	Outcome Measures	Results
McGrath-Davis et al (2011)[216]	Prospective cohort study	Feasibility, accessibility, effectiveness of an 8-week intervention	Feasibility, satisfaction, BMI, physical activity (PA), diet	Baseline BMI Percentile: Telemedicine 95.3 ± 4.1; Control 95.7 ± 3.1; Post-Intervention: Telemedicine 95.7 ± 4.4; Control 95.5 ± 4.2 No significant dietary changes in either group Both groups increased PA and decreased sedentary time, but not significantly Parents' overall satisfaction: Σ = 8.4 ± 1.6 (out of 10); parents' satisfaction with intervention components: Σ = 8.4 ± 1.6
Steiger-Gallagher et al (2011)[222]	Randomized controlled trial	Description of baseline data	BMIz, PA, Diet	BMIz: Telemedicine = 1.88 ± 0.52; Control = 1.70 ± 0.45 PA (minutes of MVPA): Telemedicine = 76.90 ± 36.27; Control = 102.87 ± 53.62 Dietary Intake: Telemedicine (kcal) = 1999.29 ± 531.29; Control = 2090.60 ± 630.88
McGrath-Davis et al. (2013)[215]	Randomized controlled trial	Description of program effectiveness after an 8-month intervention	BMIz, PA, Diet, Behavior, Feeding	Change in BMIz: Telemedicine = -0.12; Control -0.15 Change in mean minutes of MVPA: Telemedicine = +27.41; Control = -26.18 Change in Dietary Intake (kcal): Telemedicine = -89.0; Control = -102.0 Change in CBCL TPS (points): Telemedicine = -3.64; Control = -2.85 Change in BPFAS MCFS: Telemedicine = -0.04; Control = -0.04

Abbreviations: MVPA = Moderate to Vigorous Physical Activity; kcal = kilocalories; CBCL = Child Behavior Checklist – Total Problem Score; BPFAS MCFS = Behavioral Pediatrics Feeding Assessment Scale – Mean Child Frequency Score

Table 7. TeleFIT

Author	Study Design	Purpose	Outcome Measures	Results
Irby et al (2012)[15]	Retrospective review	Feasibility of adapting a clinical program to telemedicine	BMIz, attrition rates	TeleFIT: 64% (n=22), BrennerFIT: 69% (n = 179) saw an improvement in BMIz Before telehealth implementation, 4 rural families participated in the hospital-based program, two-years after telehealth implementation, 31 rural families had enrolled. No significant differences in attrition between BrennerFIT and TeleFIT

3.3.5 TeleObe

TeleObe is a telemedicine program used in conjunction with an in-patient obesity treatment program for children and adolescents in Germany. Young people in the program spend the first 4-6 weeks receiving a structured intervention program in the hospital, with telemedicine support provided after participants returned home. While admitted to the program, children received roughly 50 sessions with doctors, mental health professionals, and diet and exercise professionals. Telemedicine support after discharge was provided through an online module, which provided information to participants and was used to administer follow-up assessments and gather post-intervention data from participants. Throughout the telemedicine portion, e-mail and mobile phone contact was also used to send reminders to participating children.

By utilizing the real-time feedback provided through the online module, program facilitators could identify the need for additional support among program participants. This additional support was provided through telephone or internet-based counselling from the physician or

psychologist, or from an exercise or diet professional. Details of the additional support provided via telemedicine are listed in Table 8.

Acceptance of the telemedicine program was high among participants, with 93% of participants engaged 6-months after the initiation of the program, and 46% engaged at the 12-month follow-up[223]. Significant decreases in BMI occurred after the in-patient program (mean BMI decreased from 82.4 kg to 76.0 kg). Decreases in BMI were maintained at the 12-month follow-up. After receiving the telemedicine portion of the program, patients reported increases in wellbeing and satisfaction, and improvements in eating behavior and exercise. The authors argued that the telemedicine portion of the program was important in sustaining the behavioral and clinical changes observed after the initial period of hospitalization. However, the lack of a comparison group makes it difficult to determine what, if any, role the telehealth support played in maintaining the improvements seen at the completion of the in-person program. This information may also be difficult to translate to a North American setting, where in-patient programming for children with obesity is not utilized in routine practice.

Table 8. TeleObe

Author	Study Design	Purpose	Outcome Measure	Results				
				Baseline	3-Months	6-Months	9-Months	12-Months
Schiel et al (2008)[223]	Prospective cohort study	Program effectiveness	Additional Support Required	---	10% wellbeing/ satisfaction, 1% eating behavior, 49% exercise (muscle strengthening), 31% exercise (continuing strengthening)	14% wellbeing/ satisfaction, 1% depression, 3% eating behavior, 64% exercise (muscle strengthening), 50% exercise (continuing training)	13% wellbeing/ satisfaction, 4% motivation, 2% eating behavior, 46% exercise (muscle strengthening), 57% exercise (continuing training)	3% wellbeing/satisfaction, 3% depression, 3% motivation, 31% exercise (muscle strengthening), 23% exercise (continuing training)
			Eating Behavior Score	84.9	+12.1%	+8.5%	+10.0%	+14.4%
			Exercise	8.6	+307.0%	+312.8%	+343.0%	+312.8%
			Depression Score	53.0	-4.3%	-10.9%	-12.5%	-14.7%
			Motivation Score	90.7	-12.3%	-12.8%	-21.9%	-16.0%
			BMI	30.5 $\pm$ 5.6	-9.3%	--	--	-10.1%
			Wellbeing/ treatment satisfaction	50.4	+8.1%	+12.5%	+10.9%	+25.6%

3.4 Conclusion

Albeit limited, the literature suggests that implementing telehealth to provide treatment counselling for children with overweight and obesity may be feasible. Telehealth has been implemented as both a primary treatment method (TeleFIT, UC Davis Telemedicine) and as a complimentary method of care used in conjunction with in-person treatment (Loozit®, University of Kansas Telemedicine and Telehealth, TeleObe). The published research has demonstrated the potential for telehealth to reduce barriers to care, improve access to specialty services, and reduce attrition rates observed in traditional in-person care settings, especially for families in rural settings. Telehealth has also demonstrated value in coordination of care and personalizing treatment to participants' individual needs. However, the heterogeneity and type of delivery of the programs and the limited outcomes data from these programs make it difficult to synthesize a conclusion as to their effectiveness.

Though the programs differ significantly, there are several trends observed in the programs reviewed thus far. One finding is that there tend to be comparable outcomes between in-person and telehealth-based iterations of a program for managing child obesity[15,215]. A lack of added benefit was observed when telehealth was used as an adjunct in follow-up care after an in-person intervention in one study[13], while another study showed sustained health improvements when telehealth was used to provide follow-up care after an intensive intervention[223]. It is important to note, however, that the latter study lacked a comparison group which would have helped to isolate the effectiveness of the telehealth, while the former study did utilize a comparison group and showed no effect. Telehealth has displayed repeated effectiveness in its ability to manage a child's course of care as it relates to obesity

management. Effectiveness has been observed in terms of changes to children's diagnoses, medications, healthcare services, and treatment plans when telehealth is used to communicate with children after a structured intervention[219,221,223].

More research is needed in observing health and behaviour measures before and after enrollment in these services and in isolating telehealth as a measurable variable. More high quality studies are needed to compare the effects of telehealth as a mode of healthcare delivery and in assessing its effectiveness as a means of providing supplementary care. There are still yet to be any interventions for child obesity in the literature that: are delivered primarily using a telehealth platform, provide telehealth services in the user's home, or truly isolate the effectiveness of telehealth use in comparison to an equal in-person intervention. However, there are merits observed thus far in the use of telehealth for pediatric obesity counseling. While some Canadian clinical guidelines for treating obesity in children have not included telephone-based counselling as a treatment strategy[224], the area of telehealth may receive consideration in the future as a way to overcome barriers to accessing care.

3.4.1 Implications for Program Evaluation Planning

The acceptability of telehealth programs in the literature was an encouraging finding for researchers in the HealthLink BC Eating and Activity Program for Kids (the Program). While some models of telehealth utilization differed significantly from the Program model (i.e., the University of California Davis and TeleObe models), the literature was helpful for identifying the barriers to and facilitators of successful telehealth implementation in this field, as well as rates of satisfaction among users[221,223]. Other programs (TeleFIT, University

of Kansas, the Loozit® Program) set forth expectations for outcomes in obesity interventions operated using telehealth[13,15,215]. This assisted in managing expectations for observable changes over the course of the Program, wherein the literature has shown modest changes in some cases and non-significant changes in other cases . These programs reviewed also provided insight on attrition, retention, and optimal program length for Program planning[15,222]. Importantly, a review of these programs identified several gaps in the information collected and reported. For example, the University of Kansas program lacked reports of hematology or children's waist circumference[215,222], which are valuable indicators of metabolic health. Therefore, we included a request for blood work and waist circumference measurements on the Referral Form for the Program (discussed later and in Appendix A). While physical activity was often assessed in the research literature, there were gaps identified in the assessment of sedentary time[215,222]. We responded to this gap by requesting the QEP to collect a comprehensive battery of assessments to measure children's sedentary time throughout the Program. The University of Kansas program evaluation also lacked a measurement of the child's self-worth[215,222], prompting the decision to incorporate measures of personal strengths and difficulties, as well as self-concept (see Appendices D and E) into the Program Evaluation. Additionally, sleep quantity or quality was not reported in any of the program evaluations reviewed, but was incorporated into our baseline assessment, lifestyle counselling, and follow-up measurements for the Program (also see Appendix C). Finally, the Loozit® and University of Kansas programs measured and reported dietary intake and patterns in their samples. In our Program evaluation, RDs measured similar characteristics including diet quality, quantity, and patterns, as well as design and implement a novel tool suited specifically for the Program (see Appendix G)[225].

Chapter 4: Overview of the Program and Evaluation

The purpose of this chapter is to provide background information on the design and content of the HealthLink BC Eating and Activity Program for Kids (the Program). Program development began in November of 2012 and was implemented in March of 2015 after input from researchers, Program staff, and key stakeholders such as the BC Ministry Health and the Childhood Obesity Foundation.

4.1 Introduction

The HealthLink BC Eating and Activity Program for Kids (the Program) is the third program to be launched under the Childhood Healthy Weights Intervention Initiative (CHWII) in the province of British Columbia, Canada. The first two programs in the CHWII are ShapedownBC and Mind, Exercise, Nutrition, Do It! (MEND), which were implemented in 2011 as part of the Healthy Families BC Initiative. ShapedownBC is a hospital-based child obesity intervention program that utilizes group meetings to deliver diet, physical activity, and mental health support to children with overweight or obesity and their families. MEND is a community-based program delivered through local community centres that focuses on health lifestyle behaviour modifications for children and families. Both of these programs have been evaluated in the literature[226,227]. While the existing programs (ShapedownBC and MEND) provide services to children and families in a face-to-face setting, the counselling services provided by the Program are telephone-based. It is the aim of the Program to reduce geographic and/or resource-based barriers to accessing an in-person program and reach children and their families in rural and remote areas of British Columbia.

4.1.1 Overview of the Program

The Program was developed through a collaborative effort between HealthLink BC, the Physical Activity Line (Health & Fitness Society of BC), and the University of British Columbia (Cognitive and Functional Learning Laboratory), with input and support from the Childhood Obesity Foundation, CHWII partners, and the BC Ministry of Health. HealthLink BC, started in 2001, is a government-funded health services provider that offers a comprehensive suite of health information to residents of the province via telephone or e-mail at no cost. The Physical Activity Line (which has since transitioned to become Physical Activity Services at HealthLink BC) was also a government-funded telehealth service originally operated by the Health & Fitness Society of BC that provided evidence-based and individualized physical activity information at no cost to Canadians. The Cognitive and Functional Learning Laboratory, University of British Columbia (UBC) was part of the conceptualization of the Program, extensively involved in its development, and provided oversight on incorporating evaluation metrics into the Program from its inception. The research team from the LEARN Laboratory (UBC) was also tasked with the evaluation of the Program.

The core components of the Program involved: 1) assessment and counselling related to food and nutrition status and eating behaviours provided by the registered dietitians (RDs) at HealthLink BC, 2) physical activity, sedentary behaviour, and sleep assessment and counselling from a QEP from the Physical Activity Line, and 3) evaluation and monitoring of overall health via communications with physicians or other healthcare providers referring their patients to the Program. The Program was intended to be delivered to the child or teen

with the involvement of their parent/s and/or guardian/s. However, the participation of the parent or guardian varied among participants, with several older teens opting to participate without the involvement of a parent or guardian. A child or teen was able to participate in the Program alone, provided that the parent or guardian provided their permission. The involvement of the parent, guardian, child, and in some cases siblings varied week-to-week, depending on the content of the call and the motivation of the family member/s. The preference was that the Program should be delivered as a family-based intervention, but in some cases, was in fact a child- or teen-focused program.

4.1.2 Participation in The Program

Participants were primarily referred by a physician or nurse, but could be referred to the Program via another CHWII program or through self-referral. Once referred to the Program, a comprehensive intake was conducted by Program staff (RDs or the QEP) to detail each participant's individual needs via an Assessment Call. After a careful review of the participant's intake information, an individualized program was developed for that child or teen. Registered dietitians and the QEP covered topics such as: reducing the consumption of low-nutrient high-calorie foods and sugary drinks, increasing fruit and vegetable consumption, reducing screen time, increasing physical activity throughout the day, improving bed time routines, and cooking and eating as a family.

Each family's program was individualized to meet the needs identified in their initial assessment. For example, a family successfully meeting physical activity recommendations with a child who enjoys physical activities may spend more time on diet- and nutrition-

related content, if that need was identified at their intake. Content used in the counselling process aligned with best practices and national standards in physical activity and diet and nutrition (i.e. Canada's Food Guide[228], 24-Hour Movement Guidelines[229], etc.). The specific content delivered to individual participants was not reported to researchers and is not detailed in this thesis. While an individualized program is a relative strength of the Program in customizing care, it introduces variability in comparison of the interventions among participants.

After a participant's individualized program was completed, their follow-up information was compared to the information obtained at baseline. To collectively track the progress of participants in the Program and those participants' behavioural changes and health outcomes, a program evaluation was conducted.

4.2 Developing the Evaluation: Program Management

Throughout the development of the Program and Program evaluation, a program manager from HealthLink BC was tasked with coordinating and tracking the many tasks required to build this intervention. The program manager requested that a logic model be created to track the development of the Program's evaluation. This model was developed to detail the inputs, activities, outputs, and outcomes of the Program evaluation. This Evaluation Planning Logic Model was used to track the progress of evaluation activities and to establish a temporal order of actions. The logic model is presented in Figure 2.

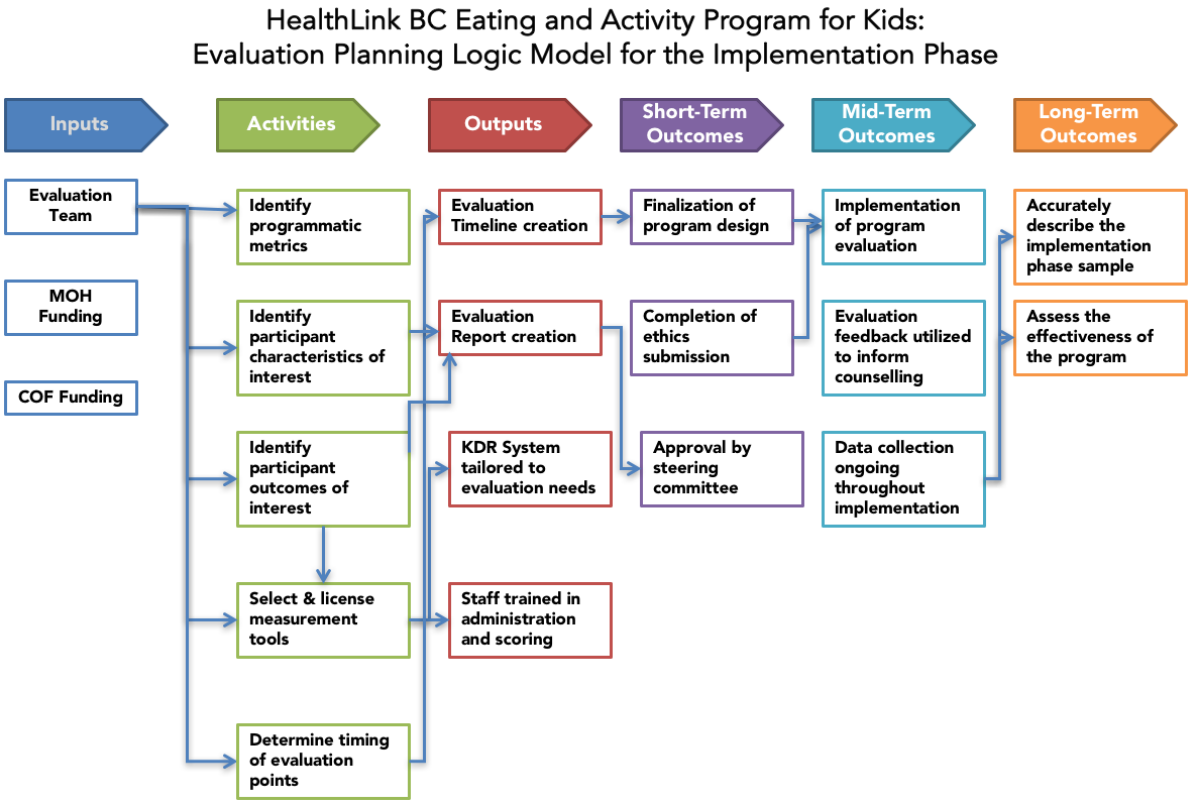

Figure 2. Program Evaluation Planning Logic Model

4.3 The Purpose of the Evaluation as Research

The overall purpose of this dissertation was to first, describe the population of children and families referred to a novel telehealth program for obesity treatment, and second, to assess the effectiveness of that program in its ability to produce behavioural and clinical changes in participating children and families across the program's initial phase of implementation (~24 months). The Program evaluation aimed to achieve several goals, which included: 1) to accurately describe the children and families who enrolled in the implementation phase of the Program, using a demographic questionnaire and information provided in the referral process 2) to measure the effectiveness of the Program as a behavioural modification intervention through the use of a series of questions, questionnaires, and surveys, and 3) to

assess the ability of the Program to create clinical improvements in participating children's health statuses through review of referring physicians' reports.. Information derived from this evaluation will be used to further enhance the Program as it relates to future recruitment, customized program content, and the delivery of best practice and quality service to children and families in the province of British Columbia. The purpose of using a program evaluation to inform future program development is to create a sustainable, easily accessible, free service aimed at improving the health and wellbeing of children and families.

The evaluation framework was based on current available evidence and was designed to be cognizant of the potential burden to participants with a sensitivity to BC's diverse population. An awareness of the sensitivity surrounding issues of overweight and obesity also means that the Program's approach was designed towards eliminating weight bias and stigma and positively supporting the children and families who enrolled in the program. The evaluation strategy for the pilot program reflected its affiliation with the CHWII and incorporated many of the metrics reported in the literature from ShapedownBC and MEND[226,227]. Due to the unique structure of the Program, some aspects of the evaluation were derived from a review of the telehealth literature in pediatric programming for overweight and obesity (Chapter 3). Data collection protocols and metrics were extracted from the published evaluations of ShapedownBC, MEND, and two additional telehealth programs (the Loozit® Program[13] and a telehealth program conducted at the University of Kansas[222]) to be consistent with the standards of reporting in the field. A short report comparing these four programs was submitted to the Program staff during Program evaluation development. The result is a comprehensive, customized evaluation approach that

is aligned with the larger provincial initiative, yet suited to the delivery platform of the Program.

The field of telehealth is expanding and sharing this evaluation through peer-reviewed publication and internal reporting will help to inform and expand the emerging knowledge base. Each measurement or data point has been carefully weighed in its ability to: identify potential areas for participant improvement, shape the participants' treatment plan, and to serve as a possible indicator of the Program's ability to influence behaviour. The metrics are described in detail later in this chapter.

4.3.1 Process Variables

The evaluation intended to collect both processes and outcomes data for the Program. As this was a novel program and one of a very small number of pediatric weights telehealth programs documented in peer-reviewed literature, providing a detailed description of this information was deemed important. The process data initially intended to be analyzed included detailed referral data (location and frequency of referrers, referral settings, satisfaction with referral process), telephony information (including time and length of calls and number of attempts to call participants), and technical data related to the platform required to deliver these services (connection speed, privacy policies, charting procedures). In contrast to initial expectations, only limited information related to the referral setting, number of phone calls completed, and wait times were shared with the evaluators. The process variables that have been shared with researchers and presented in this thesis are

broadly divided into recruitment and retention. The referral information is outlined in Chapter 5: Baseline Participant Characteristics, while the number of calls completed (retention) and wait times are detailed in Chapter 6: Program Outcomes.

4.3.1.1 Recruitment

Assessing how participants came to the Program was important in understanding whether or not the Program was able to minimize or eliminate barriers to healthcare. It was inferred that children referred to the Program by partner programs (due to long wait lists or failure of families to meet inclusion criteria) or who came from rural and remote areas of the province would be considered to have addressed those barriers. In order to target those rural and remote sites throughout the province, researchers examined the existing information on pediatric obesity and available programming throughout the province.

The sites identified for the Program's initial recruitment were selected through an evidence-based examination of geographic gaps in service, pediatric population density, and health risk factors reported at the regional level. This process is illustrated in Figure 3. The process involved an examination of pediatric population rates across the province, perceived health needs of regions in the province, and proximity to existing CHWII programs. Population information was obtained through data from BC Stats[230]. As geographic prevalence rates for obesity in children are not documented, a proxy indicator of children's health was used. We relied on region-specific data reported in the *Summary Report on Health for British Columbia from Regional, Longitudinal and Gender Perspectives*[231]. This report provides regional rates of certain chronic diseases (e.g., cancer, anxiety, depression, dementia), as well

as health-related behaviours like cigarette smoking, alcohol consumption, physical activity, and fruit/vegetable consumption. Although this report only described data for adults, we inferred that some of these health behaviours (i.e., physical activity and fruit/vegetable consumption) could be similar for adults and their children. Finally, a community's proximity to an existing CHWII program was also considered. A map indicating the presence of CHWII programs by region is displayed in Figure 4 (map used with permission from BC Stats).

Of 93 local health areas first considered, sites with an existing CHWII program or that were in close proximity to a program were excluded (n = 18 and 9, respectively). From the remaining 66 areas, sites with a pediatric population density greater than or equal to the provincial average (19.6%) were selected (n = 15). Additional sites were added if a local area was within 1% of provincial population average under 19 years of age with a high prevalence of adult health risk factors (n = 2). Two sites already identified by need were also given priority because of interest expressed previously by a local physician. This selection process generated a group of 17 recruitment sites, which are listed in Table 9. Among those 17 recruitment sites, the mean overall population was 15,088 and ranged from 4,222 to 41,481. The mean population under 19 years of age was 22.6%, and the average proximity to an existing CHWII program was 153 km.

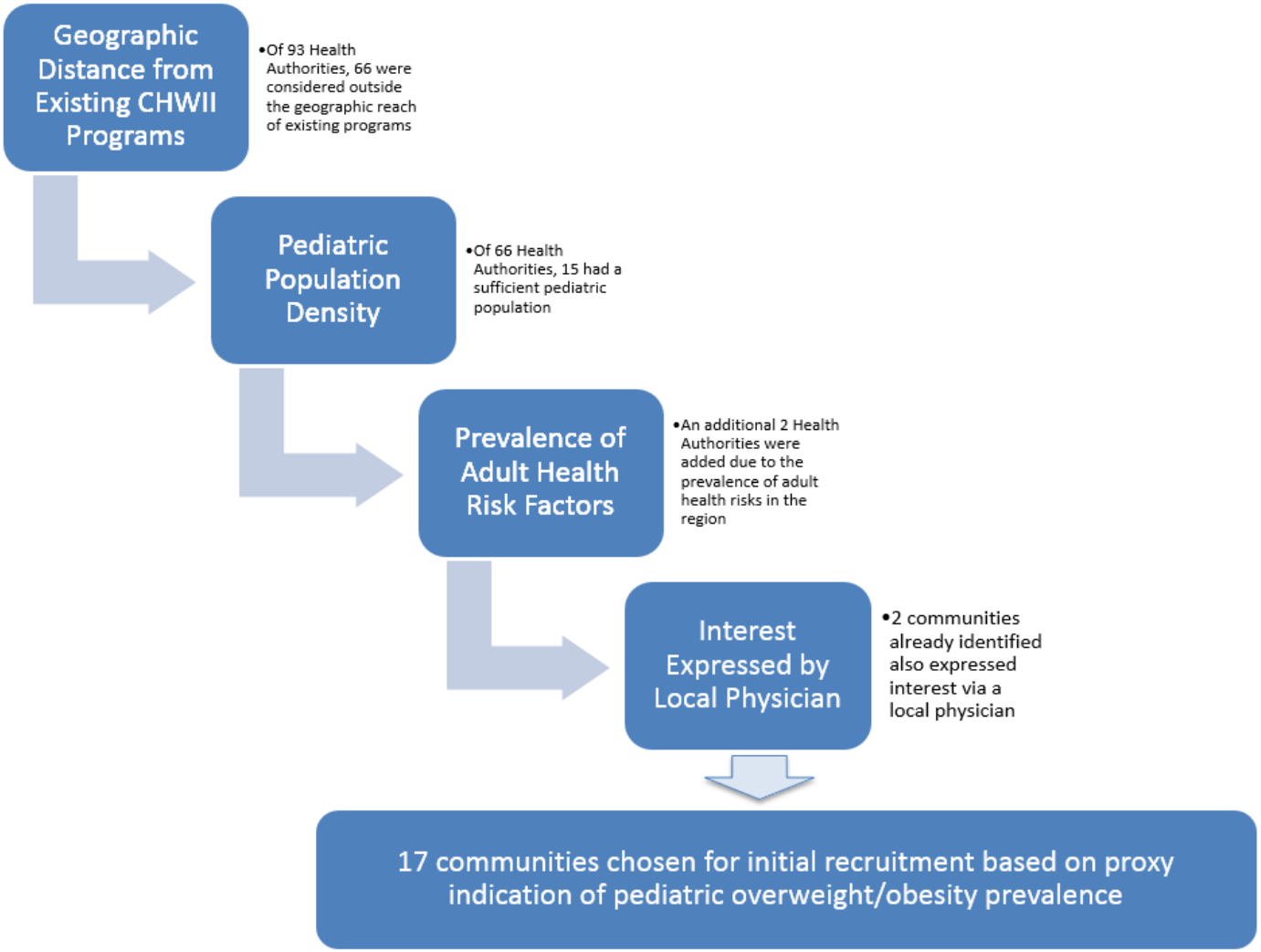

Figure 3. Decision Making Process for Initial Recruitment Site Selection

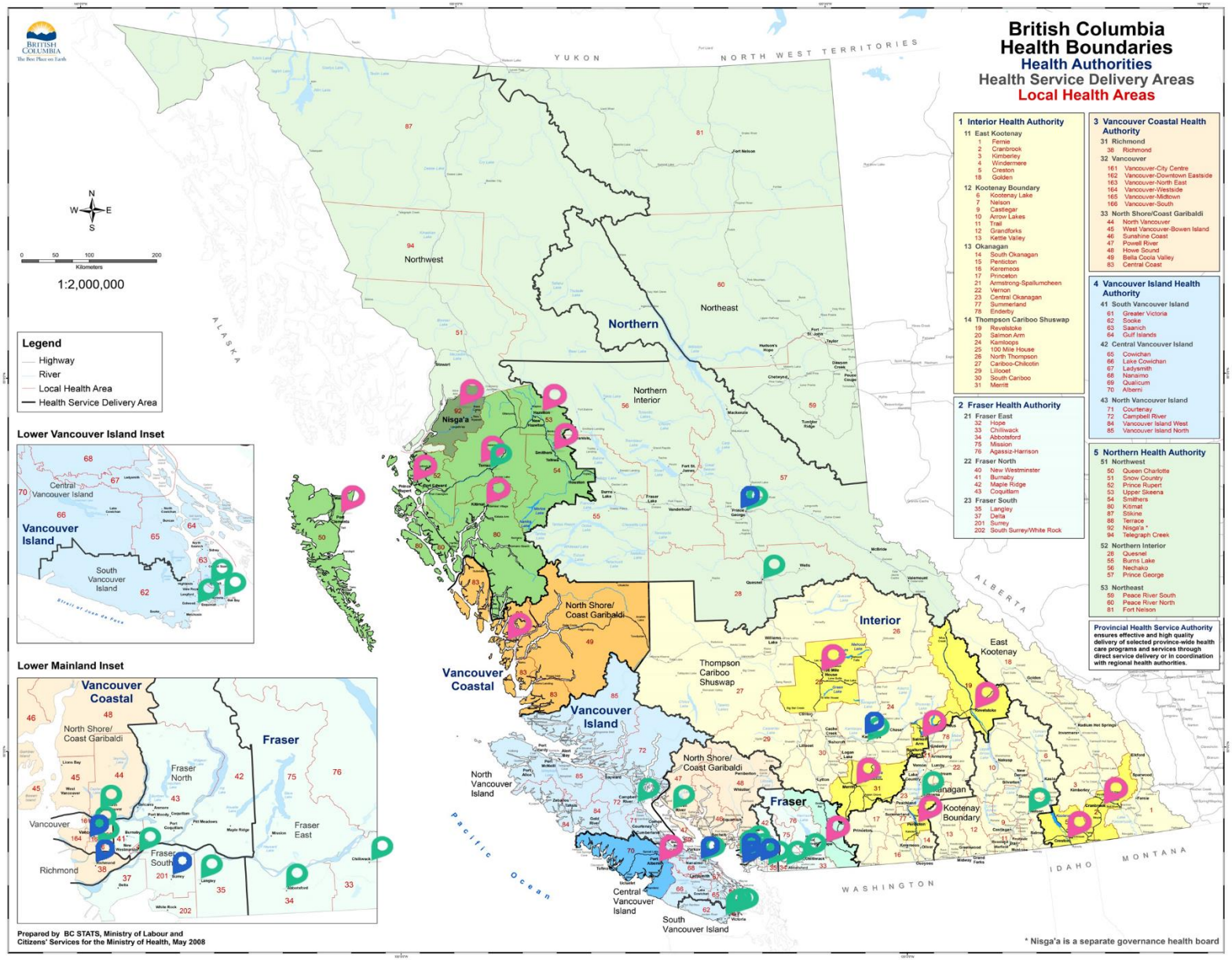

Figure 4. Distribution of CHWII Programs in British Columbia, 2015 (Pink = HEAPK Proposed Site, Green = MEND, Blue = ShapedownBC)

Table 9. Selected sites for initial recruitment in the Program

Community	Closest CHWII (km)	Population	% of Pop. < 19y
100 Mile House	196.0	13635	18%
Alberni	85.5	30712	21%
Bella Coola Valley	487.0	2596	25%
Cranbrook	230.0	25174	22%
Creston	124.0	12337	20%
Hope	53.4	7572	19%
Kitimat	62.1	9427	23%
Merritt	86.5	11513	22%
Nisga'a	99.6	1953	28%
Penticton	62.4	41482	18%
Prince Rupert	144.0	13709	26%
Queen Charlotte	348.0	4306	21%
Revelstoke	212.0	7739	20%
Salmon Arm	109.0	33264	19%
Smithers	205.0	16718	27%
Terrace	0.0	20140	27%
Upper Skeena	99.6	4222	28%
Mean	**153.2 km**	**15,088**	**22.6%**

4.3.1.2 Retention

In order to measure the dose of the Program that participants received, retention data was collected. Retention measures examined how many participants progressed from the referral to the Appointment Call and from the Appointment Call to the Assessment Call, how many Program Calls a participant completed, and how many follow-up appointments were conducted. Program Staff also collected information on the reasons why families chose not to engage with the Program or why they decided to stop their weekly Program Calls before completing seven scheduled calls. These measures were consistent with the reporting framework from ShapedownBC and the MEND Program. This information was collected to track attrition and to inform the knowledge base on telehealth's ability to deliver healthcare services effectively and sustainably.

