University of Alberta

Leadership as Life Skills in Relation to Health Behaviours and Bodyweight in Grade 5 Students

by

Adam Roger Ferland

A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Master of Science
in
Epidemiology

Department of Public Health Sciences

Fall 2013
Edmonton, Alberta

Abstract

Childhood obesity has risen dramatically over recent decades in Canada, attributed largely to increasingly obesogenic environments. Our understanding of obesity now recognizes its complex ecological etiology, yet life skills – critical to how children engage with their surroundings – have been overlooked. The provincially representative 2012 REAL Kids Alberta survey of grade 5 students and their parents included novel questions assessing leadership skills of students according to the 7 habits model of *The Leader in Me*, which aligns well with life skills.

This thesis investigates the validity of these leadership questions, and the associations between leadership, as a model of life skills, and children's health behaviours – diet quality, physical activity, and sleep duration – and bodyweight status. Results indicate that leadership is strongly associated with diet quality and physical activity in children, and should be a priority for understanding and addressing the obesity epidemic and the health of children.

Acknowledgements

I would like to express my abundant gratitude to Dr. Paul Veugelers for the opportunity and considerable support to complete this thesis. Without his understanding and encouragement this would not have been possible.

I would additionally like to thank the additional members of my supervisory and examining committees, Drs. Kate Storey, Doug Gleddie, and Linda Carroll, whose recommendations and insight have served to clarify and improve this research.

My gratitude also goes to everyone at the Population Health Intervention Research Unit, who have been invaluable colleagues and friends throughout this process. Dr. Yen Li Chu and Kerry Vander Ploeg, in particular, have been a source of unending assistance.

And lastly, I would like to extend my thanks to all of the students, parents, and schools who participated in REAL Kids, and to Alberta Health for its support of the program, for helping to enable this research.

Table of Contents

1 Introduction 1

1.1 The Obesity Epidemic 1

1.2 Determinants of Excess Body Weight 2

1.3 Life Skills 3

1.4 The Leader in Me 4

1.5 Objectives 6

1.6 References 7

2 Validation of leadership questions for elementary school children 12

2.1 Introduction 12

2.2 Methods 12

2.2.1 Variables 13

2.2.2 Analytic Approach 16

2.3 Results 18

2.4 Discussion 19

2.5 Tables 20

2.6 Figures 22

2.7 References 25

3 Leadership skills are associated with health behaviours among Canadian children 27

3.1 Introduction 27

3.2 Methods 29

3.2.1 Measures of Interest 30

3.2.2 Data Analysis 32

3.3 Results 33

3.4 Discussion 34

3.5 Tables 36

3.6 References 39

4 Discussion 43

4.1 Overview 43

4.2 Major Findings 44

4.3 Implications 45

4.4 Strengths 46

4.5 Limitations 47

4.6 Conclusions 49

4.7 References 49

List of Tables

Table 2-1: Leadership item response distribution for parents and students, and weighted agreement between them 20

Table 2-2: Correlation and significance between leadership health behaviours and direct measures or self-efficacy scores 21

Table 3-1: Description of the 7 habits of the Leader in Me process 36

Table 3-2: Characteristics of Grade 5 students in REAL Kids Alberta 2012 survey 37

Table 3-3: Association of leadership skill scores with health behaviours and bodyweight status among grade 5 children in Alberta, Canada 38

List of Figures

Figure 2-1: Distribution of diet quality score according to self report of healthy snacking 22

Figure 2-2: Distribution of physical activity score according to self report of exercise 23

Figure 2-3: Distribution of weekday sleep duration according to parental report of sleep 24

Figure 2-4: Distribution of weekend sleep duration according to parental report of sleep 25

Abbreviations

BMI	Body Mass Index
DQI-I	Diet Quality Index International
FFQ	Food Frequency Questionnaire
PAQ-C	Physical Activity Questionnaire for Children
REAL Kids	Raising healthy Eating and Active Living Kids
WHO	World Health Organization

1 Introduction

1.1 The Obesity Epidemic

Obesity is a worldwide epidemic, with particularly high prevalence in the developed world.[1] Rates of overweight and obesity in Canada have be steadily increasing since the 1970s,[2] and has increasingly begun to emerge at earlier and earlier ages of development, with rates of overweight and obesity in children and youth increasing since the 1980s.[3] Though the prevalence in Alberta is above the national average for adults, it is below the national average in children 2-17 years.[4] The most recent national data collected from 2009 to 2011, the Canadian Health Measures Survey pegs 19.7% of children 5-11 as overweight and 13.1% as obese[5] using World Health Organization (WHO) cut-offs.