4.3.2 Outcome Variables

In addition to the process information included in the program evaluation, outcome data was collected and analyzed. Program outcomes were broadly categorized as behavioural outcomes (those outcomes that measured change in health-related behaviour), and clinical outcomes (those outcomes that demonstrated physiological changes among program participants).

4.3.2.1 Behavioural Outcomes

One of the hypotheses in this research was that the Program would be able to initiate behavioural changes in its participants. Measuring behavioural outcomes among the families that participated in the Program is an important component to evaluating the overall effectiveness of the intervention. Changes in participants' health-related behaviours were hypothesized to predate any physical changes and were a primary target of the intervention. For example, Program Staff and researchers expected to see self-reported increases in physical activity or improvements in

diet quality, quantity, and patterns before observing decreases in weight or BMI. Behavioural outcomes measured in the evaluation included: diet quality and quantity, eating behaviours, physical activity and sedentary behaviour, sleep, personal strengths and difficulties, and self-perception, all of which were assessed using valid and reliable tools.

4.3.2.2 Clinical Outcomes

A major goal of the Program was to change health behaviours as a means to changing clinical indicators of health. Based on other intervention programs in the literature, clinical changes were expected to be modest during the course of the initial evaluation phase (at 6 mo). It was also hypothesized that sustained behavioural modifications may elicit clinical changes (i.e., slowed weight trajectory, change in BMI, improvement in markers of clinical diagnoses) over the course of the extended follow-up period at 2 years. The scope of this thesis, however, only includes follow-up to the 6-month point. Clinical outcomes included: height, weight, BMI, waist circumference, and blood pressure. The clinical outcomes were measured by the referring healthcare provider(s) of the participant, who collected the data in-person.

4.4 Evaluation Methods

The evaluation implemented a program evaluation design aimed to capture both processes and outcomes information. The goal was to help the Program deliver high-quality service to children and families, continually refine and improve the program, and to examine the effectiveness of the Program in its efforts to improve children's health and wellbeing.

4.4.1 Participants

The Program was available for any child or teen (under 19 years of age at the time of referral) in the province of British Columbia. To be included, a participant should have had a BMI that

coincided with overweight or obesity, or be on a growth trajectory that indicated a child might soon leave the healthy range. Non-English-speaking children, teens, or families were accommodated with translation services provided by the province. Inclusion criteria were designed to permit ease of enrollment for any child, teen, or family who thought that they could benefit from the Program.

While a detailed recruitment plan was created (and detailed in Section 4.3.1.1), that plan was not formally implemented in practice. Instead, HealthLink BC staff notified a small group of physicians about the Program initially, and received referrals through those channels. This was in part to introduce participants slowly, permitting Program Staff to refine Program delivery and manage the workload. As the Program progressed, several of those physicians first notified about the Program continued to refer, and word of the Program spread through professional working groups. There was an information page about the Program added to HealthLink BC's website (https://www.HealthLinkBC.ca/healthy-eating/healthy-weight/kids-program), which also attracted several of the self-referring families. Detailed information on individual referrers and referral patterns was collected by HealthLink BC, but was not provided to researchers. In the next phase of the program, it is our recommendation that HealthLink BC revisits the originally established recruitment plan and implement accordingly.

4.4.2 Data Collection and Program Measures

There were five stages to data collection, which included: The Referral Phase, the Appointment Call, the Welcome Package, the Assessment Call, and the Post-Intervention Follow-Up. The overall Program flow is detailed in Figures 5 and 6.

4.4.2.1 Referral Phase

The Program began when a child or teen was referred either by themselves or a parent, through a partner CHWII program (i.e., when wait lists were especially long for enrollment in ShapedownBC or MEND), or by a healthcare provider. A limitation of using telephone counselling is that it is a non-face-to-face modality. To increase the rigor of the data collected, the primary healthcare provider who interacted in-person with the participants collected the children's health status and anthropometric measurements. In addition to medical history, the standard battery of measurements in a pediatric weight intervention was collected, which included: height, weight, BMI, and blood pressure. Copies of bloodwork were also requested if such testing was indicated based on the physician's exam. Examples of relevant bloodwork would include: a normal hematology profile, thyroid stimulating hormone, aspartate aminotransferase, alanine aminotransferase, lipid profile, albumin, basic metabolic panel, alkaline phosphatase, or any other measures a physician would see fit (See Appendix A for Patient Referral Form). The referral provided important information in describing the population of participants referred to the Program, and in providing baseline information for future analyses

of clinical changes across the Program.

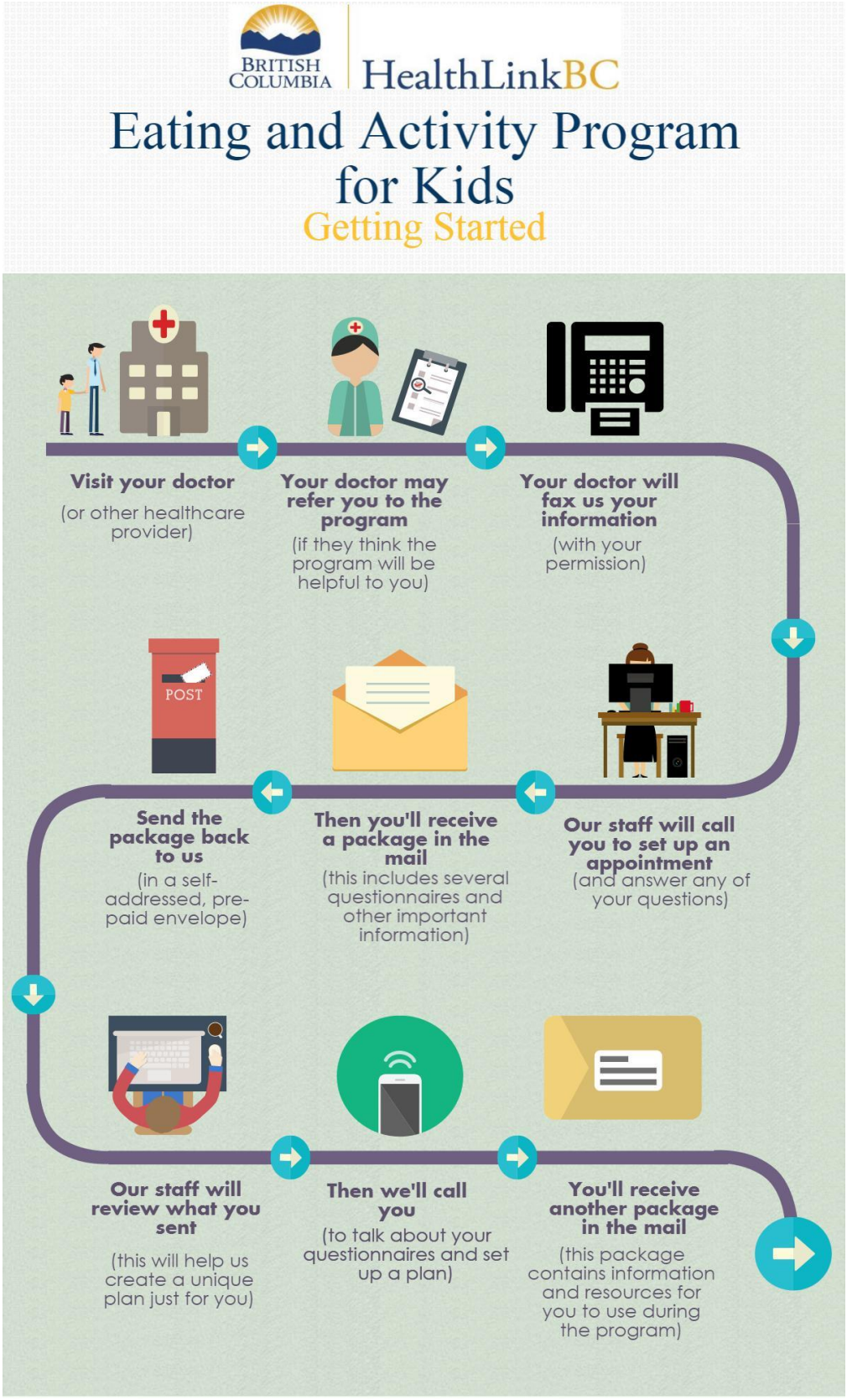

Figure 5. Visual Depiction of Program Initiation, Lasinsky© (Piktochart, Malaysia Incorporated Co.)

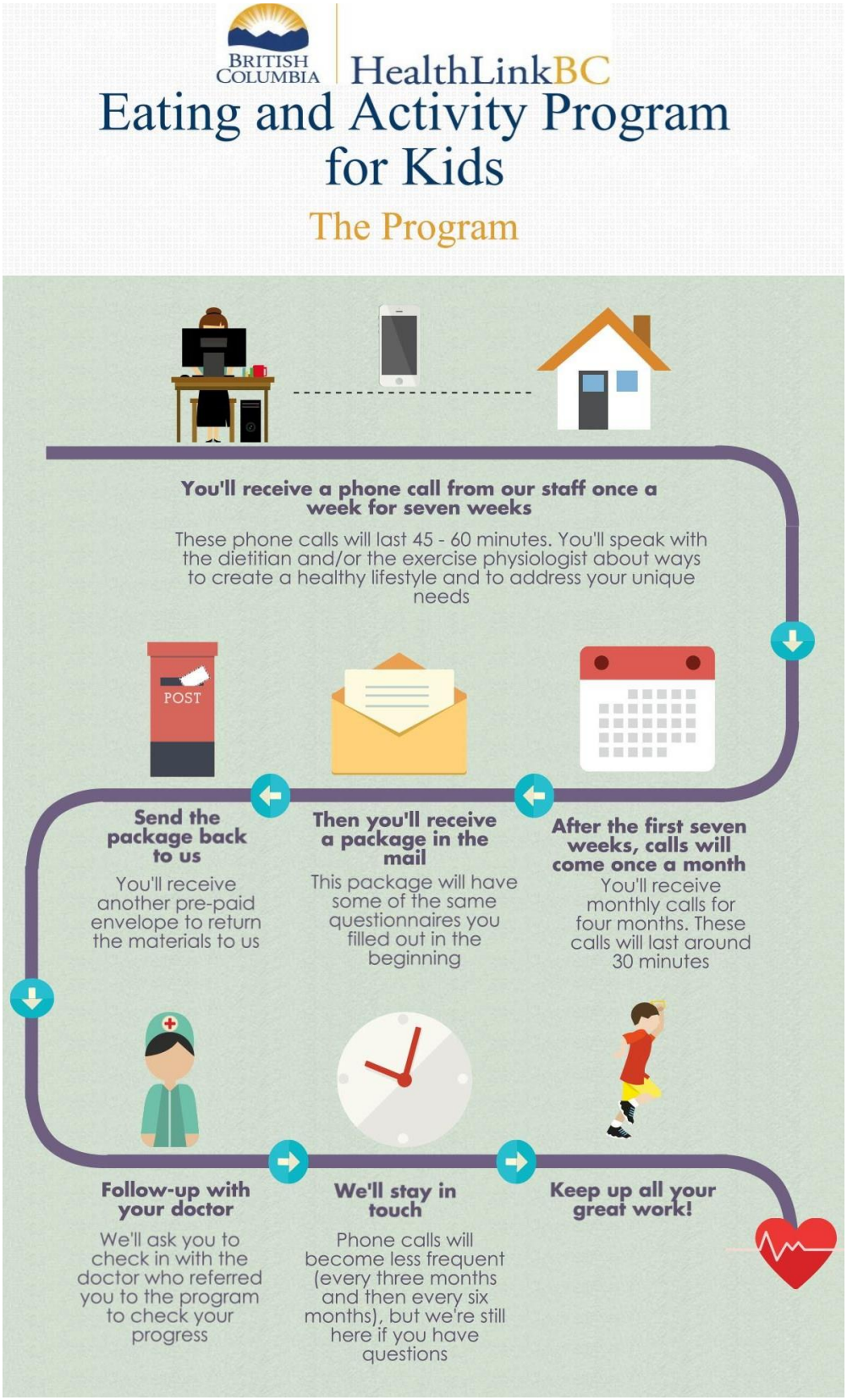

Figure 6. Visual Depiction of Progression Through the Program, Lasinsky© (Piktochart, Malaysia Incorporated Co.)

Referring providers were also asked to provide a record of waist circumference (WC) for the child or adolescent. The decision to document WC was made in response to strong evidence for the importance of waist circumference in predicting childhood obesity-related health risks[232]. In order to obtain the measurement effectively and appropriately, the Program Staff created materials that showed primary care providers and medical office assistants the proper technique for assessing WC. Pilot materials were also created to support referring providers in communicating with potential program participants in a way that was free of bias or stigmatization. These materials were developed in line with recommendations on how to sensitively approach issues of body weight with patients[233]. The success of the Program's word-of-mouth recruitment efforts was tracked internally at HealthLink BC by recording the areas and offices from which the children and families were referred; however, this information was identified as protected information and not provided to UBC's research team for the evaluation.

4.4.2.2 Initial Point of Contact (Appointment Call)

Following referral to the Program, a Program Staff member contacted the participant over the telephone. In this first outgoing call, the Program Staff introduced themselves, explained what the Program was, answered any questions, and families confirmed their intention to participate. This was also an opportunity to confirm the accuracy of information provided to the Program in a physician's referral. Families whose preferred language was not English received the first call and all subsequent calls through an interpreter provided from the Provincial Language Services.

4.4.2.3 The Welcome Package

After initial phone contact, families received a Welcome Package, which included a number of paper-basedassessments: The Family Demographic Questionnaire, the Child Sleep Questionnaire, the Strengths and Difficulties Questionnaire, the Harter Self-Perception Profile,

and the Dutch Eating Behaviour Questionnaire; as well as informed consent and assent forms. As baseline measures, each of these assessments contributed to information needed to describe the population of individuals referred to the Program. When re-administered at follow-up, these questionnaires (except for the demographic questionnaire) represented measures of potential behaviour change across the intervention.

The Family Demographic Questionnaire (Appendix B) was an unvalidated, internally-developed instrument designed to obtain demographic and socioeconomic information from participating families. Language for the questionnaire and response options were adapted from Statistics Canada and the Canadian Health Measures Survey[196,234]. Collecting information pertaining to the families' social and economic environment was intended to assist staff in providing culturally-appropriate care, as well as counselling specific to the circumstances and needs of the individual participants. This information was also used to provide descriptive information to researchers for evaluation and reporting purposes, and to permit grouped analyses.

The Sleep Questionnaire (Appendix C) was also developed internally. Individual questions included in the sleep survey have been used in a larger, validated sleep questionnaire[27] and have shown high reliability in identifying deficiencies in either the quality or quantity of sleep[235]. Sleep measures were included in the program because of the emerging body of evidence on the importance of good sleep habits and sleep's relationship to weight status and adiposity. Addressing sleep needs is part of the Program's holistic approach to improved health and wellbeing, and a timely response to recent findings in the literature[126]. Researchers were also interested in examining the role of sleep as a mediator of changes in physical activity and/or diet.

Measurements of children's overall behaviour and their self-perception are often reported in the literature on pediatric weight interventions[13,223,227,236]. Opting to administer the Strengths and Difficulties Questionnaire (SDQ) (Appendix D) in lieu of the Child Behavior Checklist (CBL) (commonly used throughout the literature) was a response to the medium in which the Program operates. By using the abbreviated SDQ, which has been validated against the CBL, program staff are able to respect participants' time while still gathering important information[237]. The SDQ measures children's strengths and difficulties across several categories: Total Difficulties, Emotional Symptoms, Conduct Problems, Hyperactivity-Inattention, Peer Problems, Prosocial Behaviour, and provides an overall Impact Score, which addresses the chronicity, distress, and burden of the child's difficulties. The SDQ has demonstrated acceptable reliability and validity in screening for potential mental health issues in children[29].

The Harter Self-Perception Profile (Appendix E), also administered in similar programs, was used because it serves as a useful indicator of the child's self-esteem and self-worth. The Harter Self-Perception Profile has demonstrated high internal consistency reliability and convergent validity against other tools, although it can be challenging to truly validate a child's self-perceptions[28]. While the Program primarily sought to change health-related behaviours, there is a clear understanding that fostering a sense of empowerment and belief in one's ability to change their behaviour is a fundamental first step. Many other pediatric telehealth programs have provided an indicator of social-emotional wellbeing in the participating children. Since the Program did not have a trained mental health professional on staff, clinically diagnostic mental health tools could not be used. However, the Harter Self-Perception profile has been validated in assessing overall self-perception in children by individuals without professional psychology credentials[28]. The SDQ and Harter Self-Perception Profile were administered to facilitate an

understanding of how overweight or obesity affect a child's social and emotional health, and how improving physical health may also influence measures of social and emotional health.

Finally, the Dutch Eating Behavior Questionnaire (DEBQ) (not enclosed in this document due to copyright protections) was included in the Welcome Package. The DEBQ is a widely used tool in the field[238–240], and has been validated across a number of populations[24,25]. The DEBQ helps to identify restrained, emotional, and external eating behaviours, and was used by the Program's registered dietitians to create an appropriate treatment strategy for children who displayed problematic eating behaviours. Generally, children under 13 received the Dutch Eating Behavior Questionnaire for Children (DEBQ-C), which was adapted from the DEBQ and displays good internal consistency among the scales, while adolescents aged 13 years and older received the DEBQ. Including data from the DEBQ and DEBQ-C help in reporting the prevalence of problematic eating behaviours in the Program. Registered dietitians were also able to utilize information from these questionnaires to specially address certain types of problematic eating (emotional, external, or restrained).

4.4.2.4 The Assessment Call

After returning the welcome package, the Program staff completed an Assessment Call with the participating child (depending on the child's age) and his or her parent/guardian. The Assessment Call served as an opportunity to compile a medical history from participating children/adolescents by discussing their primary care provider's notes and allowing participants to provide their own information about health concerns, family histories, and dietary, physical activity, and lifestyle habits. The information collected in the Assessment Call provided additional information used in describing the population of families referred to the Program at

baseline, and when these tools were re-administered at follow-up, served as an indication of potential behavioural change.

As part of documenting the families' existing health practices, the Godin-Shephard Leisure-Time Exercise Questionnaire (Appendix F) was administered to record the amount of physical activity in which participants engaged at the beginning of the Program[241].

While the Godin-Shephard tool was originally validated in an adult population, it has demonstrated moderate test-retest reliability and convergent validity in a sample of Grade 5 children[242]. Children or their parents were also asked to report the number of sports or activities in which the child engaged. All participants (and participating family members) were cleared for physical activity participation via the Physical Activity Readiness Questionnaire for Everyone (PAR-Q+), the most advanced evidenced-based risk stratification and screening tool available, and where applicable, the ePARmed-X+[243]. The risk stratification component of these tools was also used to provide individualized physical activity prescriptions during the Program.

The QEP also documented the child/teen's sedentary behaviour patterns (i.e., leisure time screen time). Leisure time screen time (LTST) is distinguished from general screen time in that it excludes school-related screen time (e.g., computer usage in school or at home for school-related work) in children. The 24-Hour Movement Guidelines for Canada recommend no more than 2 hours of leisure time screen time per day[229]. Tracking sedentary behavioura across the period of intervention was an important indicator of the Program's ability to shift leisure behaviours in children away from sedentary pursuits toward ones more physically active.

Given an existing, validated measure was not available to support unique program and evaluation needs, a novel, ethics approved diet quality, quantity, and patterns instrument was

developed by T. Mihalynuk (Appendix G) and administered by Program RDs. The tool was developed in consideration of pragmatic issues such as reduced burden to both dietitian practitioner and client[225]. The dietary variables under study included those within and outside of Canada's Food Guide (including low-nutrient, high-calorie foods), eating patterns (out of vs. in the home and skipping meals), and an area for dietitians to document key areas of practitioner impact, and prompt areas requiring further attention. Client-reported intakes were documented via food frequency and 24-hour recall sections. Diet quality, quantity, and patterns were derived from a child's self-report or a parent's report of their child's typical daily intake. Questions to assess household food security, which have been adapted from the Canadian Community Health Survey[244], were also administered. The questions and reponse options were as follows:

> ***Which of the following statements best describes the food eaten in your household in the past 12 months?***
>
> *(always enough, enough not-kind, sometimes not, often not, n/a, don't know)*

> ***You and other household members worried that food would run out before you got money to buy more. Was that often true, sometimes true, or never true in the past 12 months?***
>
> *(often true, sometimes true, never true, n/a, don't know)*

Metrics surrounding diet quality and quantity and the home food environment were important in determining the overall consumption patterns among these children and measuring the Program's ability to shift these patterns in a positive direction.

4.4.2.5 The Post-Intervention Follow-Up Phase

The post-intervention follow-up phase consisted of three parts: the follow-up package, the follow-up phone call, and the follow-up visit with the referring physician. These parts were meant to: collect follow-up questionnaires and surveys, reassess diet, physical activity, and sleep measures, and to obtain follow-up anthropometrics and vital signs, respectively. The follow-up questionnaires and surveys provided information related to potential behavioural change, while the physician's follow-up report was meant to provide information related to potential changes in clinical health.

A follow-up questionnaire package was sent to participants roughly 6-months after program initiation (results provided Chapter 6) and will be sent again approximately 24-months after program initiation (results outside the scope of this thesis). This package included: the Dutch Eating Behavior Questionnaire, The Child Sleep Questionnaire, the Strengths and Difficulties Questionnaire, and the Harter Self-Perception Profile. Questionnaire responses post-intervention were compared to the responses at baseline to identify any changes that occurred over the course of the Program.

The follow-up phone call was an opportunity to reassess diet quality, quantity, and patterns, as well as physical activity, sedentary behaviour, and sleep. Registered Dietitians and the QEP re-administered the diet tool, Godin Leisure Time Exercise Questionnaire, and several of the assessment questions on sedentary behaviours, leisure time screen time, and physical activity. This phone call was conducted at 3-months after Program initiation (roughly when children completed the weekly phone calls in the Program) and again at 6-months after Program initiation.

Children and teens were also encouraged to return to their physician to obtain follow-up health measures roughly six months after beginning the Program. Information requested by Program Staff included: height, weight, BMI, waist circumference, medical diagnoses, blood pressure, and the results of any blood work that the physician deemed necessary.

Researchers and Program Staff recognized that this piecemeal approach to the follow-up was not ideal, but was necessitated by the limitations of the telehealth platform and the absence of an online component. Timelines of when information was collected throughout the Program are displayed in Figures 7 and 8.

HEAPK BASELINE DATA												
	Physician Referral	Appointment Call	Welcome Package	Assessment Call	Resource Package	Call #1	Call #2	Call #3	Call #4	Call #5	Call #6	Call #7
Patient Health Number	✓											
Height	✓											
Weight	✓											
BMI	✓											
Date of Birth	✓											
Blood Pressure	✓											
Waist Circumference	✓											
Medical History	✓											
Blood work	✓											
Language Preference	✓											
Mailing Address		✓										
Verbal Consent		✓										
Ethnicity			✓									
Family Income			✓									
Parental Work Information			✓									
Sleep Questionnaire			✓									
Telephone/Internet Access			✓									
Strengths & Difficulties Questionnaire			✓									
Dutch Eating Behavior Questionnaire			✓									
Written Consent/Assent			✓									
Child PAR-Q+				✓								
Parent PAR-Q+				✓								
Child ePARmed-X+				✖								
Parent ePARmed-X+				✖								
PA/SB Questions				✓								
Godin Exercise/Leisure				✓								
Food Security Status				✓								
Dietary Assessment Tool				✓								
Content Topic #1						✓						
Content Topic #2							✓					
Content Topic #3								✓				
Content Topic #4									✓			
Content Topic #5										✓		
Content Topic #6											✓	
Content Topic #7												✓
✓ - yes ✖ - if available or indicated												

Figure 7. Evaluation Timeline for Baseline Data Collection and Content Delivery

HEAPK FOLLOW-UP												
	Monthly Call #1	Monthly Call #2	Monthly Call #3	Monthly Call #4	Follow Up Package	Physician Follow Up #1	Quarterly Call #1	Quarterly Call #2	Biannual Call #1	Physician Follow Up #2	Biannual Call #2	24-Month Follow Up
				~3 mo. after completion of WPC; or ~6 mo. from PI			~6 mo. after completion of WPC; or ~9 mo. from PI	~9 mo. after completion of WPC; or ~12 mo. from PI	~15 mo. after completion of WPC; ~18 mo. from PI		~21 mo. after completion of WPC; or ~24 mo. from PI	
Height						✓				✓		
Weight						✓				✓		
BMI						✓				✓		
Blood Pressure						✓				✓		
Waist Circumference						✓				✓		
Diagnoses						✓				✓		
Blood work						✓				✖		
Physician Feedback Form						✓						
Sleep Questionnaire					✓							✓
Dutch Eating Behavior Questionnaire					✓							
Strength and Difficulties					✓							✓
Participant Satisfaction Form					✓							
PA/SB Questions	✓			✓				✓				✓
Godin Exercise/Leisure	✓			✓				✓				✓
Dietary Assessment Tool	✓			✓				✓				✓
Parent PAR-Q+								✓				✓
Child PAR-Q+								✓				✓
Parent ePARmed-X+				✖				✖	✖			✖
Child ePARmed-X+				✖				✖	✖			✖
✓ - yes ✖ - if available or indicated **WPC** – Weekly Program Calls **PI** – Program Initiation												

Figure 8. Evaluation Timeline for Follow-Up Data Collection

Chapter 5: Baseline Participant Characteristics

The following information represents the baseline findings (demographic information, anthropometric measures, diet quality, quantity, and patterns, physical activity and sedentary behaviour*, sleep, and social-emotional wellbeing) from children referred to the HealthLink BC Eating and Activity Program for Kids and whom consented to participate in the research (evaluation) component of the program.*

5.1 Introduction

The following information details the characteristics of a sample of children referred to the Program over the course of its pilot implementation. Information related to the children's anthropometric measurements, demographic information, general health status, physical activity and sedentary behaviour, diet quality, quantity, and patterns, sleep, and indicators of social-emotional health are reported. This chapter presents findings related to the first purpose of the evaluation: describing the population of individuals referred to Program across its implementation phase. The sample described herein represents participants consenting to the research component of the program, which is roughly one-quarter of all children and teens referred to the Program.

5.2 Methods

Methodological information regarding participant inclusion, the assessments, and procedures of the research has been presented in detail in Chapter 4.

5.2.1 Data Treatment and Statistical Analysis

Program staff recorded all study-related data for Program evaluation participants into a shared file with UBC researchers, once all identifying pieces of information were removed. Data was quality checked by third party staff at HealthLink BC and all statistical analyses were completed by UBC researchers. Statistical analyses were completed using Statistica 13.2 (Tibco Software, Palo Alto, CA).

Continuous variables are typically represented as a mean and standard deviation. Categorical and binary variables are displayed as percentages and/or counts. Variables for which there are well-established percentiles (e.g., waist circumference and body mass index) are represented as age-, sex-, and/or height-derived percentiles. A number of dietary variables, as well as sleep quantity and sedentary time are represented as a percentage of the recommended amount, based on field-dependent guidelines.

Demographic characteristics and interpretations were done in accordance with several large population-based surveys in Canada (e.g., the Canadian Health Measures Survey). Body mass index (BMI) was calculated from the height and weight reported upon a participant's referral utilizing the World Health Organization's Growth Charts for Canada[245]. Waist circumference percentiles were calculated using the BC Children's Hospital's anthropometric calculators, which utilize the World Health Organization's Growth Charts for Canada as reference values[246]. Unlike in an adult population, distinct values have not been generated for identifying a healthy or unhealthy waist circumference percentile for children and youth, although the 90th percentile has been suggested as a threshold of concern for metabolic disorder[140]. Waist circumference measurements were also used to calculate waist to height

ratio (WHtR). A WHtR at or exceeding 0.5 has been cited as a marker of increased risk for central obesity in children[247,248]. Anthropometric information obtained through self-report (i.e. height and weight) was not included in statistical analyses, due to the potential for inaccuracy. Only objectively-measured anthropometrics from referring healthcare providers were included in the Program evaluation.

Interpretations of blood pressure measurements were done utilizing the tools provided by BC Children's Hospital. Plotting blood pressure percentile has been indicated by Hypertension Canada's 2016 Canadian Hypertension Education Program Guidelines for Blood Pressure Measurement, Diagnosis, and Assessment of Risk of Pediatric Hypertension[249]. These guidelines designate the 95th percentile as a marker for pediatric hypertension, if a systolic or diastolic blood pressure is measured at or above the 95th percentile for age, sex, and height on at least three separate occasions. However, the measurements obtained upon Program referral were from a single blood pressure measurement, so while blood pressure is plotted herein according to percentile, we are unable to make any official designations based on these measurements.

Self-reported food group consumption was interpreted according to the sex- and age-based recommendations in Canada's Food Guide. Scores related to eating behaviours are presented without a reference group. Since the DEBQ-C and DEBQ do not yet have normative data for children, the scores from these measures are meant to observe eating behaviour patterns and tailor treatment, rather than to assign a clinical diagnosis.

Self-reported physical activity values were derived from the Godin Leisure Time Exercise Questionnaire, which asks the user to report the frequency and intensity of their physical activity. Participants in the Program were asked to complete this questionnaire based on their typical week. The questionnaire categorizes respondents based on their combined moderate to strenuous physical activity, with the rationale that moderate to strenuous physical activity is primarily responsible for the many health benefits of physical activity[26]. A score of 0-13 units classifies an individual as insufficiently active, a score between 14 and 23 classifies an individual as moderately active, and a score of 24 or more units designates a person as sufficiently active.

Results from the SDQ are presented in comparison to a reference population. Since the SDQ does not have normative data for Canadian children, the reference values for American children were used for comparison[250]. The normative data for children from the United States was obtained from approximately 10,000 children through the National Health Interview Survey (NHIS), a survey conducted by the National Center for Health Statistics (US Centers for Disease Control and Prevention)[251]. Normative data values are divided by age group. Since the number of children below 8 years and above 14 years was relatively small, the analyses have been conducted in the Program evaluation sample for boys and girls aged 8 to 10 years and 11 to 14 years.

Sleep measurements are reported as an absolute value and as a percentage of the recommended number of hours. The recommended amount of sleep for a child's age was derived from a recent consensus statement published by the American Academy of Sleep Medicine[252].

A major limitation of the analysis was that we received incomplete data sets for a number of participants from HealthLink BC. Incomplete data sets resulted from unreturned paper questionnaires, missed phone calls, and a lack of follow-up with Program staff. For each of the following baseline data categories, a sample size is listed. Considering the great diversity across individuals during childhood and adolescence, data has been interpreted according to age groups where possible. Similarly, sleep, sedentary behaviour, and food group consumption are reported as percentages of age-based recommendations to allow for comparison across the group.

5.3 Results

5.3.1 Referral Information

A total of 216 children and youth were referred to the Program between April 2015 and December 2016. Out of these individuals, 55 children and youth (26%) provided consent to participate in the Program evaluation (25 f, 30 m) (Table 10). Of those participants consenting to the research, most participants were referred by a physician (52%; n = 28), followed by self-referral (33%; n = 18) and referral by a partner program (MEND or Shapedown BC) in the CHWII (13%; n = 7). Only 2% (n = 1) of participants were referred by a nurse. The Program utilized a family-based lifestyle counselling approach. In some instances, where a child was referred, a parent/guardian requested that a sibling also participate. Siblings received access to the Program, but these individuals were not included in the analyses of the data.

Table 10. Referral Information

Referrals	n (%)
Total Referrals	**216**
Evaluation Participants	**55 (26%)**
	25f, 30m
Referral Source	**n (%)**
Physician	**29 (53%)**
	13 f, 16 m
Self-Referred	**18 (33%)**
	5 f, 13 m
CHWII Partner	**7 (13%)**
	6 f, 1 m
Nurse	**1 (2%)**
	1 f

5.3.2 Demographic Information

Demographic information is displayed in Table 11. The Program evaluation sample included more boys (n = 30) than girls (n = 25). There was no significant difference in mean age between boys (11.5 $\pm$ 2.9) and girls (11.1 $\pm$ 3.9) (p = 0.48). The distribution of age followed an inverted U-shape with most participants falling between the range of 8 and 13 y, but included children and youth age 2 to 17 y. Families participating in the Program evaluation were mostly Caucasian (71% of parents and 65% of children and youth), although Asian, Indian, Fijian, First Nations, Persian, Pakistani, Metis, and multi-ethnic families were represented in the sample. Most participants resided in an urban area of British Columbia (80%, n = 44), while 20% of participants (n = 11) lived in rural or remote areas of the province.

The highest level of parental education attained by the parent completing the demographic survey was obtained, with 78% (n = 39) of parents having completed a college or university

program. Parents also tended to work full-time (56%, n = 28) (30 or more hours per week), although 14% (n = 7) reported working part-time (between 15 and 30 hours per week), and 30% (n = 15) reported working between 0 and 15 hours per week. Approximately 37% (n = 18) of families were considered a low-income household in accordance with federal standards, 100% of families (n = 49) were below the median household income for British Columbia[253], and 35% (n = 16) reported some level of food insecurity in the home. All participants in the Program evaluation sample had regular access to a telephone (100%, n = 55), and nearly all participants had regular access to the Internet (98%, n = 49).

Table 11. Demographic Information

Characteristics	n (%)
Sex	
Female	25 (45%)
Male	30 (55%)
Age (y) (Mean ± SD)	
Females and Males	11.3 ± 3.3
Females	11.1 ± 3.9
Males	11.5 ± 2.9
Distribution of Age (y)	
<5	1 (2%)
5-7	5 (9%)
8-10	17 (31%)
11-13	20 (36%)
14-16	10 (18%)
17	2 (4%)
Geographic Designation	
Urban	44 (80%)
Rural/Remote	11 (20%)
Low-Income Households	18 (37%)
Below Median Household Income	49 (100%)
Parent/Guardian Ethnicity	
Caucasian	35 (71%)
Asian	7 (14%)
Indian	3 (6%)
Fijian	1 (2%)
First Nations	1 (2%)
Persian	1 (2%)
More than one ethnicity	1 (2%)
Child/Youth Ethnicity	
Caucasian	32 (65%)
Asian	6 (12%)
Indian	2 (4%)
First Nations	2 (4%)
Persian	1 (2%)
Pakistani	1 (2%)
Metis	1 (2%)
Fijian	1 (2%)
More than one ethnicity	3 (6%)

Characteristics	n (%)
Parental Work Hours Per Week	
Full-time (30+ hr/wk)	28 (56%)
Part-time (15 - 30 hr/wk)	7 (14%)
Less than Part-time (0 - 15 hr/wk)	15 (30%)
Parental Education	
College diploma	15 (30%)
Bachelor's degree	13 (26%)
High school or equivalent	8 (16%)
University certificate	8 (16%)
More than a bachelor's degree	3 (6%)
Trade certificate	2 (4%)
Less than high school	1 (2%)
Internet Access	
Yes (always)	49 (98%)
No (not always)	1 (2%)
Food Security	
Insecure	16 (35%)
Secure	30 (65%)

5.3.3 Anthropometric and Health Information

Anthropometric and health information are displayed in Table 12. Mean BMI at baseline was 29.4 $\pm$ 6.2 for the combined sexes. The mean BMI for boys (30.2 $\pm$ 6.3) was significantly higher than the mean BMI for girls (26.5 $\pm$ 5.7) ($p = 0.04$), and boys (74.8 $\pm$ 28.9 kg) had significantly higher body weight than girls (58.0 $\pm$ 22.7 kg) ($p = 0.03$). Among this sample, 64% (n = 29) of participants were above the 99th percentile for BMI, 27% (n = 12) of children and youth were between the 95th and 99th percentiles for BMI, and 9% (n = 4) were below the 95th percentile for BMI. Five of twenty-seven children (19%) for whom systolic blood pressure was reported were at or above the 95th percentile for blood pressure. Systolic and diastolic blood pressure did not differ significantly between boys and girls ($p = 0.09$, 0.11). A total of 11 waist circumference measurements were received upon referral. Of 11

measurements, 9 participants (82%) had a waist circumference measurement above the 90th percentile for age and sex. Mean WC percentile for the combined sexes was 94.7 $\pm$ 16.5. While absolute WC measurements did not differ between the sexes ($p = 0.33$), when reported as a WC percentile, boys mean WC percentile was significantly higher than that for girls ($p = 0.02$). Out of the 11 participants with a waist measurement recorded, 10 (91%) had a Waist to Height Ratio (WHtR) at or above 0.5. The mean WHtR was 0.6 $\pm$ 0.08 and did not differ significantly between the sexes as an absolute value ($p = 0.84$) or as a percentile measurement ($p = 0.63$).

Table 12. Anthropometric and Health Information

Characteristics	All Participants	Girls	Boys	p
BMI (kg/m^2)				
Mean ± SD	28.3 ± 6.2 (n = 46)	26.5 ± 5.7 (n = 23)	30.2 ± 6.3 (n = 23)	0.04*
BMI Percentile				
>99th	29 (64%)	13 (57%)	20 (87%)	--
95th-99th	12 (27%)	7 (30%)	2 (9%)	--
<95th	4 (9%)	3 (13%)	1 (4%)	--
Height (cm)				
Mean ± SD	149.8 ± 18.9 (n = 46)	145.1 ± 19.4 (n = 23)	154.5 ± 17.5 (n = 23)	0.09
Weight (kg)				
Mean ± SD	66.4 ± 27.1 (n = 46)	58.0 ± 22.7 (n = 23)	74.8 ± 28.9 (n = 23)	0.03*
Systolic BP (mmHg)				
Mean ± SD	113 ± 11 (n = 27)	110 ± 12 (n = 13)	117 ± 10 (n = 14)	0.11
>99th percentile	3 (11%)	1 (8%)	2 (15%)	--
95th – <99th percentile	2 (7%)	--	1 (8%)	--
90th – <95th percentile	1 (4%)	--	--	--
50th - <90th percentile	15 (56%)	8 (67%)	7 30%)	--
<50th percentile	6 (22%)	3 (25%)	3 (23%)	--
Diastolic BP (mmHg)				
Mean ± SD	69 ± 10 (n = 22)	65 ± 10 (n = 10)	73 ± 9 (n = 12)	0.09
> 99th percentile	--	--	--	--
95th – <99th percentile	3 (14%)	1 (11%)	2 (16%)	--
90th – <95th percentile	3 (14%)	1 (11%)	2 (16%)	--
50th - <90th percentile	9 (41%)	3 (27%)	5 (42%)	--
<50th percentile	7 (32%)	4 (44%)	3 (25%)	--
Waist Circumference (WC)				
WC Mean ± SD (cm)	94.7 ± 16.5 (n = 11)	91.6 ± 17.1 (n = 5)	97.3 ± 18.7 (n = 6)	0.33
WC Percentile (Mean ± SD)	94.6 ± 6.3 (n = 11)	89.6 ± 8.0 (n = 5)	98.4 ± 1.0 (n = 6)	0.02*
Waist to Height Ratio (WHtR)				
WHtR (Mean ± SD)	0.6 ± 0.1 (n = 11)	0.6 ± 0.1 (n = 5)	0.6 ± 0.1 (n = 6)	0.84
WHtR Percentile (Mean ± SD)	94.4 ± 6.9 (n = 11)	95.7 ± 4.7 (n = 5)	93.4 ± 9.2 (n = 6)	0.63

BMI: body mass index; BP: blood pressure; SD: standard deviation; WC: waist circumference; WHtR: waist to height ratio

5.3.4 Food and Nutrition

A summary for the analysis of food and nutrition is shown in Table 13. Results showed a general under-consumption of fruits and vegetables, and milk and alternatives in boys and girls, and an over-consumption of grain products and meat and alternatives. Consumption patterns by food group showed high variability across the sample, as represented in Figures 9 and 10. These figures represent the range of consumption when compared to the percentage of recommended daily servings.

Sugary drinks were consumed on average 5.4 $\pm$ 6.2 times per week. Low nutrient, high calorie foods (LNHCF) (defined as foods aside from sugary drinks that do not fit within CFG), were consumed with a mean frequency of 7.1 $\pm$ 6.0. Reports of sugary drink and LNHCF consumption varied widely across the sample, ranging from 0 to 28 times/wk and 0 to 42 times/wk, respectively. In the sample, 11 (23%) families reported eating out of the home three or more times per week, and 18 (37%) individuals in the sample reported skipping meals.

A summary of clinical eating behaviours (restrictive, emotional, and external eating) are summarized in Table 13.

Table 13. Food and Nutrition at Baseline

Food Group	All Participants	Females	Males
Grain Products			
Too few (<100% RDS)	14 (29%)	9 (36%)	5 (19%)
Appropriate (100-149% RDS)	19 (39%)	8 (32%)	11 (42%)
Too many (150+% RDS)	16 (33%)	8 (32%)	10 (39%)
Milk and Alternatives			
Too few (<100% RDS)	30 (61%)	15 (63%)	15 (60%)
Appropriate (100-149% RDS)	13 (27%)	6 (25%)	7 (28%)
Too many (150+% RDS)	6 (12%)	3 (12%)	3 (12%)
Meat and Alternatives			
Too few (<100% RDS)	6 (12%)	4 (17%)	2 (8%)
Appropriate (100-149% RDS)	17 (35%)	8 (33%)	9 (36%)
Too many (150+% RDS)	26 (53%)	12 (50%)	14 (56%)
Fruits and Vegetables			
Too few (<100% RDS)	39 (80%)	17 (71%)	22 (88%)
Appropriate (100-149% RDS)	7 (14%)	5 (21%)	2 (8%)
Too many (150+% RDS)	3 (6%)	2 (8%)	1 (4%)
Low-Nutrient High-Calorie Foods			
Times consumed per week (Mean $\pm$ SD)	7.1 $\pm$ 6.7 (n = 49)	6.1 $\pm$ 6.1 (n = 24)	7.6 $\pm$ 10.4 (n = 25)
Sugary Drinks (CFG + Non CFG)			
Times consumed per week (Mean $\pm$ SD)	5.6 $\pm$ 6.6 (n = 49)	5.1 $\pm$ 6.0 (n = 24)	6.1 $\pm$ 7.1 (n = 25)
Eating Behaviours			
Skipping meals	18 (37%)	11 (46%)	7 (28%)
Eating out (3+ times/week)	11 (23%)	4 (17%)	7 (29%)

RDS: recommended daily servings; SD: standard deviation; CFG: Canada's Food Guide

Table 14. Dutch Eating Behavior Questionnaire at Baseline

DEBQ Scale	All Participants	Females	Males
External Eating			
Score (Mean ± SD)	2.8 ± 0.8 (n = 46)	2.9 ± 0.7 (n = 21)	2.8 ± 0.8 (n = 25)
Emotional Eating			
Score (Mean ± SD)	1.9 ± 0.9 (n = 46)	1.8 ± 0.8 (n = 21)	2.0 ± 0.9 (n = 25)
Restrained Eating			
Score (Mean ± SD)	2.3 ± 0.7 (n = 46)	2.5 ± 0.9 (n = 21)	2.1 ± 0.5 (n = 25)

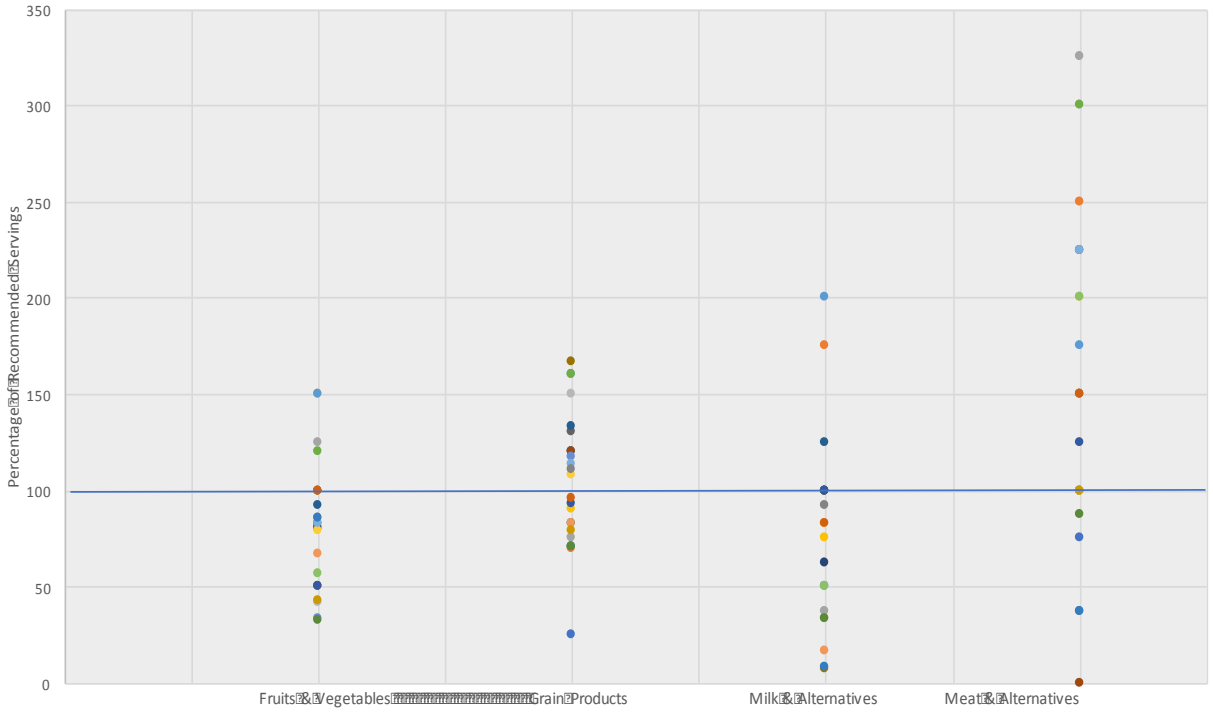

Figure 9. Percentage of Recommended Servings by Food Group Girls 2 to 17 Years

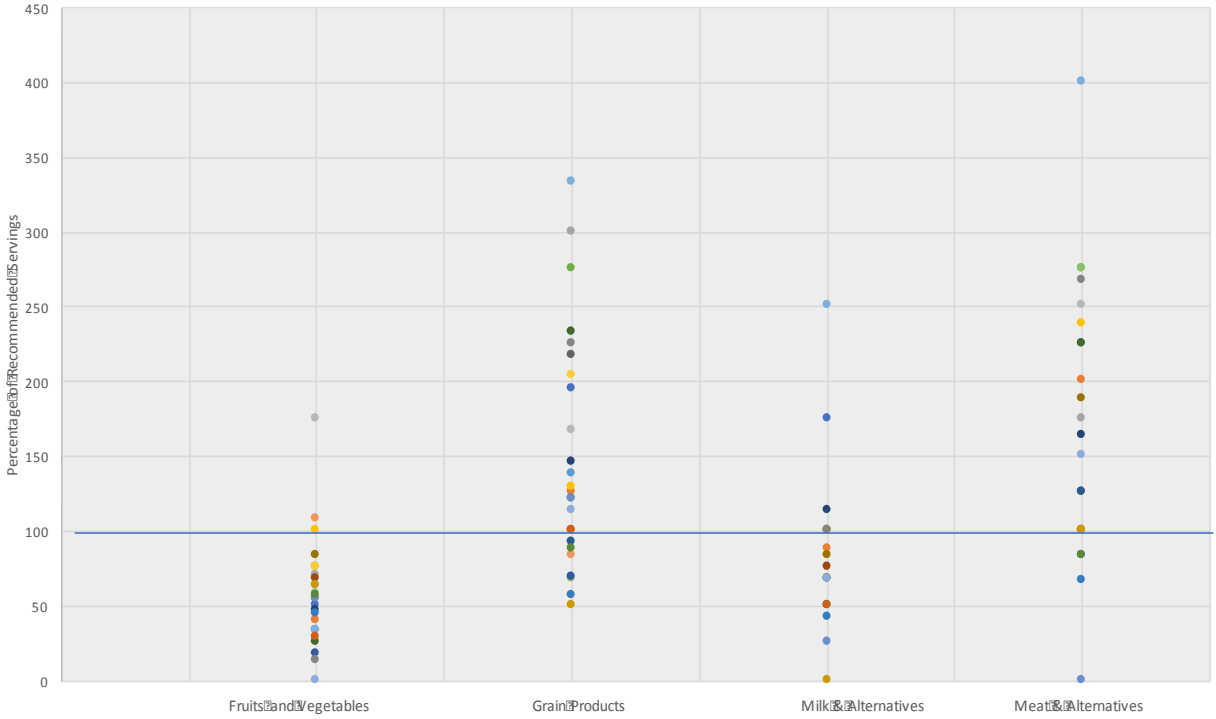

Figure 10. Percentage of Recommended Servings by Food Group Boys 5 to 17 Years

5.3.5 Physical Activity and Sedentary Behaviour

Participant self- or parent-reported physical activity (PA) and sedentary behaviour (SB) characteristics are presented in Table 15. In the cohort, 15% (n = 6) of children and youth were designated as insufficiently active, 28% (n = 11) were classified as moderately active, and 58% (n = 23) of children were classified as sufficiently active based upon their self-reported levels of weekly moderate to vigorous activity. A total of 44% (n = 20) of participants reported participating in no sports or activities, 29% (n = 13) of participants reported participating in 1 sport or activity, 16% (n = 7) of participants reported participating in 2 sports or activities, and 11% (n = 5) of participants reported participating in 3 or more sports or activities. Mean leisure time screen time (LTST) was 192 $\pm$ 92 minutes per weekday. A total of 72% (n = 31) of participants reported levels of LTST that exceeded the recommendations as per the 24-Hour Movement Guidelines. The majority of children (64%, n = 28) acquired more than 120 minutes of sedentary time per day every day in a typical week, while only 5% (n = 2) of children reported acquiring fewer than 120 minutes of sedentary time per day on all days of the week.

Table 15. Physical Activity and Sedentary Behaviour at Baseline

	All Participants	Females	Males
Total Physical Activity (GSLTEQ)			
0-21 units	5 (12%)	1 (5%)	4 (19%)
22-50 units	17 (41%)	7 (33%)	10 (48%)
51-75 units	13 (31%)	8 (38%)	5 (24%)
76-100 units	3 (7%)	2 (10%)	1 (5%)
100+ units	4 (10%)	3 (14%)	1 (5%)
Moderate to Vigorous Physical Activity (GSLTEQ)			
0-13 units (Insufficiently Active)	6 (15%)	2 (10%)	4 (19%)
14-23 units (Moderately Active)	11 (28%)	4 (19%)	8 (38%)
24+ units (Sufficiently Active)	23 (58%)	15 (71%)	9 (43%)
Organized Sports & Activities			
0 sports/activities	20 (44%)	8 (36%)	12 (52%)
1 sport/activity	13 (29%)	6 (27%)	7 (30%)
2 sports/activities	7 (16%)	5 (23%)	2 (9%)
3+ sports/activities	5 (11%)	3 (13%)	2 (9%)
Sedentary Behaviour			
Met sedentary time guidelines 7 days/wk	2 (5%)	1 (5%)	1 (5%)
Met sedentary time guidelines 4-5 days/wk	6 (14%)	4 (19%)	2 (9%)
Met sedentary time guidelines 2-3 days/wk	8 (18%)	4 (19%)	4 (18%)
Met sedentary time guidelines 0 days/wk	28 (64%)	12 (57%)	15 (68%)
Leisure Screen Time			
Minutes per weekday (Mean $\pm$ SD)	192 $\pm$ 92 (n = 43)	166 $\pm$ 92 (n = 21)	216 $\pm$ 91 (n = 22)

GSLTEQ: Godin Shephard Leisure Time Exercise Questionnaire

5.3.6 Social-Emotional Health

Table 16 summarizes the mean scores from the Athletic Competence, Physical Appearance, Behavioural Conduct, and Global Self Worth scales of the Harter Self-Perception Profile (HSPP) and each subscale of the Strengths and Difficulties Questionnaire (SDQ).

For the SDQ, girls in the sample tended to score higher for Total Difficulties, Emotional Symptoms, and overall Impact Score (Figures 11 and 12). Older girls in the Program evaluation sample (11-14 y) also tended to report a greater level of Peer Problems than was reported in the normative data set (Figure 12). Boys in the sample tended to score higher than the normative values for Total Difficulties, Emotional Symptoms, Conduct Problems, Peer Problems, and overall Impact Score (Figures 13 and 14). These higher scores indicate poorer outcomes for the subscales. Younger boys (8-10 y) also tended to display lower levels of Prosocial Behaviour than did the larger population, indicating worse prosocial behaviours (Figure 16).