The epidemic of obesity in increasingly younger children poses a severe threat to our health and well-being. The adverse effects of morbidity due to overweight become more severe the longer excess weight is carried, and there are emerging trends of additional problems associated with life-long obesity, which tracks from childhood into adulthood.[6] Childhood obesity has been associated with greater risk of, enhanced complications from, and earlier onset of a diverse array of conditions including hypertension and cardiovascular disease,[7] respiratory conditions like obstructive sleep apnea and asthma,[8] type 2 diabetes mellitus,[9] liver disease,[10] disability interfering with daily living,[10]

psychosocial issues like low self-esteem,[11] reduced quality of life,[12] and musculoskeletal injuries and deformities.[13,14]

This represents a substantial impact on the lives of individuals and their families, as well as a significant and growing social and financial burden on public healthcare systems. The healthcare costs of overweight and obesity were estimated to be directly responsible for $6 billion, and indirectly for $5 billion, in Canada in 2006, and expected to grow.[15]

1.2 Determinants of Excess Body Weight

Excess body weight is due to an ongoing energy surplus.[16] Diet and physical activity[17] have commonly been recognized as the primary behavioural determinants of energy balance, but sedentary behaviour and sleep duration have increasingly also been implicated as important behavioural determinants.[18,19] These behaviours are themselves the product of a complex network of influences, and many of which are now seen as obesogenic environments, due to systemic changes in them having substantially altered the contexts in which these behaviours manifest and driving many of the behavioural changes driving the obesity epidemic.[20] Thus, there has been growing recognition of the importance of understanding and treating obesity using an ecological model to account for its heavily interconnected determinants and complex etiology.[21]

Across the spectrum, significant influences have included community characteristics including the built environments,[22] neighbourhood social condition,[23] and school food policies;[24] interpersonal factors like the family

environment and parental behaviors,[25] and peer relationships;[26] and personal characteristics including gender and age,[27] perinatal factors like birthweight and breastfeeding,[28] and psychosocial factors like self-efficacy.[29] While research and interventions are broadening to investigate potential determinants that have not previously received as much attention, many studies investigating proximal factors are still focused on the effect of health behaviours.

1.3 Life Skills

Psychosocial competencies have been a consistent theme, though within education itself, and as a target of behavioural change in health interventions. Self-efficacy,[30] attitudes,[31] and emotional awareness[32] have been targets of interventions to modify behaviours. Numerous psychological models have been formulated which bring together multiple psychosocial factors into a single construct of choice behaviour and behavioural change, such as Social and Emotional Learning,[33] Social Cognitive Theory,[34] and the Theory of Planned Behavior.[35,36]

Many of these models align quite closely to the WHO's model in the domain of health education of "life skills", which are defined as "abilities for adaptive and positive behaviour that enable individuals to deal effectively with the demands and challenges of everyday life,"[37] including communication, empathy, problem solving, and coping skills.[38] Life skills have been emphasized as an important aspect of health education,[37,39] and some elements of the life skills model have been effectively incorporated into health interventions. However,

most of these interventions are short term,[40] target adolescents,[41–43] and often focus on domain specific life skills, while children begin developing critical cognitive skills like independent reasoning and effective learning skills during middle childhood, prior to adolescence.[44] Even these limited approaches have shown greater effectiveness than knowledge and behaviour based interventions in preventing problematic behaviours like substance abuse[41–43,45] and other risky behaviours,[46,47] though there is evidence that these preventive effects may be due to general mediating pathways.[48]

It remains to be shown whether this general mediating pathway is also influential in determining positive health behaviours. The effect of life skills in mediating choices around diet and physical activity early in development will need to be established to be most effective in preventing childhood obesity,[49] but there are already indications that even at young ages children can be empowered to make healthy choices by a sense of responsibility over their own actions,[50] and developing a sense of personal control may help them maintain healthy behaviours as they transition into adolescence and adulthood.[51]

1.4 The Leader in Me

The Leader in Me is an organization framework for incorporating leadership skills, based on Steven R. Covey's book *The 7 Habits of Highly Effective People,* in schools.[52] The program began in 1999 when A.B. Combs Elementary sought to transform its educational model, and found that the fundamental skills identified as priorities in consultations with parents and community leaders

aligned well with Covey's 7 habits.[53] Since then, the program has been formalized and grown to include 1500 schools worldwide, including 109 in Alberta. The 7 habits are titled in the model as:[53]

- **Habit 1: Be proactive**
- **Habit 2: Begin with the end in mind**
- **Habit 3: Put first things first**
- **Habit 4: Think Win-win**
- **Habit 5: Seek first to understand, then to be understood**
- **Habit 6: Synergize**
- **Habit 7: Sharpen the saw**

The first three habits are categorized as independence skills. Habit 1 deals with taking personal responsibility to control what happens in life, and initiative to exercise that control. Habit 2 is concerned with having a sense of direction, and setting goals. It also emphasizes the importance of objectives being meaningful and beneficial. The last independence skill, habit 3, incorporates prioritization and planning to act effectively in working toward goals. It includes the organization skills to create plans, as well as self discipline to follow through on them.