When compared to a reference population for the HSPP[28], girls in the Program evaluation sample tended to score quite similarly across each of the four subscales (Figure 18). However, the boys tended to score lower in Athletic Competence and Physical Appearance than did a reference population of children (Figure 19)[28].

Table 16. Social Emotional Health at Baseline

	All Participants	Females	Males
Harter Self-Perception Profile			
Athletic (Mean ± SD)	2.6 ± 0.7 (n = 29)	2.7 ± 0.7 (n = 13)	2.4 ± 0.7 (n = 16)
Physical (Mean ± SD)	2.6 ± 0.8 (n = 29)	2.6 ± 1.0 (n = 13)	2.5 ± 0.7 (n = 16)
Behavioural Conduct (Mean ± SD)	3.0 ± 0.7 (n = 30)	3.1 ± 0.8 (n = 14)	3.0 ± 0.7 (n = 16)
Global (Mean ± SD)	3.1 ± 0.7 (n = 29)	3.2 ± 0.8 (n = 13)	3.0 ± 0.7 (n = 16)
Strengths and Difficulties Questionnaire			
Overall (Mean ± SD)	12.6 ± 6.4 (n = 50)	11.7 ± 6.4 (n = 23)	13.3 ± 6.3 (n = 27)
Emotional (Mean ± SD)	3.8 ± 3.4 (n = 51)	3.9 ± 2.9 (n = 23)	3.8 ± 3.9 (n = 28)
Conduct (Mean ± SD)	2.2 ± 1.8 (n = 51)	1.8 ± 1.5 (n = 23)	2.5 ± 2.0 (n = 28)
Hyperactivity (Mean ± SD)	4.3 ± 2.7 (n = 51)	3.6 ± 2.2 (n = 23)	5.0 ± 2.9 (n = 28)
Peer Problems (Mean ± SD)	2.7 ± 2.0 (n = 51)	2.4 ± 2.0 (n = 23)	2.9 ± 2.1 (n = 28)
Prosocial (Mean ± SD)	8.2 ± 1.9 (n = 51)	8.7 ± 1.7 (n = 23)	7.8 ± 2.0 (n = 28)
Impact Score (Mean ± SD)	2.5 ± 2.9 (n = 50)	2.0 ± 2.5 (n = 23)	2.9 ± 3.3 (n = 27)

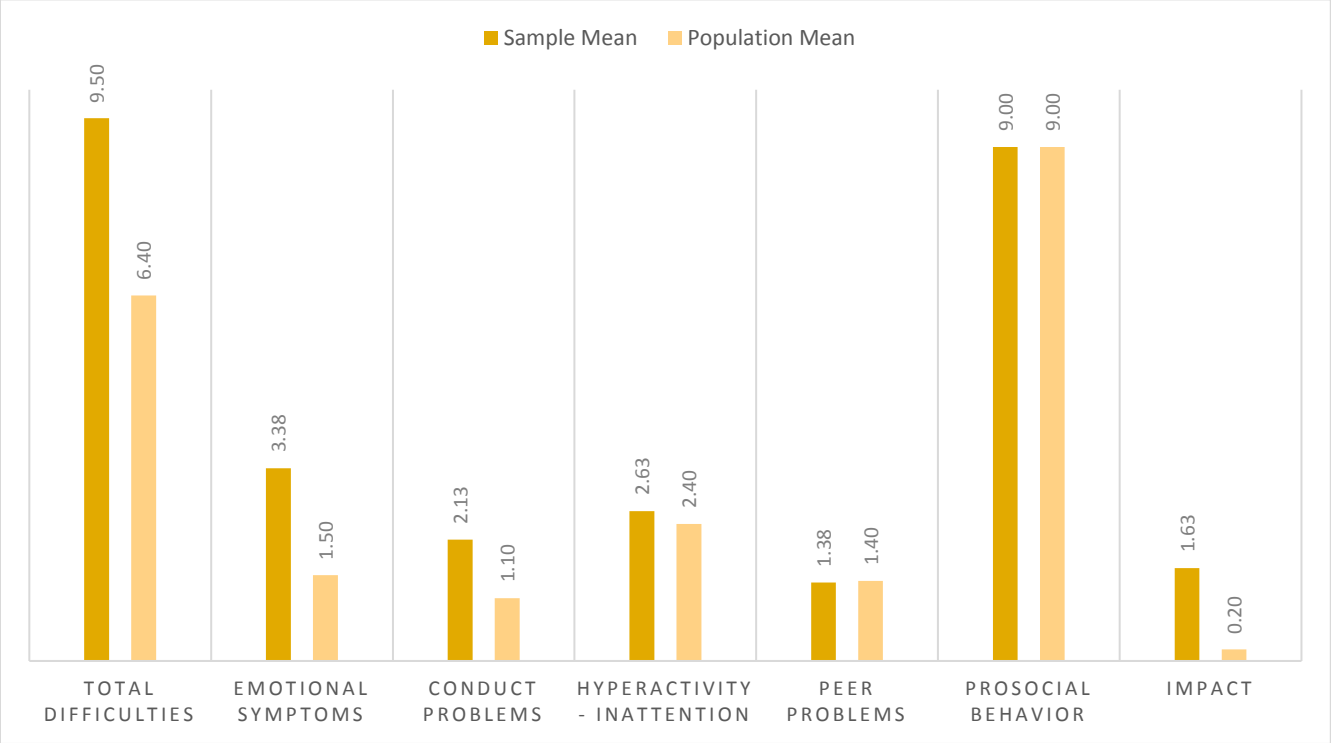

Figure 11. Strengths and Difficulties Questionnaire for Girls 8 to 10 Years

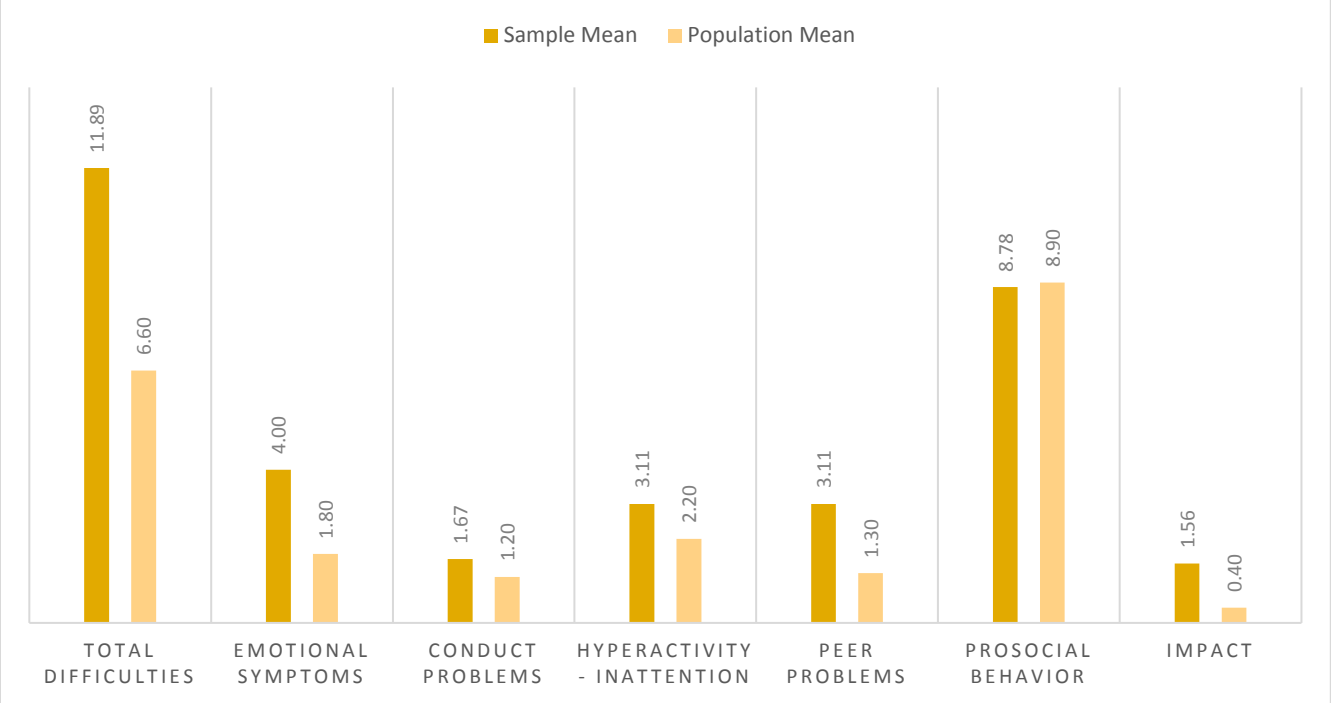

Figure 12. Strengths & Difficulties Questionnaire for Girls 11 to 14 Years

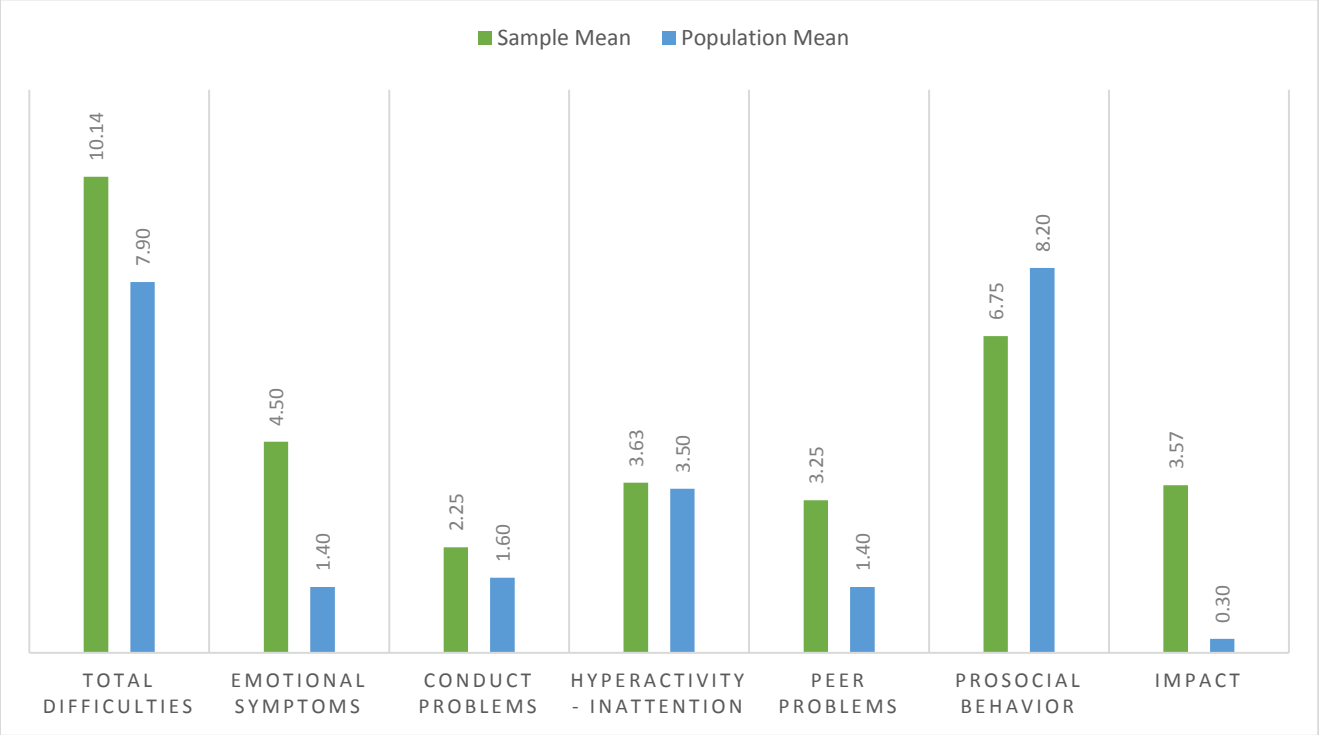

Figure 13. Strengths and Difficulties Questionnaire for Boys 8 to 10 Years

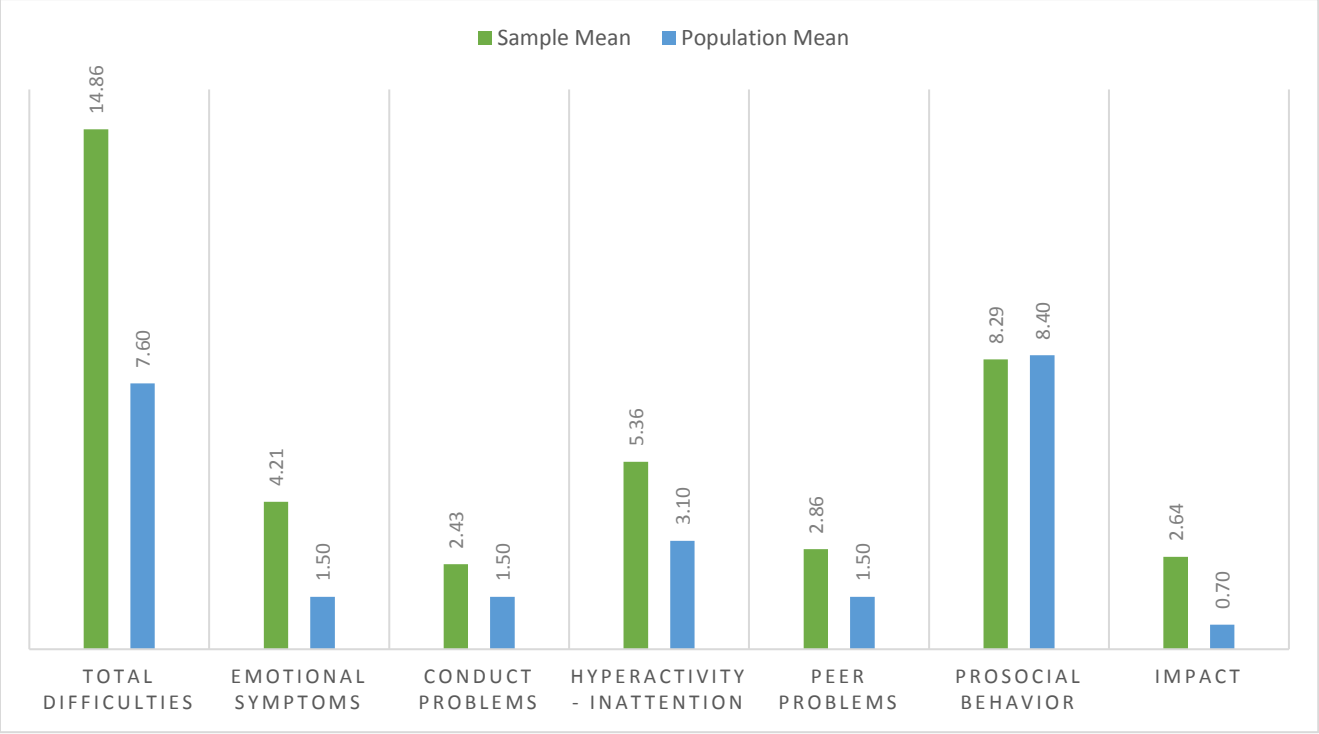

Figure 14. Strengths and Difficulties Questionnaire for Boys 11 to 14 Years

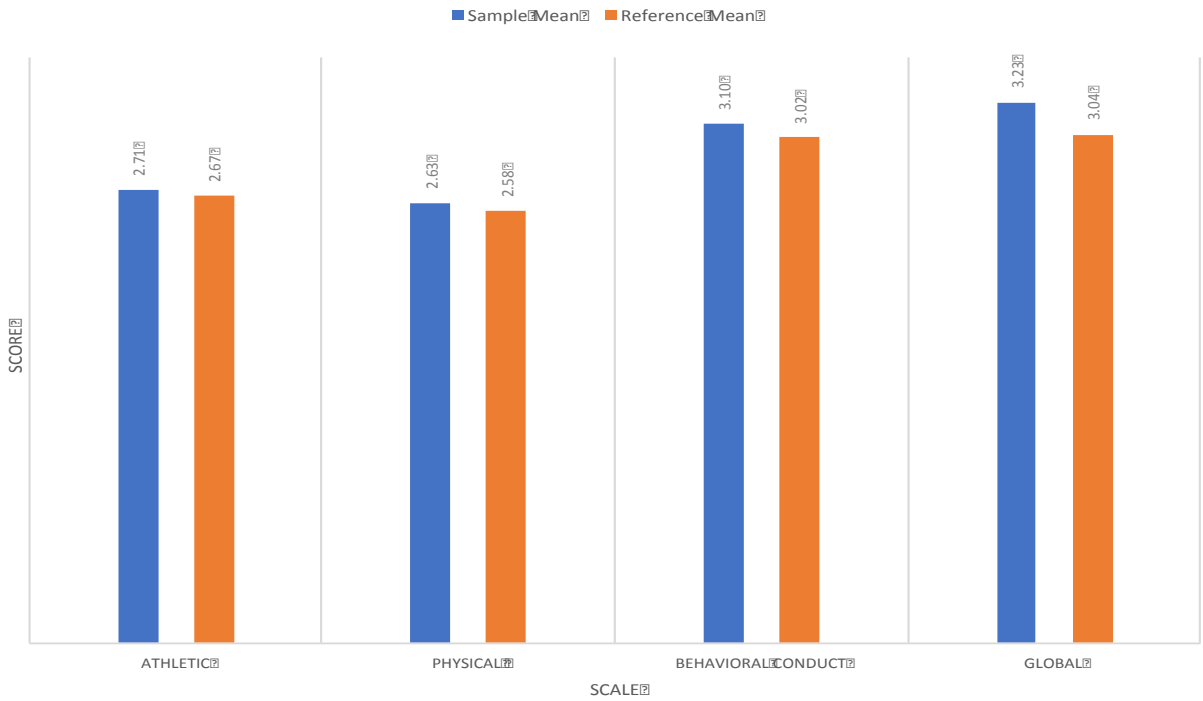

Figure 15. Harter Self-Perception Profile for Girls 8 to 18 years

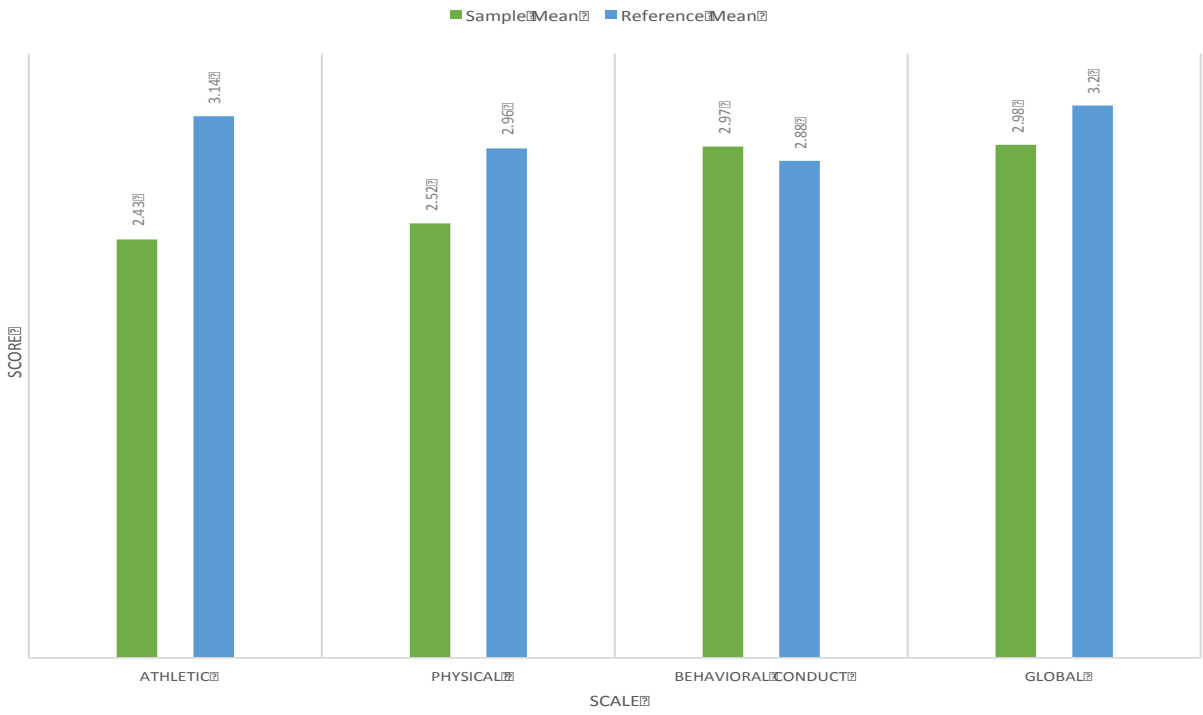

Figure 16. Harter Self-Perception Profile for Boys 8 to 17 Years

5.3.7 Sleep

Table 17 summarizes the self- or parent-reported sleep habits of children in the Program participants. Mean sleep per weeknight across the sample was 9.3 ± 1.1 hours. Figure 17 represents the percentage of recommended sleep each child or teen in the Program was acquiring each weeknight. Most participants (75%, n = 38) were achieving 100% of their recommended sleep quantity. While 26% (n = 13) of children reported no sleep problems, 43% (n = 22) reported feeling "unrefreshed" upon waking in the morning, 26% (n =13) of children reported daytime sleepiness, 26% (n = 13) of children reported breathing through their mouth during sleep, and 41% (n = 21) of children reported snoring. A total of 45% (n = 20) of Program participants reported having a television or screen in the child's bedroom, while 55% (n = 24) did not.

Table 17. Sleep at Baseline

	All Participants	Females	Males
Sleep Quantity (hr)			
Hours per weeknight (Mean ± SD)	9.3 ± 1.1 (n = 51)	9.3 ± 0.9 (n = 25)	10.8 ± 1.4 (n = 26)
Sleep Risk Factors			
No sleep problems	13 (26%)	8 (32%)	5 (19%)
Unrefreshed in AM	22 (43%)	10 (40%)	12 (44%)
Daytime sleepiness	13 (26%)	6 (24%)	7 (26%)
Mouth breathing	13 (26%)	3 (12%)	10 (37%)
Snoring	21 (41%)	9 (36%)	12 (44%)
TV/Screens in Bedroom			
No	24 (55%)	12 (57%)	12 (52%)
Yes	20 (45%)	9 (43%)	11 (48%)

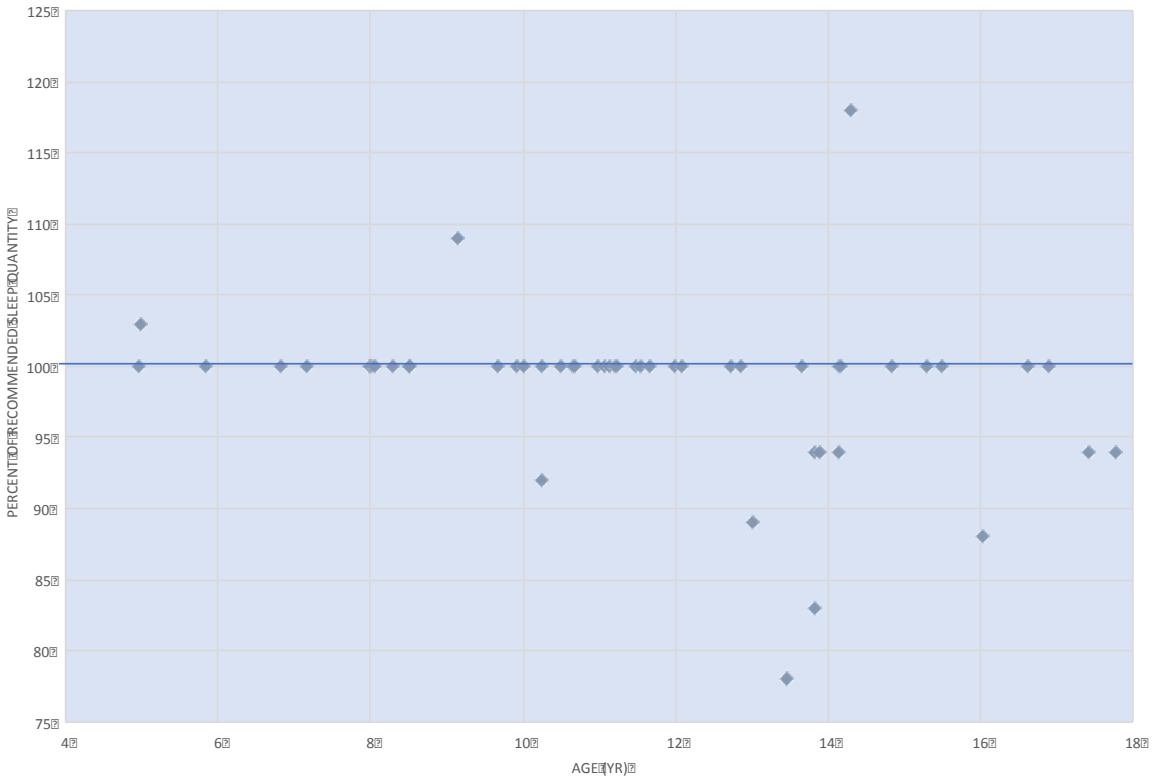

Figure 17. Self- or Parent-Reported Percentage of Recommended Sleep per Weeknight

5.4 Discussion

5.4.1 Referral Information

The rate of participation in the Program evaluation was relatively low at 26% (n = 55 of the 216 families referred to the Program). The total number of participants is notably fewer than for the evaluation published by partner CHWII program, ShapedownBC (n = 119), but is comparable to the evaluation published from the MEND program, wherein 54 children were documented in the treatment group[226,254]. The University of Kansas Center for Telehealth and Telemedicine reported a sample of 38 participants in the telehealth arm of its program in their published baseline findings[222].

Boys or the parents of boys in this sample tended to self-refer with a greater frequency than girls or their parents. Referrals from partner programs were predominantly female, and healthcare provider referrals were relatively equal among the sexes. The small sample size of the evaluation group makes gendered comparisons difficult, but literature elsewhere has shown that parents were more likely to misperceive boys who would qualify as overweight or obese as having a healthy weight when compared to girls (which would seem contradictory to the small sample presented here)[255]. A further review of self- and physician referral patterns across the larger Program population may be valuable in exploring this finding.

5.4.2 Demographic Information

There were slightly more boys than girls in the sample, and the mean ages for boys and girls were comparable. Individuals in the sample tended to fall between 8 and 13 y, although the group ranges in age from 2 to 17 y. The mean age for children and youth referred to the Program was 11.3 $\pm$ 3.3. years, which is comparable to the mean age for children in the Shapedown BC evaluation (11.6 $\pm$ 2.6 y)[227].The age-related patterns of referral coincide with what has been observed elsewhere in the literature, with children generally in the late childhood/early adolescence phase referred to tertiary services more frequently than younger children[256].

Children, youth, and their parents were predominantly Caucasian, although multiple ethnicities are represented in the sample. The relative percentages of Caucasian, Asian, Indian, and First Nations groups roughly coincide with the provincial ethnic breakdown according to the 2011 Canadian Census[257]. Families in the sample also tended to come from urban areas of the province (80%), with a relative minority residing in rural or remote areas

(20%). These figures are similar to the overall geographic distribution throughout BC, in which 86% of British Columbians reside in urban areas, while 14% take residence in rural or remote areas of the province [257]. With a stated goal of attracting and treating families in rural and remote areas, the Program may be well-served to increase recruitment in those communities.

A majority of parents worked full-time, and most parents had attained a certificate or degree from a college or university. The fact that many families have working parents supports previous literature citing maternal work as a potential contributing factor to overweight and obesity in children[52]. Despite having a largely college-educated population, a number of families (37%) qualified as low-income households based upon Low-Income Cut-Offs (LICOs), which are defined by Statistics Canada. However, the Low-Income Cut-Offs are based on federal standards which only factor the household size and household income [258]. These cut-offs do not weigh the relative cost of living by region or city. This prevalence of low income families in the Program evaluation sample may not be an entirely accurate representation, as the cost of living in the Greater Vancouver area where the majority of the BC population (53%) is concentrated, greatly exceeds the nationwide average[259]. While 37% of families would be designated as low-income, all the families in the evaluation sample were below the median household income for the province. This further strengthens previous research that has established higher rates of overweight and obesity in children among families with low socioeconomic status[53,75,90]. In addition to families reporting low-income households, a similar number of families (35%) also reported some level of food insecurity in their home. However, the consensus from the registered dietitians in the Program was that there were limitations in the questions regarding food insecurity. For example, a question

such as “Which of the following statements best describes the food eaten in your household in the past 12 months? (*always enough, enough not-kind, sometimes not, often not, n/a, don’t know*)” may not be an accurate depiction of true food insecurity. For example, some families (regardless of income) may prefer to buy different or more expensive types of food, but not necessarily acquire those items. A family answering that food security question may indicate that they had enough food, but not the kinds that they would prefer to buy (for example, preferring organic produce over regular or more costly cuts of meat). This may not be a clear indication of a home that is food insecure. Registered dietitians in the Program followed up with families who reported true food security as an issue in the home and provided information on available resources in the province.