The following three habits, 4-6, are categorized as interdependence skills, covering skills related to cooperation and socialization. Habit 4 deals with fairness, and empathy. It stresses the importance of recognizing the interests of others, and looking for creative solutions to conflict that benefit everyone. Habit 5 is centered on effective communication. It includes trying to understand the perspectives of others when listening, as well as confidence and clarity in

expressing personal perspectives. Habit 6 highlights the value of diversity, and the benefit of acceptance and integrating diversity.

Habit 7 stresses the importance of health and promotes a healthy diet, physical activity, and adequate sleep. It further endorses continued self-improvement and learning in varied contexts. The overall philosophy of the model has been to ensure that all students obtain the basic skills, competencies, and character traits needed for an equitable opportunity at success in life. Taken together, the leadership paradigm formed by these habits presents an effective and congruous model of life skills as articulated by the WHO,[37,39] designed to be understood by children and suitable for investigating the role of general life skills in health behaviours.

1.5 Objectives

This thesis research will first evaluate the validity of a self-reported leadership construct determined by the questions included in the REAL Kids Alberta 2012 as a tool to assess the life skills of pre-adolescent children. It will then examine whether leadership is associated with bodyweight status, diet quality, physical activity, and sleep duration, to determine the importance of leadership skills in addressing the obesity epidemic.

This research was granted ethical approval by the University of Alberta Research Ethics Board 2.

1.6 References

1. Visscher TL, Seidell JC. The public health impact of obesity. Annu Rev Public Health 2001;22(1):355.

2. Belanger-Ducharme F, Tremblay A. National Prevalence of Obesity: Prevalence of obesity in Canada. Obes Rev 2005;6(3):183–6.

3. Tremblay MS, Willms JD. Secular trends in the body mass index of Canadian children. Can Med Assoc J 2000;163(11):1429–33.

4. Shields M, Tjepkema M. Regional differences in obesity. Health Rep 2006;17(3):61–7.

5. Roberts KC, Shields M, de Groh M, Aziz A, Gilbert J-A. Overweight and obesity in children and adolescents: results from the 2009 to 2011 Canadian Health Measures Survey. Heal Reports Stat Can Can Cent Heal Inf Rapp Sur Santé Stat Can Cent Can Inf Sur Santé 2012;23(3):37–41.

6. Herman KM, Craig CL, Gauvin L, Katzmarzyk PT. Tracking of obesity and physical activity from childhood to adulthood: the Physical Activity Longitudinal Study. Int J Pediatr Obes IJPO Off J Int Assoc Study Obes 2009;4(4):281–8.

7. Behn A, Ur E. The obesity epidemic and its cardiovascular consequences. Curr Opin Cardiol 2006;21(4):353–60.

8. Sebastian JC. Respiratory physiology and pulmonary complications in obesity. Best Pract Res Clin Endocrinol Metab 2013;27(2):157–61.

9. Hannon TS, Rao G, Arslanian SA. Childhood Obesity and Type 2 Diabetes Mellitus. Pediatrics 2005;116(2):473–80.

10. Backholer K, Wong E, Freak-Poli R, Walls HL, Peeters A. Increasing body weight and risk of limitations in activities of daily living: a systematic review and meta-analysis. Obes Rev 2012;13(5):456–68.

11. Austin SB, Haines J, Veugelers PJ. Body satisfaction and body weight: gender differences and sociodemographic determinants. BMC Public Health 2009;9:313.

12. Wu XY, Ohinmaa A, Veugelers PJ. Diet quality, physical activity, body weight and health-related quality of life among grade 5 students in Canada. Public Health Nutr 2011;FirstView:1–7.

13. Daniels SR. Complications of obesity in children and adolescents. Int J Obes Apr2009 Supplement 1;33:S60–S65.

14. Fiona Regan, Peter Betts. A Brief Review of the Health Consequences of Childhood Obesity [Internet]. In: Childhood Obesity. CRC Press; 2005 [cited 2013 Jul 11]. page 25–38.Available from: http://dx.doi.org/10.1201/9781420038071.ch3

15. Anis AH, Zhang W, Bansback N, Guh DP, Amarsi Z, Birmingham CL. Obesity and overweight in Canada: an updated cost-of-illness study. Obes Rev 2010;11(1):31–40.

16. Kipping RR, Jago R, Lawlor DA. Obesity in children. Part 1: Epidemiology, measurement, risk factors, and screening. BMJ 2008;337(7675):922–7.

17. Tremblay MS, Whims JD. Is the Canadian childhood obesity epidemic related to physical inactivity? Int J Obes Relat Metab Disord 2003;27(9):1100.