Finally, families were asked about their access to the Internet. Program developers did not deliver content online in the Program pilot, but rather evaluated the Internet capabilities of families participating in the Program for potential future utilization. All but one family reported consistent access to the Internet, which may lead to the incorporation of an online component to the Program in the future. The prevalence of internet access in the program evaluation sample is similar to provincial reports of internet access across the province, which state that 95% of residents have access to high-speed internet[260].

5.4.3 Anthropometrics and Health Information

The mean BMI scores for children and youth in the Program were expectedly higher than for typically developing young people, but were similar to BMI scores observed in the MEND Program[236]. Boys tended to have higher body weight measurements and BMI scores than girls and tended to report more negative health-related measurements and behaviours across a

number of other areas. In terms of BMI percentiles for age, sex, and height, most children and youth referred to the Program (64%) were above the 99th percentile. The Canadian Task Force on Preventive Health Care recommends that physicians refer children with overweight or obesity as determined by BMI (>97th percentile for children 2-5 y, and >85th percentile for children and youth 5-19 y) to lifestyle intervention programs[185]. Based on this sample, it appears that physicians were tending to wait until young patients are further from a healthy growth trajectory (at or above the 99th percentile) to begin referring them to structured interventions, when referrals may be more successful if the child is referred to an intervention when they reach the 85th percentile. This is an area that warrants further research.

While few definitive conclusions can be drawn from the single blood pressure measurements submitted with Program referrals, it does appear that a small group of children may be at risk for or have already acquired hypertension. Another indication of potentially poor metabolic health is the child's waist circumference measurement. Waist circumference has been indicated as marker for increased risk of dyslipidemia and insulin resistance [247,261]. While clear diagnosable standards for children's waist circumference and WHtR are still developing, a WHtR value at or above 0.5 is used as a marker for further exploration of a child's internal health. Although waist circumference measurements were frequently missed on a child's referral to the Program, the overwhelming majority of children with a reported waist circumference exceeded a WHtR of 0.5. Further explorations of metabolic health in these circumstances could be warranted.

5.4.4 Food & Nutrition

There was a marked variability and range observed in the self- or parent-reported consumption of Canada's Food Guide food groups. For example, the range in a single food group (meat and alternatives) ranged from roughly 0 to 400% of the recommended daily servings across the sample. As with most self-reported lifestyle data, it is difficult to determine the accuracy of these reports due to errors in recall, reporting biases, and inherent margins of error for the novel, non-validated tool. This is confounded by the marked non-linearity, co-linearity, and overall complexity of reporting and analyzing dietary intakes and patterns of individuals and populations at large. Moreover, Canada's Food Guide relies on serving sizes that may be difficult for parents (and especially young people) to estimate. Nonetheless, certain trends were apparent in the Program evaluation sample. Participants tended to under-consume fruits, vegetables, and milk or milk alternatives. Participants were also likely to over-consume processed grain and meat products. A lack of fruits and vegetables, and an abundance of refined carbohydrates and meat products are characteristic of a typical present-day North American diet[262].

In addition to the food groups measured, RDs in the Program also asked participants to report the frequency with which they consumed sugary drinks and other low-nutrient high-calorie foods (LNHCFs) (Appendix G). Because of the poor nutrition profile for these items, Canada's Food Guide does not provide recommended daily servings. Consumption varied widely for these items, as well. Children and youth reported consuming sugary drinks from 0 to 28 times per week, and having LNHCFs from 0 to 42 times per week. The high consumption of sugary drinks and unhealthy snack foods have been observed in other pediatric obesity programs[222,263].

Normative values for the DEBQ and DEBQ-C are still being developed. However, the tool was helpful for identifying potentially problematic eating behaviours in the Program's participants. There were also several relationships of interest regarding the Emotional eating subscale of the tools. The positive correlation between age and emotional eating behaviours is consistent with other findings in the literature[264,24]. As children grow older and develop more social context around food, eating, and weight, the emotional aspects of eating emerge. The lack of a significant relationship between emotional eating and BMI observed in this study coincides with other findings in the literature[265]. The developers of the DEBQ posited that younger children may have more natural reactions to emotional distress, such as avoiding food rather than overconsuming food in times of high emotional stress. The relationship between physical activity and emotional eating has yet to be explored, and may present further evidence of a protective effect provided by physical activity. Further research is necessary to determine whether or not increasing physical activity levels can assist in reducing emotional eating behaviours.

5.4.5 Physical Activity and Sedentary Behaviour

According to participant-reported physical activity levels (via the GSLTEQ), most of the children in the sample were classified as achieving adequate physical activity. Baseline data from another telemedicine intervention for pediatric obesity also found that children appeared to be acquiring sufficient physical activity, but were overconsuming low-nutrient, high-calorie foods[222]. There was a small group within the evaluation sample, though, that reported acquiring no or very minimal moderate to vigorous physical activity through a typical week. Like dietary reporting, these responses are likely subject to recall errors,

reporting biases, and margins of error within the tool. Physical activity (PA) self-reports may be especially prone to inaccuracy in this population due to a child's difficulty in accurately recalling and reporting their PA. Even in cases where parents report on behalf of a child, a parent's perception of their child's PA is dependent upon how much of their child's daily activity the parent or guardian observes[266]. However, in terms of both overall and moderate-to-vigorous physical activity girls tended to report higher levels than boys in the sample. Girls also tended to participate in more organized sports and activities and to acquire less leisure time screen time than boys. This may be partly explained by the fact that boys referred to the Program tended to have higher body weights than girls referred to the Program. Both boys and girls still reported levels of screen time in excess of recommendations, and require strategies to reduce their levels of sedentary behaviour. The sex differences observed throughout the baseline data require further exploration into both the referral patterns and general health status of boys versus girls in the Program.

5.4.6 Social-Emotional Health

Children in this sample tended to report greater personal and social difficulties than established norms provided by the SDQ. Both girls and boys often, but not always, reported higher levels of emotional and peer problems and seemed to experience these difficulties with greater chronicity than a reference population of children. Boys and girls both displayed greater overall difficulties than a reference group of children. This is not uncommon among children with overweight or obesity. Bullying and stigmatization are well-documented in this population[166,168,169]. The HSPP displayed less conclusive differences between the Program sample and reference means, but there is a clear indication that social-emotional support may

be beneficial in the intervention process. In fact, a number of other child obesity intervention programs are staffed primarily or at least in part by psychology professionals[227,267].

5.4.7 Sleep

Children, youth, or their parents often reported meeting sleep quantity recommendations. However, the quality of the sleep that children in the sample achieved was often affected by known sleep disruptions like snoring or mouth-breathing. The quality of sleep may also manifest in reports of being tired throughout the day or waking up feeling unrefreshed. Considering the effects of sleep quality and quantity on physical activity behaviours[268], as well as cardiometabolic parameters[126,127], a focus on sleep hygiene in the intervention process may be beneficial. Sleep may be another area in which objective measurements (i.e., accelerometry) could provide a more accurate picture of sleep quality and quantity.

5.5 Conclusion

Researchers hypothesized that the Program would attract children with complex healthcare needs. Based upon the data available from partner programs[236,254] and overall inclusivity of this Program, it was anticipated that children referred to the Program would exhibit unfavorable behaviours related to physical activity, sedentary behaviour, diet, and/or sleep and experience the complex and interrelated health-related consequences of those behaviours. Children in the Program evaluation sample did in fact exhibit several unfavourable health characteristics, including high BMIs (nearly two-thirds of children above the 99th percentile) and waist circumference measurements (the mean waist circumference was near the 95th percentile), along with a number of health-related behaviours requiring attention. Diet quality, quantity, and patterns are areas for improvement throughout the

Program as evidenced by baseline evaluations of food, nutrition, and eating behaviours. Reported measures often exceeded recommendations, but must also be interpreted with the understanding that underreporting is common in dietary self-reports[269,270]. This means that in some cases, children and youth may be consuming more than what has been reported in the assessment.

Although children, youth, or their parents often reported acquiring sufficient physical activity, there may still be a need to inquire further about physical activity habits through the counselling process. Since over-reporting one's level of physical activity is commonly found across individuals[115], children and youth may not in fact be accumulating the amount of physical activity needed to improve and maintain good health. An excess of leisure time screen time was also prevalent, and may be addressed through the intervention process. While sleep quantity was often in line with standards, there is an opportunity to improve upon the quality of sleep and to address several of the sleep-related risk factors mentioned previously.

While food, nutrition, physical activity and sedentary behaviour are often components of a behavioural intervention program for children who are overweight or obese, this Program is also designed to address sleep quality, quantity, and hygiene as a more comprehensive approach to a child's day-to-day cycle of wellness. The Program will also be tasked with addressing the findings from baseline measures of social and emotional health, which indicate that this sample of children may be more likely to experience difficulties in their relationships or to view themselves in a more negative way than other children.

Chapter 6: Program Outcomes

This chapter presents the outcomes from the pilot of the HealthLink BC Eating and Activity Program for Kids (the Program). Changes in anthropometric measurements, diet quality and quantity, physical activity and sedentary behaviour, social emotional health, and sleep are reported herein. Adherence and attrition in the Program are also discussed.

6.1 Introduction

The purpose of this chapter is to present the data at 3-months and 6-months after initiation of the Program in relation to baseline data. The HealthLink BC Eating and Activity Program for Kids was a relative novelty at the time of its implementation. Telehealth has been used in other aspects of pediatric obesity treatment (detailed in Chapter 3), but the Program was unique in several ways. First was its ability to have registered dietitians (RDs) and a QEP working alongside one another to coordinate care delivery. Second, was that the majority of the content delivered to families through the Program was done over the telephone through weekly scheduled phone calls (although some supplementary materials and assessments were delivered through the postal mail). Most other pediatric telehealth programs in the literature have used telehealth as supplement to a primarily in-person program. The Program discussed herein had no in-person component to the delivery of the intervention. The characteristics of children, teens, and families at the time they referred to the Program were discussed in the previous chapter. This chapter builds on that information to discuss the changes observed at 3-months and 6-months after initiation of the Program.

6.2 Methods

Methodological information regarding participant inclusion, the assessments, and procedures of the research has been presented in detail in Chapter 4. The data presented here was collected at three-months and six-months after Program initiation and compared to baseline data. Only physical activity and sedentary behaviour, sleep, and diet quality and quantity assessments were administered at 3-months. All variables were collected again at 6-months and included objective health measurements from the physician who referred the child or teen and performed their follow-up assessment, as well as self-reported measures of health behaviours obtained over the telephone or through mailed paper questionnaires.

6.2.1 Data Treatment and Analyses

All data was collected by Program staff and quality assured for accuracy and completeness by an independent third-party staff member at HealthLink BC. Data was then shared with researchers using a secured file sharing site (SharePoint for Windows, 2013). All statistical analyses were performed by our research team using IBM SPSS Statistics for Windows, Version 24.0. (Armonk, NY: IBM Corp.).

For variables with three time points (baseline, 3-months, and 6-months), a repeated measures ANOVA was used to evaluate changes across time. In instances where there was only one follow-up measurement, a paired samples t-test was conducted. Participants lacking data at one or more time points were excluded from the relevant analyses, and only participants with complete data sets were included in the longitudinal investigations. Pearson product-moment correlation coefficient calculations were performed when examining the relationship between two variables. As with the baseline data, continuous variables are represented as a means and standard deviations. Categorical and binary variables are displayed as percentages

and/or counts. Other age- and sex- dependent variables (e.g., sleep and food group consumption) are reported as a percentage of the recommended amount specific to that variable.

6.3 Results

6.3.1 Referral and Uptake

Referral and retention information is displayed in Table 18. Two hundred and sixteen families had been referred to the Program at the time of evaluation. Roughly one-quarter (n = 55) of those families opted to take part in the Program evaluation. Details of participant referral, retention, and withdrawal are displayed in Figure 18. Nearly 90% (n = 49) of participants consenting to the evaluation research started the Program (i.e., completed the Assessment Call). Only 4 participants in the evaluation who were referred to the Program did not complete the Assessment Call, and an additional 2 participants completed part of the Assessment Call. Slightly more than half of participants (56%) in the evaluation sample completed 70% of Program Calls, designating them as having received a sufficient dose of the Program.

Girls tended to complete slightly more Program Calls (4.8 $\pm$ 2.7) than boys (4.2 $\pm$ 2.6), however the findings were not significant ($p = 0.44$) (Table 23). Age was also not significantly correlated with the number of Program Calls completed ($r = -0.09$, $p = 0.51$).

The wait times from the time of referral until the first contact made by Program Staff averaged roughly two weeks, but ranged from one day to ten weeks. The time from first contact by Program Staff to the Assessment Call averaged roughly five and half weeks, but

ranged from less than one week to more than twenty weeks. As the wait time from the first contact by Program Staff and the Assessment Call lengthened, participants became less likely to complete the Program Calls. Correlational analyses show a negative relationship between wait time and number of Program Calls completed ($r = -0.47$, $p = 0.0005$) (Figure 19).

Table 18. Referral and Program Uptake

Characteristic	n (%)	
Total Program Evaluation Participants		55
Intake Completion		
Referred and Completed Intake		49 (89%)
Referred and Did Not Complete Intake		4 (7%)
Referred and Completed Partial Intake		2 (4%)
Number of Program Calls Completed		
0		8 (15%)
1		4 (7%)
2		3 (5%)
3		3 (5%)
4		4 (7%)
5		2 (4%)
6		10 (18%)
7		19 (35%)
In Progress		2 (4%)
Attended 70% of Sessions (5+ Program Calls)		31 (56.4%)
Characteristic	**Mean ± SD**	**Range**
Wait Times		
Referral to First Contact (days)	15 ± 18	1 to 72
First Contact to Program Start (days)	39 ± 27	5 to 142
Number of Program Calls Completed		
Males and Females	4.5 ± 2.7	0 to 7
Females	4.8 ± 2.7	0 to 7
Males	4.2 ± 2.6	0 to 7
Physician or Nurse Referral (n = 30)	4.3 ± 2.8	0 to 7
CHWII Referral (n = 7)	4.7 ± 3.0	0 to 7
Self-Referral (n = 18)	4.7 ± 2.5	0 to 7

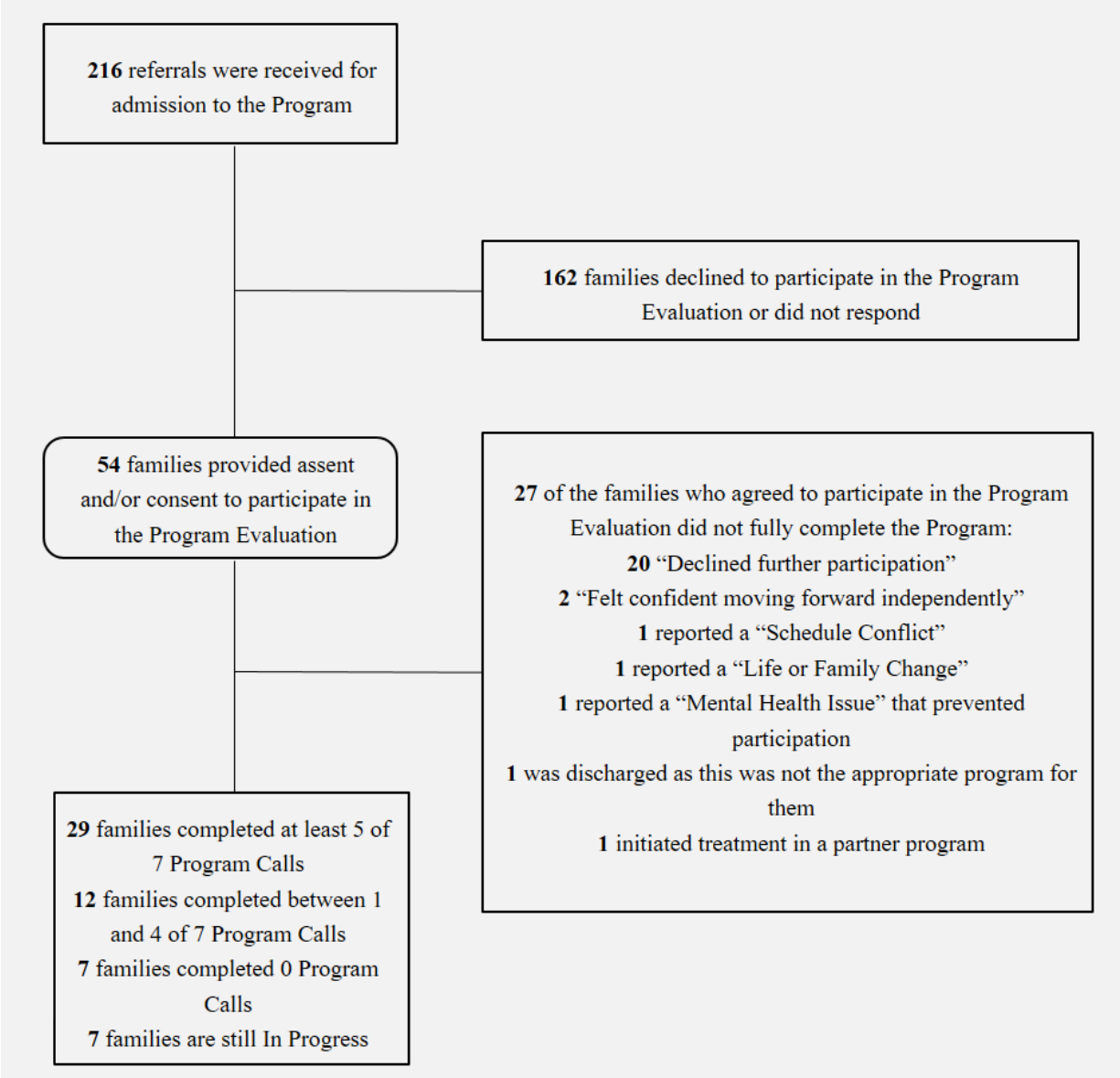

Figure 18. Program Retention and Attrition

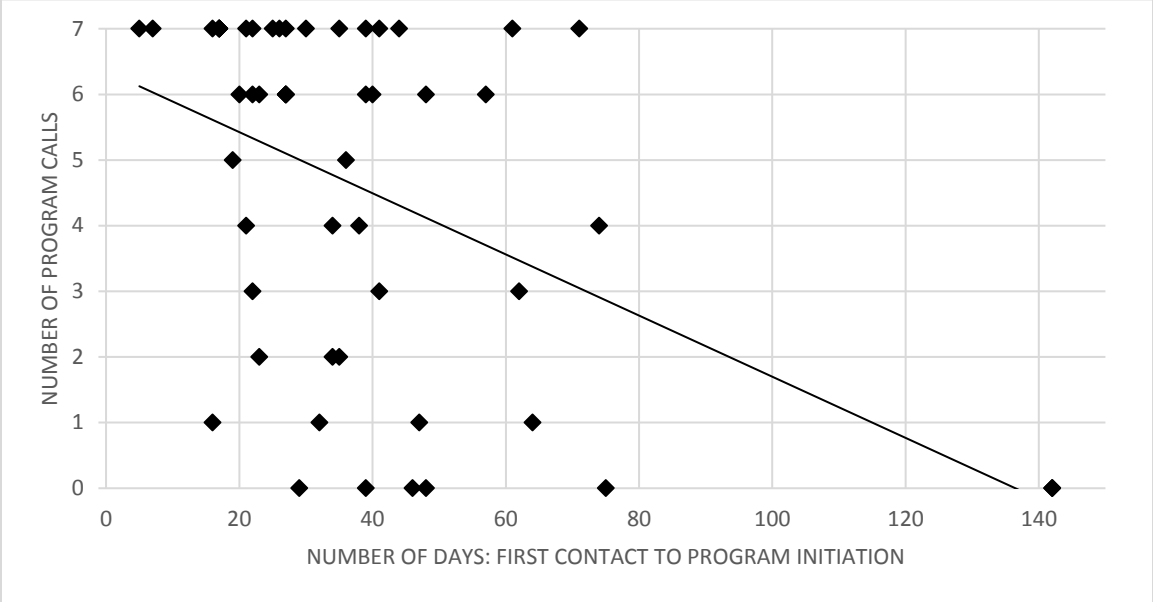

Figure 19. Correlation Between Number of Program Calls and Wait Time

6.3.2 Anthropometric and Health Information

Anthropometric and health information is displayed in Table 19. Children and teens grew significantly taller across the length of the Program (+4.6 $\pm$ 3.3 cm, $p < 0.01$). Boys showed a significant increase in weight from baseline to six months (+5.8 $\pm$ 4.0 kg, $p < 0.01$). However, analyses showed no significant changes in BMI from baseline to six months among boys, girls, or the combined sample (+0.6 $\pm$ 4.0, $p = 0.54$ for males and females combined; +0.7 $\pm$ 5.3 kg, $p = 0.69$ for females only; and +0.4 $\pm$ 1.8 kg, $p = 0.52$ for males only). There was no relationship between the number of Program Calls completed and the participant's change in BMI ($r = -0.12$, $p = 0.45$). Because of missing data, statistical analyses on blood pressure, waist circumference, and waist-to-height ratio could not be conducted between baseline and follow-up.

Table 19. Follow-Up Anthropometric and Health Information

Characteristics	n	Baseline (Mean ± SD)	6 Months (Mean ± SD)	Change (Mean ± SD)	p
Age (y)					
Males and Females	26	11.5 ± 2.6	12.4 ± 2.7	+0.9 ± 0.3	<0.01*
Females	13	11.4 ± 3.3	12.3 ± 3.3	+1.0 ± 0.4	<0.01*
Males	13	11.6 ± 1.9	12.5 ± 1.9	+0.8 ± 0.2	<0.01*
Height (cm)					
Males and Females	19	152.8 ± 14.1	158.0 ± 12.6	+4.6 ± 3.3	<0.01*
Females	10	150.0 ± 11.1	154.0 ± 11.1	+4.1 ± 3.9	0.01*
Males	9	156.0 ± 16.9	161.3 ± 15.5	+5.3 ± 2.7	<0.01*
Weight (kg)					
Males and Females	19	68.7 ± 24.3	73.9 ± 23.1	+5.2 ± 11.1	0.06
Females	10	65.7 ± 22.5	70.3 ± 16.4	+4.7 ± 15.2	0.36
Males	9	72.1 ± 27.0	77.9 ± 29.3	+5.8 ± 4.0	<0.01*
BMI (kg/m^2)					
Males and Females	19	28.6 ± 6.1	29.2 ± 5.7	+0.6 ± 4.0	0.54
Females	10	28.6 ± 6.5	29.3 ± 4.5	+0.7 ± 5.3	0.69
Males	9	28.7 ± 6.0	29.1 ± 7.1	+0.4 ± 1.8	0.52
Systolic BP (mmHg)					
Females	3	111.7 ± 2.9	116.3 ± 8.1	+4.7 ± 9.0	0.46
Males	0	--	--	--	--
Diastolic BP (mmHg)					
Females	3	72.0 ± 3.5	65.3 ± 5.5	-6.7 ± 8.6	0.31
Males	0	--	--	--	--
Waist Circumference (cm)	0	--	--	--	--

y: year; cm: centimetre; kg: kilometer: kg/m2: kilograms per metre squared, mmHg: millimeters of mercury

6.3.3 Food and Nutrition

Diet quality, quantity, and patterns from baseline to the 3-month follow-up are listed in Tables 20 and 21. At the 3-month follow-up, fruit and vegetable (FV) consumption increased in boys from an average of 58.3 $\pm$ 14.4% of the RDS to 89.7 $\pm$ 24.0% ($p = 0.03$) of the RDS (Figure 20). Consumption of processed grain products decreased among girls from an average of 121.1 $\pm$ 23.9% of the recommended daily servings (RDS) to 83.1 $\pm$ 29.6% ($p = 0.01$) of the RDS (Figure 21), and decreased in a combined sample of boys and girls from an average of 153.0 $\pm$ 93.7% of the RDS to 90.3 $\pm$ 28.3% ($p = 0.02$) of the RDS. Girls decreased the frequency of eating meals out of the home from an average of twice per week to less than once per week ($p = 0.03$). A combined sample of the boys and girls showed a trend, although non-significant, toward consuming sugary drinks fewer times each week, decreasing from 5.6 $\pm$ 6.9 times per week to 3.0 $\pm$ 5.1 times per week ($p = 0.06$). Other measures of diet quality, quantity, and eating behaviours did not demonstrate significance.

No statistically significant changes in diet quality, quantity, eating behaviours, or the Dutch Eating Behaviour Questionnaire were observed from baseline to the 6-month follow-up (Tables 22-24). Sample sizes in this group were relatively small, with data representing 6 girls and 4 boys at the 6-month follow-up. Limited responses in dietary information may be due to the length of time required to administer the dietary assessment tool, which is significantly greater than, for example, assessments of physical activity and sedentary time.

Table 20. Diet Quality, Quantity, and Patterns at 3-Month Follow-Up

	n	Baseline (Mean ± SD)	3 Mo. (Mean ± SD)	Change (Mean ± SD)	p
Grain Products (%RDS)					
Males and Females	15	153.0 ± 93.7	90.3 ± 28.3	-62.7 ± 88.3	0.02*
Males	4	240.8 ± 158.5	110.0 ± 11.0	-130.8 ± 151.2	0.18
Females	11	121.1 ± 23.9	83.1 ± 29.6	-38.0 ± 39.2	0.01*
Milk and Alternatives (%RDS)					
Males and Females	15	91.4 ± 44.7	89.5 ± 57.8	-1.9 ± 51.1	0.89
Males	4	98.0 ± 37.4	70.8 ± 34.5	+27.3 ± 57.4	0.41
Females	11	89.0 ± 48.5	96.3 ± 64.3	+7.3 ± 48.1	0.63
Meat and Alternatives (%RDS)					
Males and Females	15	200.9 ± 146.2	145.1 ± 89.8	-55.8 ± 96.2	0.04*
Males	4	200.0 ± 136.9	143.8 ± 147.8	-56.3 ± 82.6	0.27
Females	11	201.2 ± 155.9	145.5 ± 68.9	-55.6 ± 104.5	0.11
Fruits and Vegetables (%RDS)					
Males and Females	14	85.1 ± 29.8	85.6 ± 37.9	+0.5 ± 30.4	0.95
Males	3	58.3 ± 14.4	89.7 ± 24.0	+31.3 ± 10.1	0.03*
Females	11	92.4 ± 29.0	84.5 ± 41.8	-7.9 ± 28.6	0.38
Low-Nutrient High-Calories Foods (Times/Week)					
Males and Females	15	7.1 ± 7.8	5.1 ± 6.1	-2.1 ± 9.1	0.39
Males	4	9.5 ± 12.6	3.3 ± 4.6	-6.3 ± 15.6	0.48
Females	11	6.3 ± 5.8	6.2 ± 6.6	-0.1 ± 6.2	0.95
Sugary Drinks: CFG + Non CFG (Times/Week)					
Males and Females	15	5.6 ± 6.9	3.0 ± 5.1	-2.6 ± 4.9	0.06
Males	4	7.6 ± 6.7	1.3 ± 1.5	-6.3 ± 6.5	0.15
Females	11	3.9 ± 5.5	3.0 ± 5.5	-0.9 ± 3.5	0.41

% RDS: percent of daily recommended servings; wk: week; CFG: Canada's Food Guide

Table 21. Eating Behaviours at 3-Month Follow-Up

	n	Baseline (Mean ± SD)	3 Mo. (Mean ± SD)	Change (Mean ± SD)	p
Eating Behaviours					
Skipping Meals					
Males and Females	15	2.3 ± 3.7	1.1 ± 3.6	-1.1 ± 2.3	0.20
Males	4	3.4 ± 5.0	3.5 ± 7.0	1.00	0.50
Females	11	1.9 ± 3.3	0.3 ± 0.9	-1.6 ± 3.6	0.16
Eating Out (3+ times/week)					
Males and Females	14	1.8 ± 2.0	0.8 ± 0.9	-1.1 ± 2.2	0.08
Males	3	1.0 ± 0.5	1.7 ± 1.2	1.00	0.50
Females	11	2.1 ± 2.2	0.5 ± 0.6	-1.6 ± 2.2	0.03*

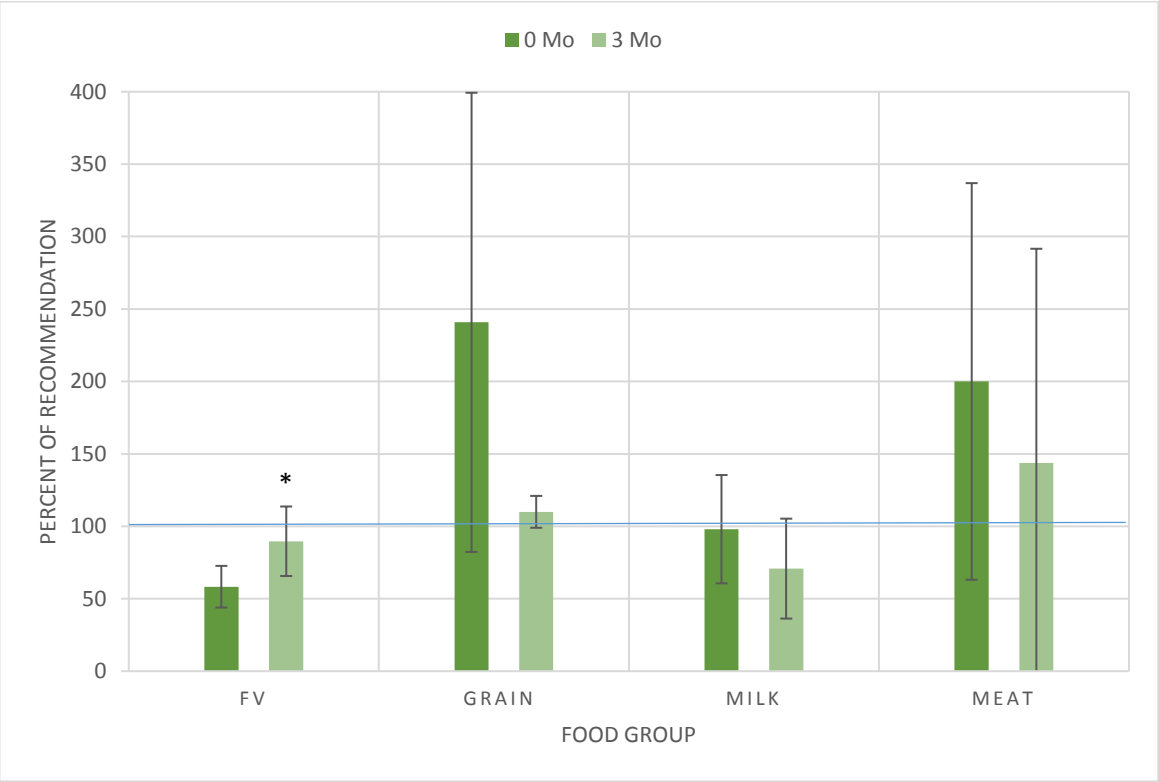

Figure 20. Food Group Consumption from Baseline to 3 Months, Boys (n = 4)

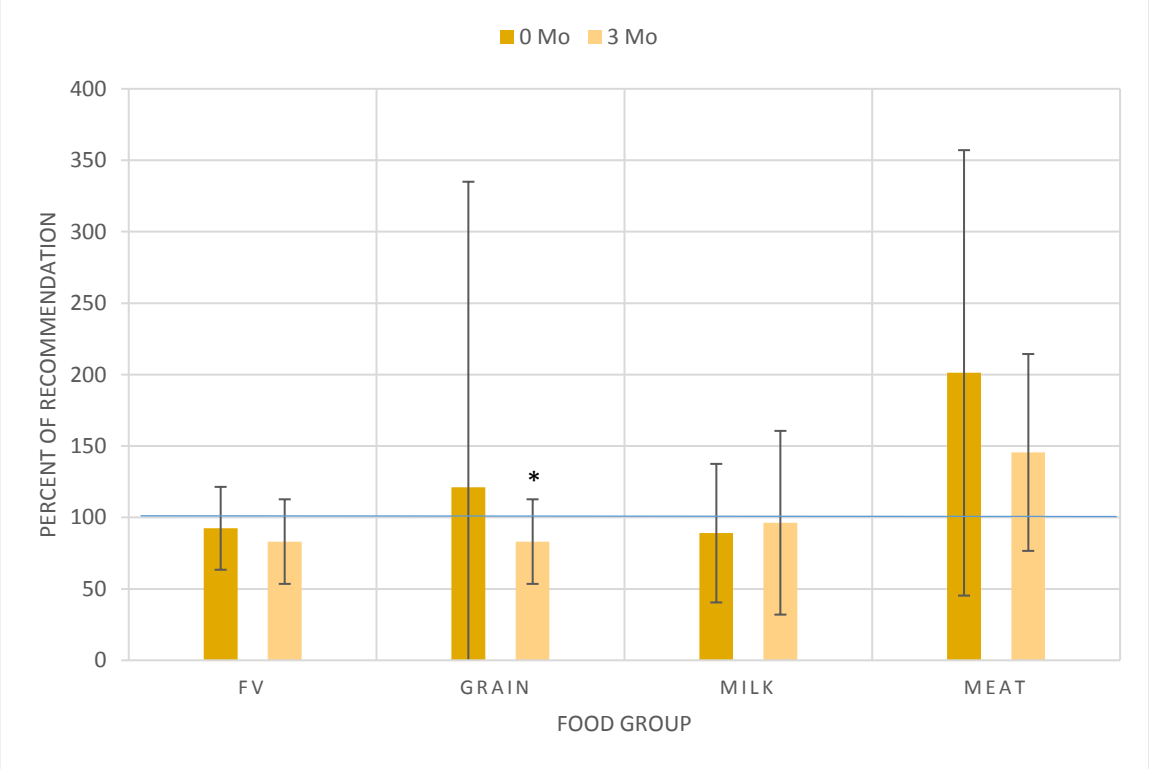

Figure 21. Food Group Consumption from Baseline to 3 Months, Girls (n = 11)

Table 22. ANOVA Results for Food and Nutrition at Baseline, 3 Months, and 6 Months (n = 6f, 4m)

Variables	Baseline (Mean ± SD)	3 Mo. (Mean ± SD)	6 Mo. (Mean ± SD)	F(b)	p	Pairwise Comparisons
Grain Products (% RDS)						
Males and Females	162.5 ± 114.0	99.1 ± 35.9	120.1 ± 44.2	1.73	0.24	--
Males	235.8 ± 163.0	114.3 ± 11.2	147.8 ± 53.9	0.94	0.51	--
Females	113.7 ± 16.8	89.0 ± 44.0	101.7 ± 27.4	0.58	0.60	--
Milk and Alternatives (% RDS)						
Males and Females	96.7 ± 38.3	83.3 ± 59.3	85.0 ± 60.2	0.34	0.72	--
Males	98.0 ± 37.4	70.8 ± 34.5	64.5 ± 29.3	0.77	0.57	--
Females	95.8 ± 42.4	91.7 ± 73.5	98.7 ± 73.9	0.35	0.72	--
Meat and Alternatives (% RDS)						
Males and Females	194.4 ± 91.7	138.4 ± 105.9	164.4 ± 94.4	2.57	0.15	--
Males	200.0 ± 136.9	120.8 ± 156.6	185.5 ± 129.1	2.45	0.29	--
Females	164.7 ± 77.5	141.5 ± 59.2	129.3 ± 75.1	1.75	0.29	--
Fruits and Vegetables (% RDS)						
Males and Females	70.5 ± 37.2	73.5 ± 47.4	72.6 ± 20.4	0.06	0.94	--
Males	46.5 ± 23.8	67.3 ± 48.9	66.3 ± 16.5	3.49	0.22	--
Females	86.5 ± 37.1	77.7 ± 50.5	76.8 ± 23.1	0.69	0.55	--
Low-Nutrient High-Calorie Foods (Times/Wk)						
Males and Females	6.1 ± 8.8	4.4 ± 6.6	5.6 ± 6.4	0.12	0.89	--
Males	9.5 ± 12.6	2.0 ± 3.4	6.9 ± 9.4	0.51	0.66	--
Females	3.8 ± 5.2	6.0 ± 8.1	4.7 ± 4.1	0.77	0.52	--
Sugary Drinks: CFG + Non CFG (Times/Wk)						
Males and Females	7.4 ± 7.7	4.6 ± 5.8	4.7 ± 7.6	1.10	0.38	--
Males	10.5 ± 8.8	3.3 ± 4.6	3.0 ± 4.8	3.88	0.21	--
Females	5.3 ± 6.9	5.4 ± 6.7	5.8 ± 9.3	0.06	0.95	--

% RDS: percent of daily recommended servings; Wk: week; CFG: Canada's Food Guide

Table 23. ANOVA Results for Eating Behaviours at Baseline, 3 Months, and Follow-Up

	Baseline (Mean ± SD)	3 Mo. (Mean ± SD)	6 Mo. (Mean ± SD)	F(b)	P	Pairwise Comparisons
Eating Behaviours						
Skipping Meals						
Males and Females	2.8 ± 4.0	1.7 ± 4.4	0.6 ± 1.4	0.64	0.55	--
Males	3.4 ± 5.0	3.5 ± 7.0	0.4 ± 0.8	1.00	0.50	--
Females	2.3 ± 3.6	0.5 ± 1.2	0.8 ±1.8	1.35	0.34	--
Eating Out (3+ times/week)						
Males and Females	1.8 ± 1.6	0.9 ± 1.0	0.4 ± 0.5	1.15	0.36	--
Males	1.0 ± 0.5	1.7 ± 1.2	0.7 ± 0.6	1.00	0.50	--
Females	2.3 ± 1.8	0.6 ± 0.7	0.3 ± 0.5	2.25	0.20	--

Table 24. Dutch Eating Behavior Questionnaire at Follow-Up

DEBQ/C Scale	n	Baseline (Mean ± SD)	6 Months (Mean ± SD)	Change (Mean ± SD)	p
External Eating (Score)					
Males and Females	10	2.6 ± 0.6	2.9 ± 0.9	+0.3 ± 1.0	0.42
Females	8	2.5 ± 0.4	3.0 ± 1.0	+0.5 ± 1.0	0.19
Males	2	--	--	--	--
Emotional Eating (Score)					
Males and Females	10	1.6 ± 0.6	1.5 ± 0.8	-0.1 ± 0.8	0.80
Females	8	1.5 ± 0.3	1.6 ± 0.9	+0.1 ± 0.7	0.71
Males	2	--	--	--	--
Restrained Eating (Score)					
Males and Females	10	2.4 ± 0.7	2.5 ± 0.7	+0.1 ± 0.6	0.56
Females	8	2.4 ± 0.7	2.4 ± 0.7	-0.03 ± 0.5	0.86
Males	2	--	--	--	--

6.3.4 Physical Activity and Sedentary Behaviour

The results of physical activity and sedentary behaviour from baseline to the 3-month follow-up are displayed in Table 25. At the 3-month follow-up, children improved in nearly all self-reported measures by increasing physical activity (PA) and decreasing inactive behaviours. Boys and girls increased their total physical activity (TPA) from an average of score of 53.7 $\pm$ 30.3 to 79.2 $\pm$ 32.8 units ($p < 0.01$) (Figure 22) based on the Godin Shephard Leisure Time Exercise Questionnaire (GSLTEQ). Boys and girls also saw significant improvements in TPA when the sexes were observed separately. Moderate-to-vigorous physical activity (MVPA) increased among boys and girls when measured by the GSLTEQ (Figure 22) and when measured by asking participants to estimate their weekly MVPA in minutes (Figure 23). MVPA measured by the GSLTEQ increased from an average of 30.8 $\pm$ 29.0 units to 62.7 $\pm$ 32.7 units ($p < 0.01$) (Figure 22), and increased from an average of 24.4 $\pm$ 13.0 minutes at baseline to an average of 58.8 $\pm$ 25.6 ($p < 0.01$) minutes at follow-up (Figure 23).

Children and youth increased the number of days on which they met national guidelines on physical activity (achieving at least 60 minutes of MVPA) and sedentary time (acquiring less than 2 hours per day). At baseline, children were meeting PA guidelines an average of roughly 1 day per week, but were meeting those guidelines between 4 and 5 days per week at the 3-month follow-up ($p < 0.01$) (Figure 24). At baseline, children were meeting sedentary time guidelines just over 1 day per week, but were meeting those guidelines between 3 and 4 days per week at follow-up ($p < 0.01$) (Figure 24).

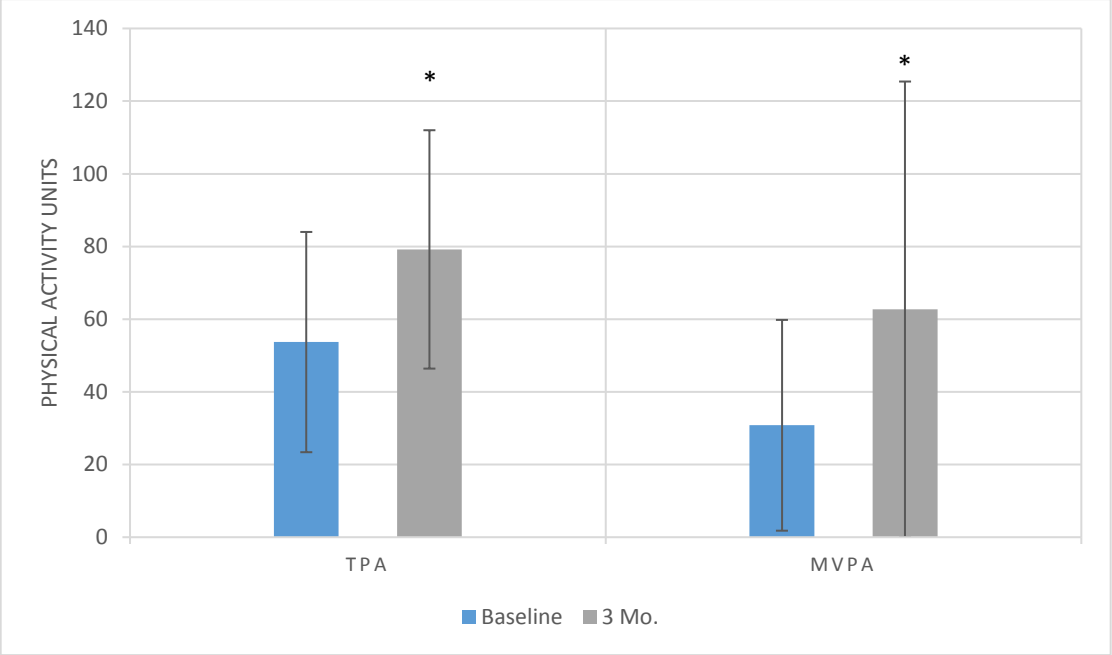

Figure 22. Total physical activity (TPA) and Moderate to Vigorous Physical Activity (MVPA) from Baseline to 3 Months measured by the Godin Leisure Time Exercise Questionnaire (n = 14)

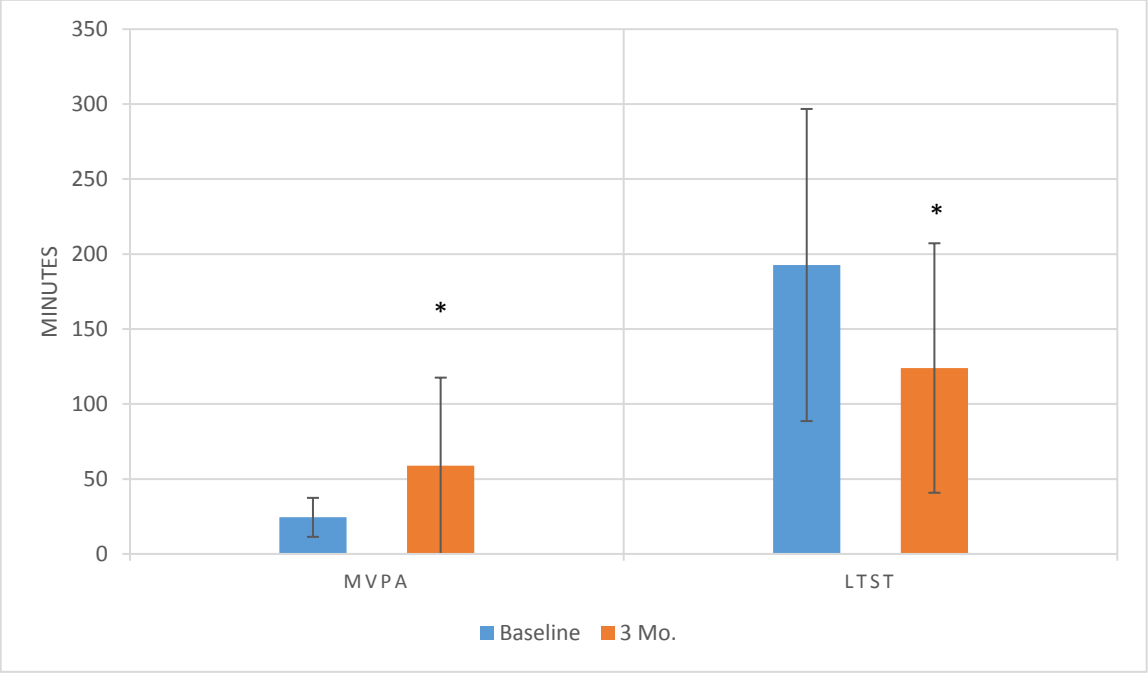

Figure 23. Moderate to Vigorous Physical Activity (MVPA) and Leisure Time Screen Time (LTST) from Baseline to 3 Months (n = 12, n = 15)

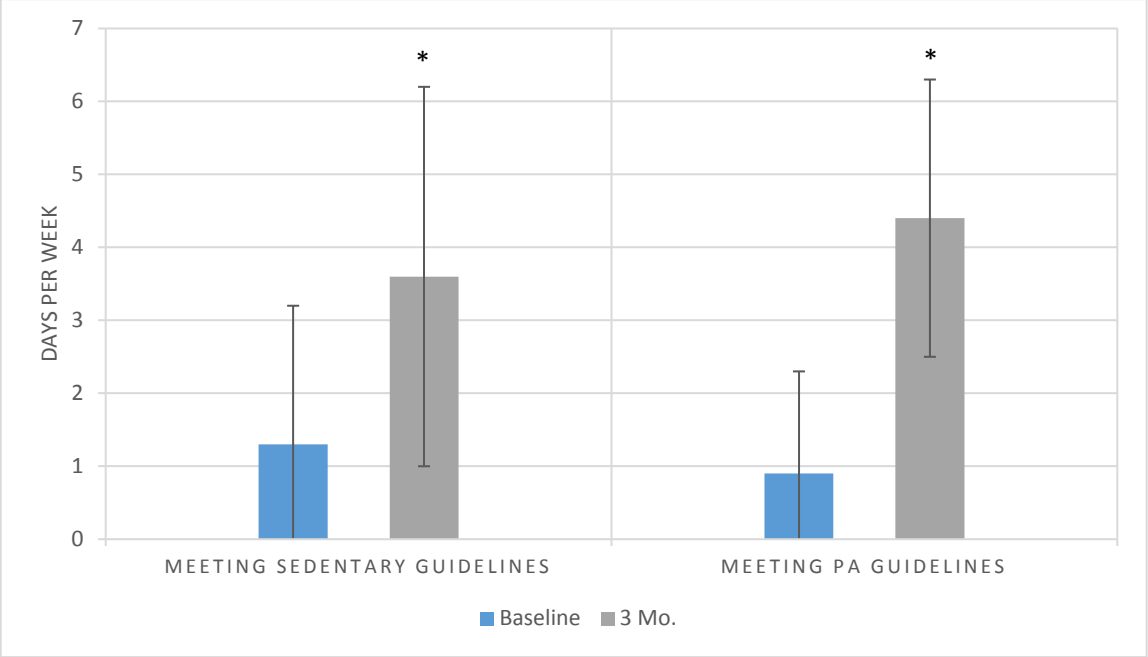

Figure 24. Days per Week Meeting Sedentary Behaviour and Physical Activity (PA) Recommendations at Baseline and 3 Months (n = 14, n = 13)

Information on physical activity and sedentary behaviour from baseline, the 3-month follow-up, and the 6-month follow-up is displayed in Table 31. Many of the changes observed at the 3-month follow-up were not observed at the 6-month follow-up, however some improvements were maintained. At the 6-month follow-up, there was still a significant increase in the number of days on which children were meeting physical activity guidelines, Wilk's Lambda = 0.014, F = (2, 2), p = 0.01 (Figure 25). There was also a significant maintained decrease in the amount of leisure time screen time (LTST) that children were acquiring each day, Wilk's Lambda = 0.186, F = (2, 4), p = 0.04 (Figure 26).

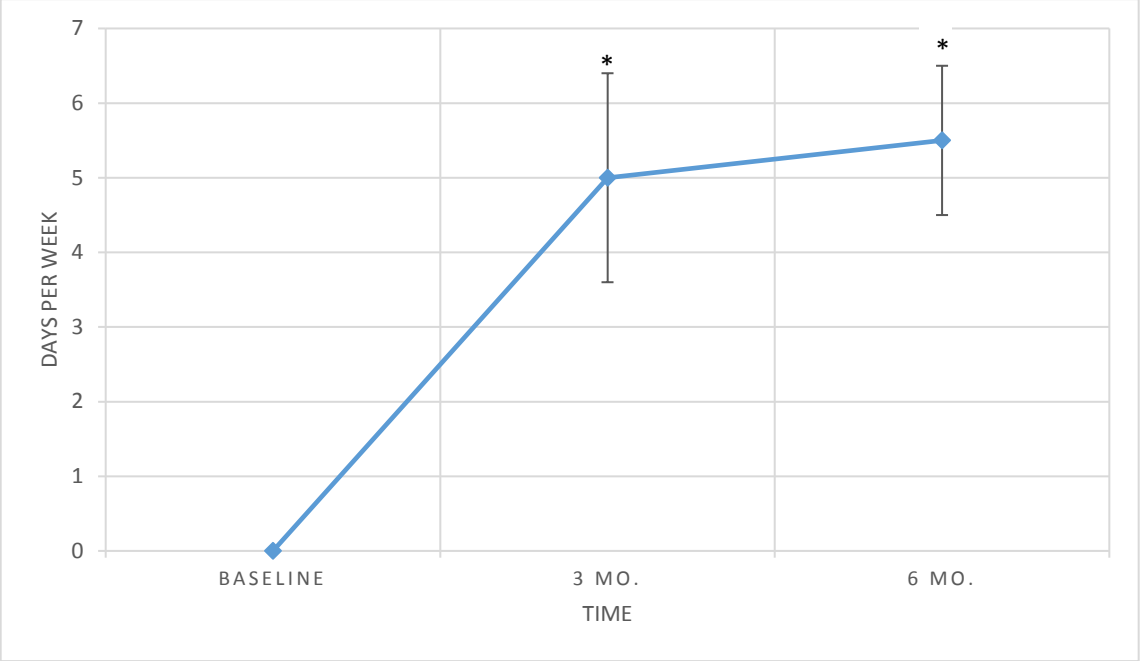

Figure 25. Days per Week Meeting Physical Activity Guidelines at Baseline, 3 months, and 6 months (n = 4)

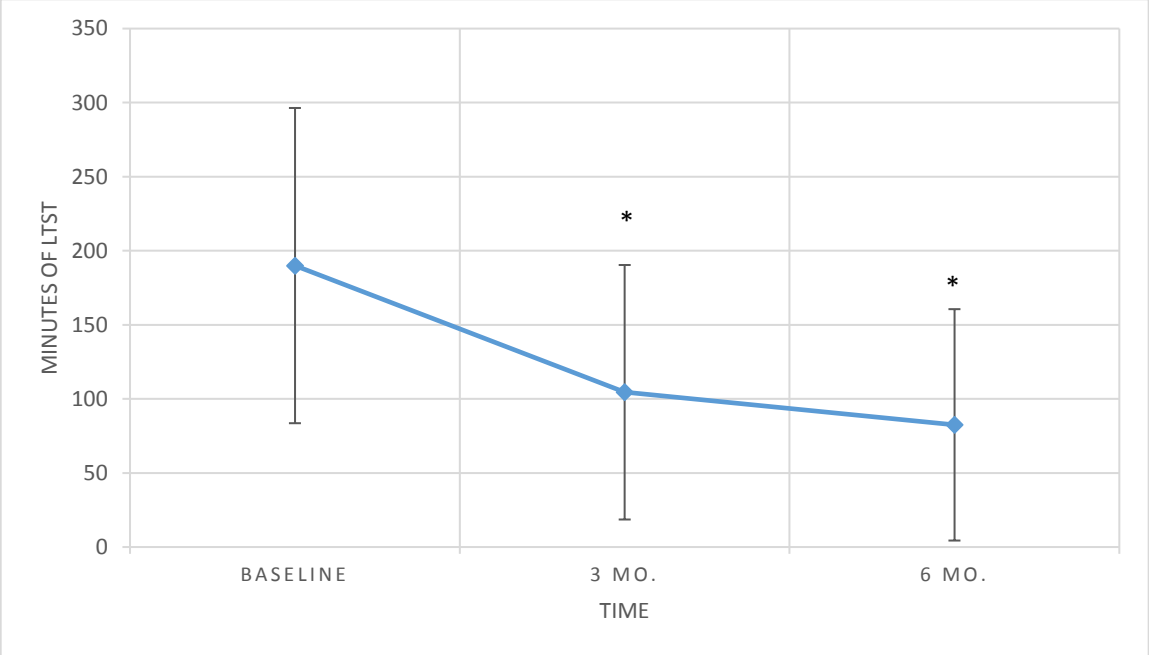

Figure 26. Minutes of Leisure Time Screen Time (LTST) at Baseline, 3 months, and 6 months (n = 6)

Table 25. Physical Activity and Sedentary Behaviour at 3-Month Follow-Up

	n	Baseline (Mean ± SD)	3 Mo. (Mean ± SD)	Change (Mean ± SD)	p
Total Physical Activity (GSLTEQ Units)					
Males and Females	14	53.7 ± 30.3	79.2 ± 32.8	+25.5 ± 23.9	<0.01*
Males	8	58.5 ± 32.3	79.8 ± 34.2	+21.3 ± 25.8	0.05*
Females	6	47.3 ± 29.1	78.5 ± 44.0	+31.2 ± 22.3	0.02*
Moderate to Vigorous Physical Activity (GSLTEQ Units)					
Males and Females	14	30.8 ± 29.0	62.7 ± 32.7	+31.9 ± 21.9	<0.01*
Males	8	37.5 ± 35.1	59.5 ± 35.1	+22.0 ± 15.1	<0.01*
Females	6	21.8 ± 17.0	67.0 ± 31.8	+45.2 ± 23.6	0.01*
Moderate to Vigorous Physical Activity (Min)					
Males and Females	12	24.4 ± 13.0	58.8 ± 25.6	+34.4 ± 18.8	<0.01*
Males	6	25.0 ± 13.2	66.7 ± 31.9	+41.7 ± 23.0	0.01*
Females	6	23.8 ± 14.0	50.8 ± 16.6	+27.1 ± 11.3	<0.01*
Organized Sports & Activities (#)					
Males and Females	14	1.1 ± 1.3	1.2 ± 1.1	+0.1 ± 0.8	0.50
Males	7	0.8 ± 1.0	1.3 ± 1.1	+0.6 ± 0.6	0.10
Females	7	1.4 ± 1.6	1.1 ± 1.2	-0.3 ± 0.5	0.17
Sedentary Behaviour (Days Meeting Guidelines/Week)					
Males and Females	14	1.3 ± 1.9	3.6 ± 2.6	+2.4 ± 2.4	<0.01*
Males	6	0.8 ± 2.0	2.8 ± 2.8	+2.0 ± 1.9	0.05*
Females	8	1.6 ± 1.9	4.3 ± 2.4	+2.6 ± 2.8	0.03*
Physical Activity (Days Meeting Guidelines/Week)					
Males and Females	13	0.9 ± 1.4	4.4 ± 1.9	+3.5 ± 1.8	<0.01*
Males	7	0.7 ± 1.1	4.0 ± 2.3	+3.3 ± 2.0	0.01*
Females	6	1.0 ± 1.7	14.8 ± 1.5	+3.8 ± 1.7	<0.01*
Leisure Screen Time (Min)					
Males and Females	15	192.7 ± 104.1	124.0 ± 83.2	-68.7 ± 13.3	<0.01*
Males	7	221.4 ± 98.6	150.7 ± 80.3	-70.7 ± 49.5	0.01*
Females	8	167.5 ± 108.7	100.6 ± 83.6	-66.9 ± 56.6	0.01*

GSLTEQ: Godin-Shephard Leisure Time Exercise Questionnaire, Min: minutes, #: count

Table 26. ANOVA Results for Physical Activity at Baseline, 3 Months, and 6 Months (n = 5)

Variables	Baseline (T1) (Mean ± SD)	3 Mo (T2) (Mean ± SD)	6 Mo (T3) (Mean ± SD)	F (b)	p	Pairwise Comparisons
Total PA (GSLTEQ units)	45.2 ± 24.3	86.8 ± 35.6	87.6 ± 30.5	7.0	0.08	T2>T1*; T3>T1*
Moderate to Vigorous PA (GSLTEQ units)	15.8 ± 11.7	61.6 ± 34.2	64.8 ± 36.4	6.0	0.09	T2>T1*; T3>T1*
Moderate to Vigorous PA (Min)	20.2 ± 10.9	48.8 ± 19.3	62.5 ± 22.2	5.4	0.16	T2>T1*; T3>T1*
PA (Days meeting guidelines/Week)	0.0 ± 0.0	5.0 ± 1.4	5.5 ± 1.0	73.0	0.01*	T2>T1*; T3>T1**
Organized Sports and Activities (#)	1.0 ± 1.7	1.0 ± 1.2	1.4 ± 1.7	1.0	0.47	--
Sedentary Behaviour (Days meeting guidelines/Week)	0.83 ± 1.3	4.2 ± 2.6	4.0 ± 3.2	3.0	0.16	T2>T1*
Leisure Time Screen Time (Min)	190.0 ± 106.4	104.2 ± 85.9	82.5 ± 78.1	8.8	0.04*	T2<T1*; T3<T1*

PA: physical activity; GSLTEQ: Godin Shephard Leisure Time Exercise Questionnaire; Min: minutes; #: count
**: p < 0.05, **: p <0.005*

6.3.5 Social-Emotional Health

Measures of social-emotional health (the Harter Self-Perception Profile and the Strengths and Difficulties Questionnaire) are described in Table 27. Follow-up scores on the Strengths and Difficulties Questionnaire for boys and girls are displayed in Figures 27 and 28, respectively. While the only statistically significant change in social-emotional health was observed among girls in the Athletic subscale of the Harter Self-Perception Profile (+0.5 $\pm$ 0.1, p = 0.01), general trends suggested some modest improvements in girls' perceived strengths and difficulties (Figure 28) and self-perception (Figure 29). There was insufficient data from boys to analyze results from the Harter Self-Perception Profile.

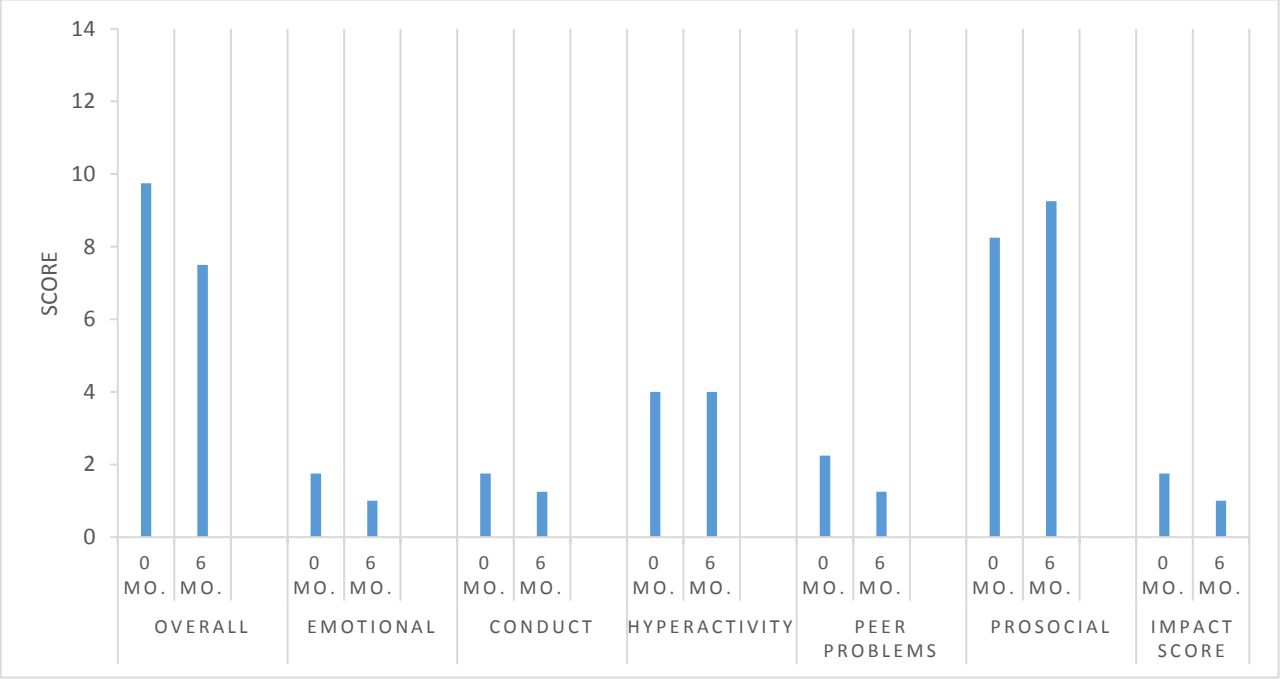

Figure 27. Strengths and Difficulties Questionnaire at Follow-Up (Boys) (n = 4)

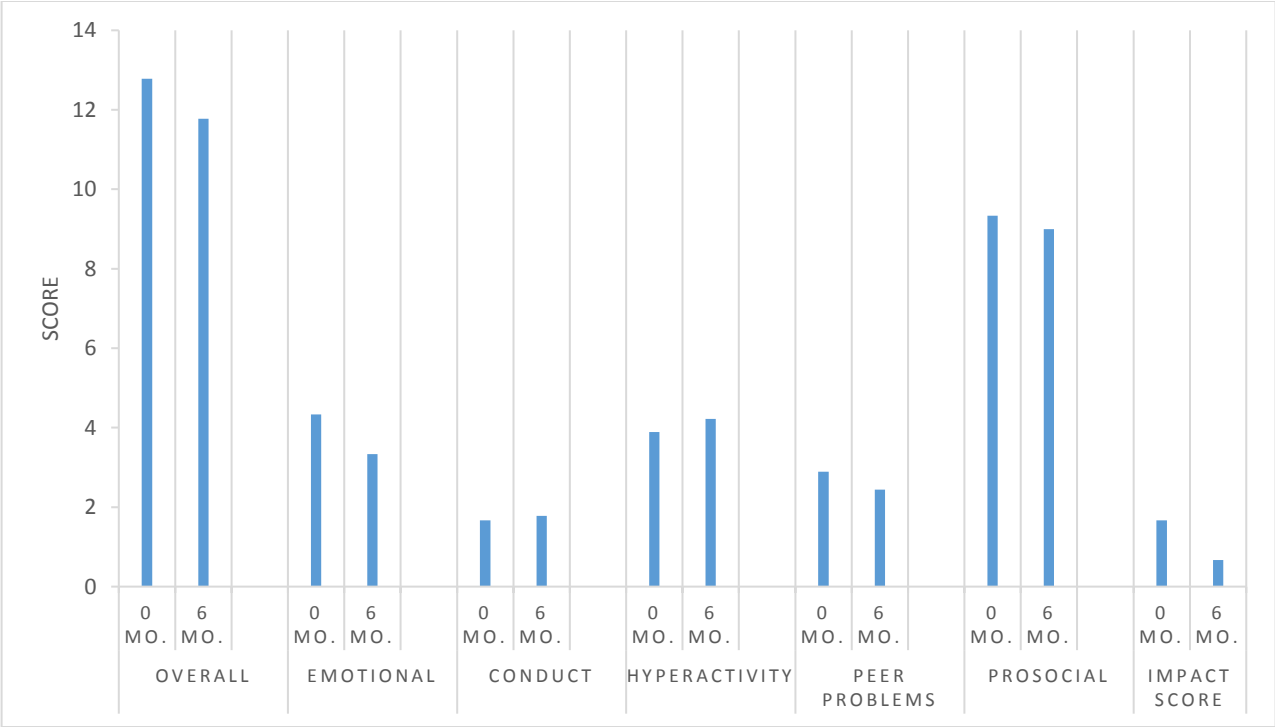

Figure 28. Strengths and Difficulties Questionnaire at Follow-Up (Girls) (n = 9)

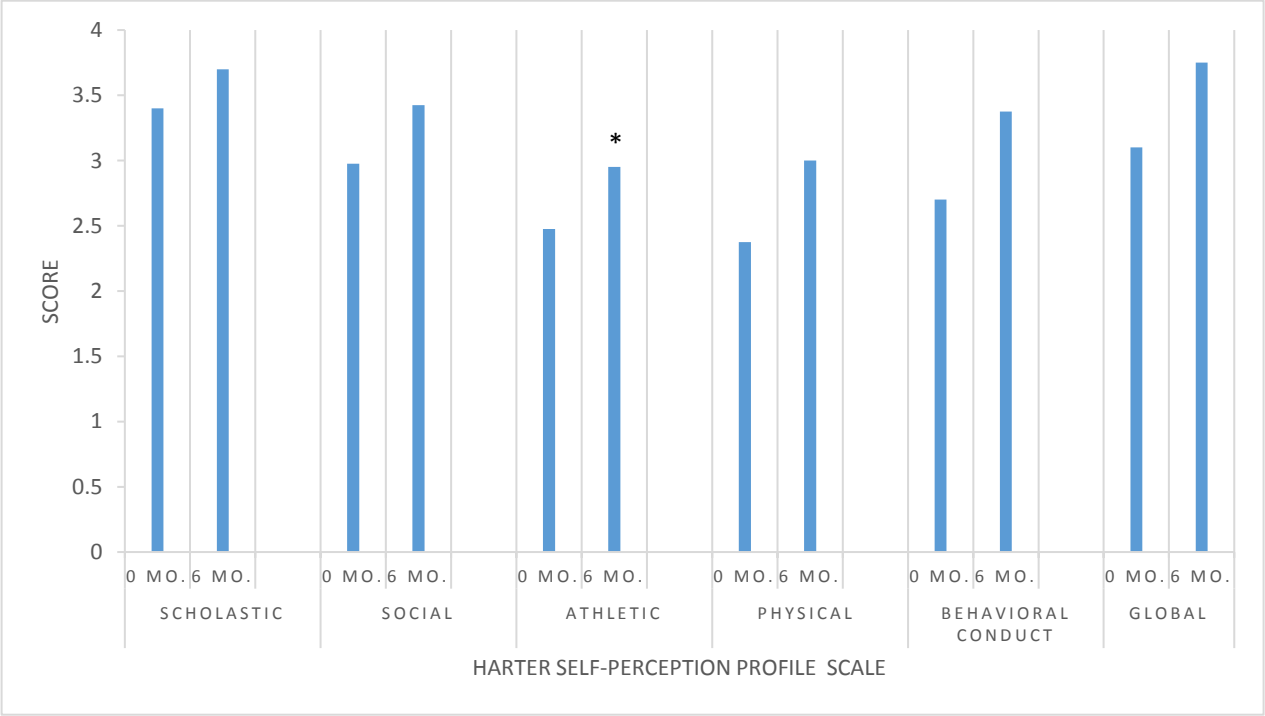

Figure 29. Harter Self-Perception Profile Scores for Girls at Follow-Up (n = 4)

Table 27. Social-Emotional Health at Follow-Up

	n	Baseline (Mean ± SD)	6 Months (Mean ± SD)	Change (Mean ± SD)	p
Harter Self-Perception Profile (Females)					
Athletic	4	2.5 ± 0.8	3.0 ± 0.7	+0.5 ± 0.1	0.01*
Physical	4	2.4 ± 0.9	3.0 ± 0.6	+0.6 ± 1.4	0.45
Behavioural Conduct	4	2.7 ± 1.2	3.4 ± 0.6	+0.7 ± 0.7	0.14
Global	4	3.1 ± 0.9	3.8 ± 0.3	+0.7 ± 1.0	0.30
Harter Self-Perception Profile (Males)					
Athletic	1	--	--	--	--
Physical	1	--	--	--	--
Behavioural Conduct	1	--	--	--	--
Global	1	--	--	--	--
Strengths and Difficulties Questionnaire (Females)					
Overall	9	12.8 ± 5.8	11.8 ± 6.2	-1.0 ± 5.3	0.59
Emotional	9	4.3 ± 2.3	3.3 ± 1.8	-1.0 ± 2.0	0.17
Conduct	9	1.7 ± 1.3	1.8 ± 1.6	+0.1 ± 1.7	0.85
Hyperactivity	9	3.9 ± 2.0	4.2 ± 3.0	+0.3 ± 2.1	0.64
Peer Problems	9	2.9 ± 1.9	2.4 ± 1.8	-0.4 ± 2.0	0.53
Prosocial	9	9.3 ± 0.7	9.0 ± 1.1	-0.3 ± 1.0	0.35
Impact Score	9	1.7 ± 1.9	0.7 ± 1.3	-1.0 ± 1.4	0.07
Strengths and Difficulties Questionnaire (Males)					
Overall	4	9.8 ± 6.5	7.5 ± 1.7	-2.3 ± 6.1	0.52
Emotional	4	1.8 ± 1.5	1.0 ± 0.8	-0.8 ± 1.0	0.22
Conduct	4	1.8 ± 2.9	1.3 ± 1.0	-0.5 ± 2.5	0.72
Hyperactivity	4	4.0 ± 4.3	4.0 ± 1.8	0.0 ± 2.9	1.0
Peer Problems	4	2.3 ± 1.0	1.3 ± 0.5	1.0 ± 1.2	0.18
Prosocial	4	8.3 ± 1.7	9.3 ± 1.0	+1.0 ± 0.8	0.09
Impact Score	4	1.8 ± 2.9	1.0 ± 1.4	-0.8 ± 1.5	0.39

6.3.6 Sleep

Sleep characteristics are displayed in Table 28. At baseline, children were generally meeting the recommended amounts of sleep as measured against age-based guidelines. On average, children were acquiring 98.5% ± 4.7% of their recommended amount of sleep at baseline. There was no significant change in sleep quantity at follow-up, with the clear majority of children continuing to get the required amount of sleep each weeknight (98.4% ± 6.6%). There was no observable change in the number of sleep-related risk factors that a child, teen, or their parent reported from baseline to follow-up (+0.4 ± 1.3, p = 0.41).

Table 28. Sleep Characteristics at Follow-Up

Characteristics	n	Baseline (Mean ± SD)	6 Months (Mean ± SD)	Change (Mean ± SD)	P
Sleep Quantity (% of Recommended)					
Both	17	98.5 ± 4.7	98.4 ± 6.6	-0.06 ± 3.0	0.94
Girls	12	97.8 ± 5.5	97.8 ± 7.8	-0.08 ± 3.6	0.94
Boys	5	100.0 ± 0.0	100.0 ± 0.0	--	--
Sleep Risk Factors (Boys)					
Number of Risk Factors	3	2.0 ± 1.0	2.0 ± 1.0	0.0	--
Sleep Risk Factors (Girls)					
Number of Risk Factors	7	1.6 ± 1.3	2.0 ± 1.2	+0.4 ± 1.3	0.41

6.4 Discussion

6.4.1 Referral and Uptake

Overall, the Program attracted a significant number of families from around the province during its implementation phase. The 216 families referred to the Program in its first two years of operation is comparable to the 214 families referred to the Shapedown BC program over the two-year period reported in their evaluation[227]. Although without enough similar programs for comparison, it is difficult to determine whether or not this number is below, at, or above what is to be expected for a new telehealth intervention.

Enrollment in the Program evaluation, however, was relatively low. The number of participants who returned or completed all follow-up assessments was also very low. A large review of in-person child obesity interventions found that drop-out rates at follow-up could be greater than 90% in some cases[271]. The low enrollment rates make it difficult to determine whether or not the evaluation sample is truly representative of the population of Program participants as a whole. The low follow-up rates also make it difficult to determine the overall effectiveness of the Program.

Most participants (89%) who were referred to the Program completed the Assessment Call. A majority of participants (56%) also completed at least five of the seven Program Calls. Prior to Program implementation, five Program Calls (or roughly 70% of the Program) was determined to be the minimum number of calls to designate a child or teen as having received the intervention. This decision was based on a comparable metric used by a CHWII partner program. Roughly one-third (35%) of participants in the evaluation completed all seven Program Calls.

Another telehealth program for obesity in children found that attrition rates for the telehealth arm of their program were lower, when compared to the comparable in-person services[15]. Without ample data on attrition in telehealth interventions for children with obesity, it may be helpful to review the attrition rates for in-person programming. A review of programs showed that the mean rate of non-attendance at initial clinic visits was 28.3% with a range of 5%– 69.3% and 32.1% with a range of 10%–75.7% for follow-up visits[10]. Another in-person treatment program reported an attrition rate of 55%, wherein children who were older and displayed greater depressive symptoms, were more likely not to complete the program[272].

As the Program progressed past its first several months of operation, a wait list of clients began to form. Wait times in the Program were roughly aligned with what has been reported from a sample of in-person pediatric obesity treatment programs[10]. Correlational analyses suggest that the longer a family had to wait to begin the Program, the fewer Program Calls they were likely to complete. This may suggest that participants lost motivation during the waiting period, became frustrated with extensive waits, or experienced new barriers to participation. The Program may be well-served to delay additional recruitment until there is capacity staff-wise to enroll more families and reduce the amount of time required to begin the Program.

6.4.2 Anthropometrics and Health Information

A relatively low rate of follow-up with referring physicians has been observed in this sample. While BMI observations were available for nineteen of the fifty-five children (35%) in the evaluation group, there were only three children with pre- and post- measurements for blood pressure and there were no children who had a baseline and follow-up measurement for waist

circumference. The issue of missing waist circumference measurements on Program referrals was observed in the baseline data, as well. Efforts to have physicians document a waist circumference upon referral needs to be strengthened, as well as a better understanding as to why such measurements are not being recorded

Based on the BMI measurements that were obtained, there was no significant change across the length of the Program. Although BMI did not decrease across the Program, it is important to note that BMI did not significantly increase, which may have been observed in the absence of an intervention. Despite the lack of change in BMI, there may be health benefits in the absence of observable weight loss. Other obesity intervention programs for children have reported changes to hematological markers of glucose handling and lipids that were unrelated to any change in weight[273]. Self-reported increases in physical activity may have also improved some aspects of metabolic health without producing a change in weight. With improved reporting from physician follow-up appointments, these types of changes could be further explored in the Program.

6.4.3 Food and Nutrition

While some measures of food and nutrition improved at the completion of the Program Calls (i.e., the 3-month follow-up), none of those changes were sustained over time. There were a very small number of participants who had both baseline and follow-up measurements and this data was subjected to large variability in a small group. Trends suggested that participants were reducing their consumption of sugary drinks and unhealthy snacks at 3-months, but those changes were not sustained at the 6-month follow-up. This suggests that rather than beginning to taper contact with participants at the 3-month point, the Program may need to consider

reinforcing behaviour change through more regular contact. This strategy has been employed in other pediatric obesity programs[216]. A re-evaluation of the Program timeline may result in a lengthened intervention phase, where weekly phone calls extend beyond the 7 calls currently planned and frequency of communication is maintained rather than reduced. Again, self-reports of diet quality, quantity, and eating behaviours are often subject to a number of errors[269], but objective measures of diet are still not available or feasible in this context.

6.4.4 Physical Activity and Sedentary Behaviour

Self-reported physical activity and sedentary behaviour appeared to be the area of greatest improvement for children and teens in the evaluation sample. Immediately after completing the weekly Program Calls, participants had improved in nearly all categories of physical activity and sedentary behaviours. Physical activity and sedentary behaviour was also one of the few areas that displayed sustained change at the 6-month follow-up. Maintaining these improvements may be a precursor to creating changes in objective physical health (i.e., weight loss or maintenance) in the future. As mentioned previously, there may be errors in these self-reported measures[115], so objective measurements of physical activity and sedentary time through accelerometry should be considered in the future.

6.4.5 Social-Emotional Health

Although there was only one significant increase across the markers of social-emotional health (girls' improvement in their Athletic self-perception), general trends in the data suggested that children and youth were reducing negative indicators of social-emotional health (i.e., emotional difficulties and conduct problems) and increasing positive indicators of their social-emotional

health (i.e., prosocial behaviour and global self-perception). The Program's ability to evaluate and address issues of social-emotional health would be improved by the addition of a mental health professional, that can administer diagnostic tools and provide follow-up care. Anecdotal reports from Program Staff indicated that participants in the Program were often experiencing complex home and family situations, with reports of bullying and teasing in school and self-isolating behaviours. Further exploration on the social-emotional outcomes of the Program from a clinical perspective is an important area for future work.

6.4.6 Sleep

Self-reported quantities of sleep each weeknight was generally appropriate at baseline and remained as such upon follow-up. Sleep quantity did not appear to be a problem for children and youth in the evaluation sample, but objective measures of sleep (i.e., through accelerometry) may provide additional insight into children's sleep patterns. The number of sleep-related risk factors (i.e., snoring, mouth breathing, daytime sleepiness, or feeling unrefreshed in the morning) a child displayed did not significantly change across the span of the Program. There is one pediatric sleep intervention for this age group documented in the literature that found with a one-time education session on sleep practices and follow-up reminders children improved sleep habits and maintained those improvements up to 20 weeks post-intervention[274]. Improvements around sleep quality may be a point of increased focus in the Program moving forward.

6.5 Limitations

At the time of evaluation completion, two participants were still in progress with the Program and did not have final follow-up data to report. In a number of other cases, follow-up data was

unavailable due to unreturned or incomplete questionnaires and/or cessation of contact with the Program. According to Program Staff, rates of returned mail for participants in the Program were notably higher than for general clients of HealthLink BC's services. This may reflect recurrent changes in home address across the sample. Analyses were performed on the data that was available, although in some cases there was insufficient information for analysis. The sporadic availability of data at the 3- and 6-month follow-up points and relative heterogeneity of the sample (i.e., variances in age and extent of overweight or obesity) have affected the statistical significance of the data. It is also difficult to measure the overall effectiveness of the Program based on the relatively small sample of participants.

6.6 Conclusion

Researcher hypothesized that this Program would: improve access to healthcare services for individuals with barriers to receiving traditional in-person care, improve participants' healthy lifestyle behaviours, and improve participants' clinical outcomes. Overall, the Program was successful in recruiting a significant number of families from the province. With a number of participants referred from partner programs due to wait lists or failure to meet inclusion criteria, it appears that the Program has been successful in improving access to healthcare services. Considering that there was minimal advertising or publicity, the Program was able to reach families throughout the province and deliver a comprehensive obesity treatment program. The Program did, however, struggle in enrolling participants in the Program evaluation, which has affected the quantity of data available to measure the effectiveness of the Program in initiating behaviour and/or health changes. Without data from the entire population of families referred to

the Program, it is not possible to determine if this sample of individuals is representative of the entire population of children, teens, and families enrolled in the Program.

The Program's ability to initiate behavioural changes in participants was difficult to detect due to small samples, large variability in the sample, and attrition at follow-up. Although there was a lack of significant changes in behaviour measurements (aside from physical activity and sedentary behaviour), some trends suggested Program effectiveness. Children and teens showed reductions in the frequency with which they consumed sugary drinks and low-nutrient high-calorie foods. Some participants also reduced their consumption of processed grain and meat products, while others improved their fruit and vegetable consumption. Children and teens reported meaningful improvements in both their physical activity and sedentary behaviours. Additionally, scores from the measures of social-emotional health indicated that children may have been trending in a positive direction over the course of the Program. There was insufficient information provided by physicians at follow-up to permit any conclusions about changes in clinical measures of health.

Systematic reviews of in-person pediatric obesity interventions have shown general similarities to this Program, in terms of the participants' outcomes[19,275,276]. Although BMI changes in this Program were non-significant, some literature has suggested that using BMI alone is too restrictive a measure for determining an intervention's success[277]. Therefore, other clinical indicators of metabolic health were also examined in the outcomes of these studies, such as blood pressure and metabolic profiles. However, these reviews did not comprehensively report changes in behavioural outcomes, which is a strength of this Program evaluation.

Overall, improvements in the Program appeared strongest immediately after the formal Program was completed, but tended to regress toward baseline levels at the 6-month follow-up. This trend has been observed throughout the literature on in-person obesity interventions for children[20,21,278]. A commonality among those interventions was that upon follow-up after program completion, the modest benefits achieved during and shortly after the program were sometimes or often no longer present[19,275,276]. (Outcomes from telehealth interventions for overweight and obesity in children are rare in the literature.)

In the future, Program length or frequency of contact should be reevaluated in an effort to support the changes observed at the immediate completion of the Program. Promoting greater participation in the evaluative aspect of the Program may also offer valuable information for practice improvement. Further suggestions for Program development are detailed in Chapter 7.

Chapter 7: Conclusions and Future Directions

This chapter summarizes the overall conclusions derived from the thesis, as well as suggestions for future directions in this area of research and for the Program, specifically. These findings will be presented to HealthLink BC as a report titled "Policy Recommendations for the HealthLink BC Eating and Activity Program for Kids".

7.1 Program Conclusions

The Program evaluation and this thesis aimed to accomplish several goals. The first goal was to report descriptive information on the population of individuals referred to this Program in its initial phase of operation. The second goal was to determine the effectiveness of the Program in initiating behaviour change, and third, to measure how effective the Program was in its ability to initiate changes in clinical health. Due to the difficulty of enrolling Program participants in the evaluation and obtaining follow-up data, we are not able to address some components of the second goal, and are unable to address the third goal, , but do have some valuable insights based on trends.

The Program evaluation includes roughly a quarter of Program participants, so any conclusions drawn from the data should be done so with caution. There are lessons to be learned, however, from the information that has been obtained through the evaluation. First, there is significant need in the province for structured lifestyle intervention programs that include nutrition, physical activity, and other lifestyle components (e.g., sleep, mental health, self-perception). The total number of referrals received by the Program in a relatively short period of time and the health

status of the children and youth being referred to the Program provide evidence that there is a population of children who require these services. The diversity of these children's health, social, and demographic profiles and observed health needs also emphasize the need for flexibility and individualization of programs, as carried out in the Program.

Researchers hypothesized that children referred to the Program would have complex health needs and some unfavourable health behaviours. The population of children in this sample tended to have BMI scores far above the minimum criteria for referral to a structured intervention ($\geq 85^{th}$ percentile for BMI), which coincided with expectations. Based on this finding, physicians should consider referring children and youth when they first begin to deviate from a healthy growth trajectory, rather than waiting until children have reached the uppermost levels of the growth charts. This suggestion coincides with new guidelines on the growth monitoring of children and youth in Canada[185]. Lifestyle intervention programs have documented a greater likelihood of success if children are referred earlier, at lower standardized BMI scores[279]. However there has been a lack of referrals observed in the literature among pediatricians seeing children who are overweight or obese[256]. Reasons for a lack of referral in that study included lack of recognition that a child's BMI met criteria for overweight or obesity, decisions to try to manage the condition at the primary care level, or a decision to delay or dismiss further care. There is evidence to suggest that parents and physicians perceive children's weight to be typical, when they have a BMI coinciding with overweight or obesity[280]. Improved public health messaging to parents and practitioners is needed when it comes to accurately assessing a child's health as it relates to their weight and corresponding height. It is possible that the presently high prevalence rates of obesity in children are shifting people's perceptions of

what a child with overweight or obesity looks like. Bringing attention to these misconceptions may be helpful in addressing excess weight earlier and intervening at a more opportune time.

In addition to the potential delay in referrals, physicians also tended to neglect several sections of the referral form in this Program. Blood pressure and waist circumference, areas of relatively minimal time cost, were generally not completed as requested. Having measures of metabolic health in the absence of hematology would strengthen the evaluation of both the baseline health status of participants and their outcomes at follow-up. Since referring physicians or nurses are the only source of objective data in the Program, researchers rely on their reporting to collect the highest-quality data available. Future qualitative assessment is needed to more accurately determine why these important measures were routinely missed on the referral forms.

Aside from the objective measures provided by referring healthcare providers, the Program relied on self-reports for all other metrics in the assessment and evaluation of participants. The extent to which objective measures of physical activity or sleep could be included may also help to improve the quality of data generated in the Program. Moving away from paper-based questionnaires, which must be sent back and forth through postal mail, would also improve the quantity of data returned to Program Staff. Anecdotally, a Program administrator remarked on the unusually high rates of returned mail related to the Program, which surpassed what the organization sees among its typical clients. Conducting assessments online or over the telephone (when appropriate) may be one strategy to address the problem of missing data.

Researchers hypothesized that the Program would be able to initiate behavioural changes in Program participants. The Program did display several successes, especially in the area of physical activity and sedentary behaviour. Moreover, while not all dietary measures reached statistical significance, it appeared that children were generally moving in the right direction for improvements in diet quality, quantity, and patterns. Improvements in fruit and vegetable consumption, reductions in processed grains and sugary drinks, and fewer meals eaten out of the home were observed. As these are often complex and inter-related variables, it is likely that sample size was not large enough to draw significant conclusions, particularly given participants marked variation and range in dietary intakes. There was insufficient data across a number of areas, which did not permit appropriate conclusions to be drawn (e.g., in measures of social-emotional health that are interpreted by age group). However, one overarching observation in the data was that most improvements reported at the 3-month follow-up were not documented at the 6-month follow-up. In accordance with the suggestions in many studies of healthy lifestyle interventions, extending the length of intervention or increasing the frequency of communication is an important consideration in future work.

In summary, a real-world telehealth platform is well-suited to deliver this Program, but did demonstrate limitations for evaluating the overall effectiveness of the Program, and did not permit researchers to address their third hypothesis, that the Program could initiate clinical changes in health. Clients, however, benefited greatly from the flexibility and accessibility of a telehealth program, but limitations have been observed in terms of reliability of reporting and follow-up response rates. The Program was also difficult to assess as a singular intervention, since its delivery often varied among participants. The Program may or may not have involved

some or all the family members and the content was individualized to meet the participants' needs. This meant that the Program could have had a very different structure and different content from participant to participant. The heavy reliance on self-reported measures, low enrollment in the Program evaluation, and poor response rates for follow-up measurements are drawbacks of operating an evaluation from a telehealth platform, which does not permit direct contact with participants. The Program was designed to be as inclusive as possible and to facilitate ease of enrollment and participation. This meant a broad age range, a spectrum of health statuses among the participants, and individualized treatment strategies. This was beneficial for participants, but did affect the ability to assess the Program scientifically and statistically. Specific suggestions for improvements to the Program and its assessment are discussed in Section 7.3.

7.2 Contributions of the Research

This program evaluation has contributed to a field where baseline and outcomes data on telehealth interventions for children with overweight or obesity was lacking. Details of the Program's development, implementation, and evaluation should prove helpful as more intervention programs are launched considering the high prevalence rates for obesity in children and teens[184]. The level of detail reported on measures of diet, physical activity, sedentary behaviour, and sleep are more extensive in this evaluation than what has been reported elsewhere. There is a regional impact from this information, where the CHWII partner programs and other healthy weights working groups can gather further information on the state of child overweight and obesity in BC, and the practices and insights gleaned from the delivery of a

novel program. Furthermore, with existing telehealth programming in Australia, the United States, and Europe[13,215,223], the reach of this information may be even broader.

In previous literature, the effectiveness of telehealth has been called into question by researchers who fear a publication bias, wherein researchers may only publish the positive outcomes from these types of interventions[281]. By disseminating the full outcomes of the Program, which are limited in some areas, we hope to begin addressing this issue. There is also a desire to share lessons learned from this evaluation with other researchers and practitioners, so that future explorations may be better informed from our experiences.

7.3 Suggestions for the Program

Although the Program attracted a number of families in its implementation phase, the uptake and recognition of the Program could be greatly improved by a minimal marketing effort. The Program lacks a recognizable name and logo, which may have reduced the Program's reach. Basic market research may be useful in exploring recognition of the Program throughout the province and constructing marketing and recruitment efforts going forward. However, the Program was already accumulating a wait list by Spring of 2016, so a marketing effort may be wisely delayed until there is a human resource and overall programming capacity to include more families. It is notable that the Program attracted as many participants as it did, considering that there was no formal marketing or advertisement.

As mentioned, within approximately one year the Program accumulated a wait list of participants. As of June 2017, the wait list for Program initiation was greater than 140 days. This

was a result of interest in the Program, as well as a shortage of Program staff. The Program has operated thus far with one full-time QEP, and between one and two full-time RDs. The QEP and RDs worked within the Program, but also treated other clients utilizing HealthLink BC's general services. Allotting more staffing resources to the Program would likely reduce the wait list and permit greater enrollment and a more effective evaluation. As observed in the follow-up data, longer wait times led to diminished engagement with the Program and potential data losses. Reducing wait times could increase the extent to which families adhere to and benefit from the Program and provide additional meaningful data for evaluative purposes.

Part of the appeal of a telehealth program is the flexibility it affords its users. In the Program, many families requested evening appointments so that working parents could participate in Program Calls. While Program staff were available for some evening appointments, they also worked during normal business hours. Expanding the staff to include individuals working during evening hours may also help the Program to continue effectively delivering its services and meeting the needs of working families.

If there is an option to expand Program staff, there should also be consideration of expanding services. A QEP and RD are well-placed to recognize and treat children's and teens' issues with diet and physical activity, but the baseline data also indicate that these children would be well-served by the services of someone with expertise in mental health or counselling. Qualified exercise professionals and RDs must operate within their scope of practice and are not able to administer clinically diagnostic tools related to mental health, so proxy measures were used. With a qualified mental health professional, these needs may be better assessed and treated.

As noted previously, enrollment in the Program evaluation and follow-up response rates were relatively low. In early stages of Program development, the team discussed possibly using small incentives to increase the likelihood of participants returning mailed packages or to encourage participants to adhere to the Program. Ultimately, the decision was made not to use any Program incentives due to concerns about permissibility for government-funded programs. In the future, incentives could be reconsidered (e.g., a t-shirt, small toy, or healthy lifestyle item like a water bottle) to encourage participants to engage in desired behaviours.

Another strategy to increase uptake of and adherence to the Program is to include an online component (i.e., website, web application, or e-mail support). It was clear that relying on paper questionnaires via postal mail was not an ideal means to collect data. Administering these tools online and receiving the data electronically would improve the effectiveness and efficiency of the process. Baseline data showed that regular Internet access was prevalent across the sample. Consequently, online delivery of assessment tools and potentially Program content seems feasible and likely beneficial and could improve the volume of data available for analysis.

Improving the administration of measurement tools is needed to improve the quality and quantity of data for evaluating the Program. Including objective measurements whenever possible would also strengthen future evaluations. For example, distributing accelerometers to measure physical activity and sleep across the span of the Program may provide more accurate data than relying on self-reports. The extent to which physicians and nurses can provide more comprehensive

information upon referral would also impact the quality and quantity of objectively measured data.

The Program could also play a role in communicating the message that children should be referred to these types of interventions as early as it is detected that they have left a healthy growth trajectory. As evidenced in the evaluation sample, children are most often being referred when they have reached the highest points on the growth chart, at or above the 99th percentile. Exploring the reasons for these delayed referrals and beginning to address them will benefit families and potentially improve the effectiveness and outcomes of intervention programs.

Another way to strengthen or sustain the positive changes observed in the Program may be to reevaluate the length of the intervention or the frequency of contact. Though lacking statistical significance, it appeared that greater positive behaviour changes occurred at the 3-month follow-up point versus than at the 6-month follow-up. At the 6-month follow-up, some positive behaviour changes were reportedly maintained, but the extent of those reported changes was beginning to diminish. Other intervention programs for obesity in childhood have observed similar trends, where improvements made during the program subside with time[276]. However, in the University of Kansas Center for Telehealth and Telemedicine example, their research showed that lengthening the intervention period was able to produce significant improvements in children's health for a longer period of time post intervention[215].

7.4 Suggestions for Future Research

The primary mandate of the Program was to deliver high-quality healthy lifestyle counselling services to children and families in the province. Unfortunately, due to the quantity and content of evaluation data available to researchers, it is difficult to generate evidence-based statements on this important aspect of the Program. However, nonsignificant or absent findings should not be interpreted as shortcomings of the Program per se, but possible limitations of the data collection and reporting procedures used to meet the unique demands of this platform.

Future research in this area must carefully weigh the balance of intervention delivery and evaluation burden. Throughout this Program, each part of the evaluation was weighed in terms of its utility versus the overall burden to the participant. The goal of implementing a telehealth option for families was to reduce the barriers to and burdens of obtaining in-person care. Given the importance of the wellbeing and health of the children and teens enrolled in the Program, the program evaluation was a secondary concern to providing healthcare to clients. This is one limitation of evaluating the effectiveness of an intervention in real-world conditions, but there may be ways to improve evaluation procedures moving forward.

At the beginning of the Program, participants were asked whether they would participate in the evaluation. This required no additional time cost for the participant, only that they provide written permission for their de-identified information to be analyzed by researchers. Considering the relatively minimal cost to participate in the evaluation, it was surprising that only one in four participants opted to take part. Future qualitative assessments could explore the reasons that individuals decide to opt into research related to the Program, and what may make an individual

more likely to opt out. Understanding the barriers to participation may help Program staff in future recruitment efforts for additional studies.

Overall increases in the number of children and teens in an evaluation would also strengthen reporting from a statistical perspective. The small numbers of children with comprehensive follow-up data (typically at or around 10 children for many variables) prevented any subgroup analyses from being conducted. Ideally, outcomes could be analyzed according to age, sex, and/or extent of overweight. With greater sample sizes, more extensive research could be performed in other areas, as well. For example, telehealth has been cited as a potentially cost-saving mechanism for healthcare systems[16]. Greater sample sizes and longer follow-up periods could provide information on the potential economic impact of such programs. Other lifestyle variables, including physical activity and dietary measures would also be strengthened by greater sample sizes when determining true significance of findings.

More complete data may also permit analyses of cost effectiveness. Telehealth is often touted as a means of cost-savings for healthcare systems[282]. With the lack of overall data available for these analyses, economic analyses would be extremely difficult and based primarily upon self-reports of health. Even with ample data, cost effectiveness studies of telehealth may be difficult due to the number of factors that must be accounted for, including: the service being assessed, what the traditional method of care would be, size of the patient group and sample, which type of economic modeling is being used, and on the uptake and adherence to the service[207]. HealthLink BC is, however, utilizing its internal data on the entire implementation phase population (n =

216) to conduct internal analyses related to Program costs and outcomes. Researchers at UBC have been providing consultation in these procedures.

One aspect commonly reported in other telehealth programs for child obesity has been an assessment of participant satisfaction[11,12,216,218,221]. HealthLink BC opted not to collect assessments of physician or participant satisfaction. While there was an indication that some physicians were pleased with the Program based on their repeated referrals, we are unable to make any definitive statements about the Program's acceptability or satisfaction among referring physicians or Program participants due to a lack of data. The extent to which those utilizing the Program were satisfied with its services represents another point for future exploration and practice improvement.

Overall, the Program represents a step forward in pediatric health initiatives, wherein a novel and comprehensive, multi-discipline lifestyle intervention program was developed, implemented, and executed across a large geographic area. While there are areas in which the Program can be strengthened, realistic limitations of funding, capacity, and regulation remain barriers to implementing some of the recommendations listed herein. Although not all evaluative aspects reached the sample sizes or statistical significance that was desired, this research provides some valuable insights in an emerging field with relatively minimal existing data.

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Appendices

Appendix A : Physician Referral Form

HealthLink BC Eating and Activity Program for Kids Referral Form

Fax completed referral to: 250-953-0493

Referring Practitioner: _____
Office Address: _____
_____
Office Phone: _____
Office Fax: _____

Client Name: _____
Gender: _____
PHN: _____
DOB: _____
Date of Referral: _____

Parent/Guardian Name: _____
Relationship to Client: _____
Address: _____
_____
Home Phone: _____
Alternate Phone: _____

☐ **I confirm that the parent/guardian is aware of this referral.**

☐ **If the child is ≥ 12 years of age, I confirm they are aware of this referral.**

Anthropometry & Blood Pressure: *Please attach growth charts if available*

Weight: _____ ☐kg ☐lbs.	Height: _____ ☐cm ☐inches	BMI: _____ (kg/m²)	BMI: _____ percentile	BP: _____ mmHg	Waist Circumference: _____ ☐cm ☐inches

Medical History:

☐ Dyslipidemia	☐ Eating Disorder	☐ Obstructive Sleep Apnea
☐ Hypertension	☐ Depression/Anxiety	☐ Sleep Disorder
☐ Metabolic Syndrome	☐ ADHD	☐ Asthma/respiratory
☐ Type 2 Diabetes	☐ Psychiatric Concerns	☐ Neurodevelopment
☐ Polycystic Ovary Syndrome	☐ Cognitive Impairment	☐ Activity Limitations/Physical Impairment
☐ Hearing or Visual Impairment	☐ Gastrointestinal _____	☐ Other Endocrine _____

Bloodwork: *Bloodwork is recommended. Please include the following tests plus other relevant results that have been completed within the past 6 months*

☐ Hematology Profile	☐ Lipid Profile	☐ Basic Metabolic Panel
☐ TSH	☐ Albumin	☐ Alk Phos
☐ AST	☐ ALT	☐ Other _____

Additional Information: *Does the family have any of the following issues/barriers that could inhibit weight management?*

☐ Financial Issues ☐ Family/Social Functioning ☐ Literacy Barriers

☐ Translation services required? Please specify language spoken: _____

☐ Other _____

Appendix B : Demographic Questionnaire

1. Including you, how many people are currently living in your household?

☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7+

2. What is your approximate yearly *household* income?

☐ Less than $5,000
☐ $5,000 to less than $10,000
☐ $10,000 to less than $15,000
☐ $15,000 to less than $20,000
☐ $25,000 to less than $35,000
☐ $35,000 to less than $45,000
☐ $45,000 to less than $55,000
☐ $55,000+

3. How would you describe your ethnicity?*

☐ Caucasian ☐ South American ☐ Asian
☐ First Nations ☐ Arab ☐ Métis
☐ African American ☐ Inuk (Inuit) ☐ Other _____

4. How would you describe your child's ethnicity?*

☐ Caucasian ☐ South American ☐ Asian
☐ First Nations ☐ Arab ☐ Métis
☐ African American ☐ Inuk (Inuit) ☐ Other _____

5. About how many hours a week do you usually work at your job? If you usually work extra hours, paid or unpaid, please include these hours.

☐ 0-15 ☐ 15-30 ☐ 30-40 ☐ 40+

6. How would you describe your level of education?

☐ Less than high school diploma or its equivalent
☐ High school diploma or a high school equivalency certificate
☐ Trade certificate or diploma
☐ College, CEGEP or other non-university certificate or diploma (other than trade certificate/diploma)
☐ University certificate or diploma below the bachelor's level
☐ Bachelor's degree (e.g. B.A., B.Sc., LL.B.)
☐ University certificate, diploma or degree above the bachelor's level

7. Which of the following best describes your access to the Internet at home (ex. smartphone, computer, tablet)?

☐ I always have access to the Internet at home.
☐ I sometimes have access to the Internet at home.
☐ I do not have access to the Internet at home.

*Providing information on your race or ethnic origin is voluntary.

Appendix C : Sleep Questionnaire

1.	**What time does your child go to bed at night?**	_____	
2.	**What time does your child fall asleep?**	_____	
3.	**What time does your child wake up in the morning?**	_____	
4.	**While sleeping, does your child ever snore?**	YES	NO
5.	**While sleeping, does your child snore more than half of the time?**	YES	NO
6.	**Does your child have a problem with sleepiness during the day?**	YES	NO
7.	**Does your child tend to breath through their mouth during the day?**	YES	NO
8.	**Does your child wake up feeling unrefreshed in the morning?**	YES	NO

Appendix D : Strengths and Difficulties Questionnaire

Strengths and Difficulties Questionnaire S 11-17

For each item, please mark the box for Not True, Somewhat True or Certainly True. It would help us if you answered all items as best you can even if you are not absolutely certain . Please give your answers on the basis of how things have been for you over the last six months.

Your name..... Male/Female

Date of birth.....

	Not True	Somewhat True	Certainly True
I try to be nice to other people. I care about their feelings	☐	☐	☐
I am restless, I cannot stay still for long	☐	☐	☐
I get a lot of headaches, stomach-aches or sickness	☐	☐	☐
I usually share with others, for example CD's, games, food	☐	☐	☐
I get very angry and often lose my temper	☐	☐	☐
I would rather be alone than with people of my age	☐	☐	☐
I usually do as I am told	☐	☐	☐
I worry a lot	☐	☐	☐
I am helpful if someone is hurt, upset or feeling ill	☐	☐	☐
I am constantly fidgeting or squirming	☐	☐	☐
I have one good friend or more	☐	☐	☐
I fight a lot. I can make other people do what I want	☐	☐	☐
I am often unhappy, depressed or tearful	☐	☐	☐
Other people my age generally like me	☐	☐	☐
I am easily distracted, I find it difficult to concentrate	☐	☐	☐
I am nervous in new situations. I easily lose confidence	☐	☐	☐
I am kind to younger children	☐	☐	☐
I am often accused of lying or cheating	☐	☐	☐
Other children or young people pick on me or bully me	☐	☐	☐
I often offer to help others (parents, teachers, children)	☐	☐	☐
I think before I do things	☐	☐	☐
I take things that are not mine from home, school or elsewhere	☐	☐	☐
I get along better with adults than with people my own age	☐	☐	☐
I have many fears, I am easily scared	☐	☐	☐
I finish the work I'm doing. My attention is good	☐	☐	☐

Your Signature .....

Today's Date .....

Thank you very much for your help

Appendix E : Harter Self-Perception Profile

What I Am Like

Name_____ Age____ Birthday _____ ☐ Boy ☐ Girl
Month Day (check one)

	Really True for me	Sort of True for me				Sort of True for me	Really True for me
			Sample Sentence				
a.	☐	☐	Some kids would rather play outdoors in their spare time	**BUT**	Other kids would rather watch T.V.	☐	☐
1.	☐	☐	Some kids feel that they are very good at their school work	**BUT**	Other kids worry about whether they can do the school work assigned to them	☐	☐
2.	☐	☐	Some kids find it hard to make friends	**BUT**	Other kids find it pretty easy to make friends	☐	☐
3.	☐	☐	Some kids do very well at all kinds of sports	**BUT**	Other kids don't feel that they are very good when it comes to sports	☐	☐
4.	☐	☐	Some kids are happy with the way they look	**BUT**	Other kids are *not* happy with the way they look	☐	☐
5.	☐	☐	Some kids often do not like the way they behave	**BUT**	Other kids usually like the way they behave	☐	☐
6.	☐	☐	Some kids are often unhappy with themselves	**BUT**	Other kids are pretty pleased with themselves	☐	☐
7.	☐	☐	Some kids feel like they are just as smart as other kids their age	**BUT**	Other kids aren't so sure and wonder if they are as smart	☐	☐
8.	☐	☐	Some kids know how to make classmates like them	**BUT**	Other kids don't know how to make classmates like them	☐	☐
9.	☐	☐	Some kids wish they could be a lot better at sports	**BUT**	Other kids feel they are good enough at sports	☐	☐
10.	☐	☐	Some kids are happy with their height and weight	**BUT**	Other kids wish their height or weight were different	☐	☐
11.	☐	☐	Some kids usually do the right thing	**BUT**	Other kids often don't do the right thing	☐	☐

	Really True for me	Sort of True for me				Sort of True for me	Really True for me
12.	☐	☐	Some kids don't like the way they are leading their life	**BUT**	Other kids *do* like the way they are leading their life	☐	☐
13.	☐	☐	Some kids are pretty slow in finishing their school work	**BUT**	Other kids can do their school work quickly	☐	☐
14.	☐	☐	Some kids don't have the social skills to make friends	**BUT**	Other kids do have the social skills to make friends	☐	☐
15.	☐	☐	Some kids think they could do well at just about any new sports activity they haven't tried before	**BUT**	Other kids are afraid they might not do well at sports they haven't ever tried	☐	☐
16.	☐	☐	Some kids wish their body was different	**BUT**	Other kids like their body the way it is	☐	☐
17.	☐	☐	Some kids usually act the way they know they are supposed to	**BUT**	Other kids often don't act the way they are supposed to	☐	☐
18.	☐	☐	Some kids are happy with themselves as a person	**BUT**	Other kids are often not happy with themselves	☐	☐
19.	☐	☐	Some kids often forget what they learn	**BUT**	Other kids can remember things easily	☐	☐
20.	☐	☐	Some kids understand how to get peers to accept them	**BUT**	Other kids don't understand how to get peers to accept them	☐	☐
21.	☐	☐	Some kids feel that they are better than others their age at sports	**BUT**	Other kids don't feel they can play as well	☐	☐
22.	☐	☐	Some kids wish their physical appearance (how they look) was different	**BUT**	Other kids like their physical appearance the way it is	☐	☐
23.	☐	☐	Some kids usually get in trouble because of things they do	**BUT**	Other kids usually don't do things that get them in trouble	☐	☐
24.	☐	☐	Some kids like the kind of person they are	**BUT**	Other kids often wish they were someone else	☐	☐

	Really True for me	Sort of True for me				Sort of True for me	Really True for me
25.	☐	☐	Some kids do very well at their classwork	**BUT**	Other kids don't do very well at their classwork	☐	☐
26.	☐	☐	Some kids wish they knew how to make more friends	**BUT**	Other kids know how to make as many friends as they want	☐	☐
27.	☐	☐	In games and sports some kids usually watch instead of play	**BUT**	Other kids usually play rather than just watch	☐	☐
28.	☐	☐	Some kids wish something about their face or hair looked different	**BUT**	Other kids like their face and hair the way they are	☐	☐
29.	☐	☐	Some kids do things they know they shouldn't do	**BUT**	Other kids hardly ever do things they know they shouldn't do	☐	☐
30.	☐	☐	Some kids are very happy being the way they are	**BUT**	Other kids wish they were different	☐	☐
31.	☐	☐	Some kids have trouble figuring out the answers in school	**BUT**	Other kids almost always can figure out the answers	☐	☐
32.	☐	☐	Some kids know how to become popular	**BUT**	Other kids do not know how to become popular	☐	☐
33.	☐	☐	Some kids don't do well at new outdoor games	**BUT**	Other kids are good at new games right away	☐	☐
34.	☐	☐	Some kids think that they are good looking	**BUT**	Other kids think that they are not very good looking	☐	☐
35.	☐	☐	Some kids behave themselves very well	**BUT**	Other kids often find it hard to behave themselves	☐	☐
36.	☐	☐	Some kids are not very happy with the way they do a lot of things	**BUT**	Other kids think the way they do things is fine	☐	☐

Susan Harter, Ph.D., University of Denver, 2012

Appendix F : Godin Leisure-Time Exercise Questionnaire

Godin Leisure-Time Exercise Questionnaire

INSTRUCTIONS

In this excerpt from the Godin Leisure-Time Exercise Questionnaire, the individual is asked to complete a self-explanatory, brief four-item query of usual leisure-time exercise habits.

CALCULATIONS

For the first question, weekly frequencies of strenuous, moderate, and light activities are multiplied by nine, five, and three, respectively. Total weekly leisure activity is calculated in arbitrary units by summing the products of the separate components, as shown in the following formula:

Weekly leisure activity score = (9 × Strenuous) + (5 × Moderate) + (3 × Light)

The second question is used to calculate the frequency of weekly leisure-time activities pursued "long enough to work up a sweat" (see questionnaire).

EXAMPLE

Strenuous = 3 times/wk

Moderate = 6 times/wk

Light = 14 times/wk

Total leisure activity score = (9 × 3) + (5 × 6) + (3 × 14) = 27 + 30 + 42 = 99

Godin Leisure-Time Exercise Questionnaire

1. During a typical **7-Day period** (a week), how many times on the average do you do the following kinds of exercise for **more than 15 minutes** during your free time (write on each line the appropriate number).

	Times Per Week
a) STRENUOUS EXERCISE (**HEART BEATS RAPIDLY**) (e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)	_____
b) MODERATE EXERCISE (**NOT EXHAUSTING**) (e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)	_____
c) MILD EXERCISE (**MINIMAL EFFORT**) (e.g., yoga, archery, fishing from river bank, bowling, horseshoes, golf, snow-mobiling, easy walking)	_____

2. During a typical **7-Day period** (a week), in your leisure time, how often do you engage in any regular activity **long enough to work up a sweat** (heart beats rapidly)?

OFTEN	SOMETIMES	NEVER/RARELY
1.	2.	3.

Appendix G : Diet Quality, Quantity, and Patterns Tool

Page 1. Food Frequency **Name / ID.** _____

I. Typical Intakes using Canada's Food Guide (CFG) servings (ask with non-judgmental perspective and tone)

	Weekly (notes)	Daily (notes)	
How often did you eat:	N <1 1-3 4-6	1 2-3 ≥4	**CFG Servings**

CFG Foods and Groups (specify servings)

vegetables (carrots, celery, tomatoes, greens) _____ (½ c cooked/raw, 100% juice; 1 c leafy greens)
fruit (bananas, oranges, apples, mango) _____ (½ c cooked/raw, 100% juice; small piece fruit)
grains (whole or refined? breads, rice, pasta) _____ (1 slice/roll; ½ cup rice/pasta; ¾ c cereal; ½ pita)
dairy (cheese, milk, yogurt; specify % MF) _____ (1 c milk /fortified soy; 50g cheese; ¾ c yogurt)
chicken / turkey (specify prep / fat) _____ (2.5 ounces / deck of cards; ½ c chopped)
pork, beef, other (specify prep / fat) _____ (2.5 ounces / deck of cards; ½ c chopped)
eggs, fish and seafood (specify prep) _____ (2 eggs; ½ c tuna / cooked fish; 6 med shrimp)
legumes (beans, peas and lentils) _____ (¾ c cooked beans; ¼ c hummus or tofu)
nuts & seeds (including nut / seed butters) _____ (¾ cup or 1 handful; 2 tbsp)

Low Nutrient, High Calorie items (specify servings)

sweets (candy, cookies, pie, other) _____
salty / savory snacks (chips, crackers) _____
sweetened sodas, pop, and other drinks _____
coffee/tea/ caffeinated sodas, other _____
_____

Where N= never; <1 = per week; 1-3 = per week; 4-6 = per week; 1 = per day; 2-3 = per day; ≥4 = per day (specify)

II. Eating Patterns:

Typical meal pattern (#meals / snacks; esp. eve snacks) _____

Eating out (per day / week) _____

Eat together (per day / week) _____

III. Compare w. CFG Children Teens (specify servings per group, based on age)

Age	2-3	4-8	9-13	14-18 girls	14-18 boys
Vegetables / fruit	4	5	6	7	8
Grain products	3	4	6	6	7
Milk and alternatives	2	2	3-4	3-4	3-4
Meat and alternatives	1	1	1-2	2	3

Score: _____

IV Score a. Compare typical eating pattern with CFG: _____

b. Diet Quality Scoring (per daily serving(s)): vegetables / fruit: +2; all others +1; subtract one point per serving of empty calorie foods (sweetened drinks, candy and savory/salty foods, etc.) -1.

V. Comments:

_____
_____
_____
_____
_____

Page 2. Diet History, Notes, and Next Steps

B

AM

L

PM

S

HS

Key areas of focus / teaching points:

In call monitoring, evaluation and impact

Follow-up monitoring, evaluation, next steps and other comments