18. Saunders T. Potential Contributors to the Canadian Pediatric Obesity Epidemic. ISRN Pediatr 2011;2011:1–10.

19. Must A, Parisi SM. Sedentary behavior and sleep: paradoxical effects in association with childhood obesity. Int J Obes Apr2009 Supplement 1;33:S82–S86.

20. Swinburn B, Egger G, Raza F. Dissecting Obesogenic Environments: The Development and Application of a Framework for Identifying and Prioritizing Environmental Interventions for Obesity. Prev Med 1999;29(6):563–70.

21. Plotnikoff RC, Lightfoot P, Spinola C, Predy G, Barrett L. A framework for addressing the global obesity epidemic locally: the Child Health Ecological Surveillance System (CHESS). Prev Chronic Dis 2008;5(3):A95.

22. Carson V, Kuhle S, Spence JC, Veugelers PJ. Parents' Perception of Neighbourhood Environment as a Determinant of Screen Time, Physical Activity and Active Transport. Can J Public Health 2010;101(2):124–7.

23. Ross NA, Tremblay S, Khan S, Crouse D, Tremblay M, Berthelot J-M. Body Mass Index in Urban Canada: Neighborhood and Metropolitan Area Effects. Am J Public Health 2007;97(3):500–8.

24. Jaime PC, Lock K. Do school based food and nutrition policies improve diet and reduce obesity? Prev Med 2009;48(1):45–53.

25. Patrick H, Nicklas TA. A Review of Family and Social Determinants of Children's Eating Patterns and Diet Quality. J Am Coll Nutr 2005;24(2):83–92.

26. Lally P, Bartle N, Wardle J. Social norms and diet in adolescents. Appetite 2011;57(3):623–7.

27. Rasmussen M, Krølner R, Klepp K-I, Lytle L, Brug J, Bere E, et al. Determinants of fruit and vegetable consumption among children and adolescents: a review of the literature. Part I: quantitative studies. Int J Behav Nutr Phys Act 2006;3:22–19.

28. Shi Y, De Groh M, Morrison H. Perinatal and early childhood factors for overweight and obesity in young canadian children. Can J Public Heal Rev Can Santé Publique 2013;104(1):e69–74.

29. Spence JC, Blanchard CM, Clark M, Plotnikoff RC, Storey KE, McCargar L. The Role of Self-Efficacy in Explaining Gender Differences in Physical Activity Among Adolescents: A Multilevel Analysis. J Phys Act Health 2010;7(2):176–83.

30. Byrne S, Barry D, Petry NM. Predictors of weight loss success. Exercise vs. dietary self-efficacy and treatment attendance. Appetite 2012;58(2):695–8.

31. Cardon G, Philippaerts R, Lefevre J, Matton L, Wijndaele K, Balduck A-L, et al. Physical activity levels in 10- to 11-year-olds: clustering of psychosocial correlates. Public Health Nutr 2005;8(07):896–903.

32. McLachlan DA, Burgos T, Honeycutt HK, Linam EH, Moneymaker LD, Rathke MK. Emotion locomotion: promoting the emotional health of elementary school children by recognizing emotions. J Sch Nurs Off Publ Natl Assoc Sch Nurses 2009;25(5):373–81.

33. Durlak JA, Weissberg RP, Dymnicki AB, Taylor RD, Schellinger KB. The Impact of Enhancing Students' Social and Emotional Learning: A Meta-Analysis of School-Based Universal Interventions. Child Dev 2011;82(1):405–32.

34. Bandura A. Health promotion from the perspective of social cognitive theory. Psychol Heal 1998;13(4):623–49.

35. Contento IR, Koch PA, Lee H, Sauberli W, Calabrese-Barton A. Enhancing personal agency and competence in eating and moving: formative evaluation of a middle school curriculum--Choice, Control, and Change. J Nutr Educ Behav 2007;39(5 Suppl):S179–186.

36. Hewitt AM, Stephens C. Healthy eating among 10 - 13-year-old New Zealand children: understanding choice using the Theory of Planned Behaviour and the role of parental influence. Psychol Health Med 2007;12(5):526–35.

37. WHO. Skills for Health: Skills-based Health Education Including Life Skills: An Important Component of a Child-friendly/Healthpromoting School. [Internet]. World Health Organization; 2003 [cited 2012 Oct 16]. Available from: http://www.who.int/school_youth_health/media/en/sch_skills4health_03.pdf

38. World Health Organization Division of Mental Health. Life skills education for children and adolescents in schools. Pt. 1, Introduction to life skills for psychosocial competence. Pt. 2, Guidelines to facilitate the development and implementation of life skills programmes [Internet]. 1994 [cited 2013 Jun 27];Available from: http://apps.who.int/iris/handle/10665/63552

39. WHO. The Ottawa Charter for Health Promotion [Internet]. Ottawa: World Health Organization; 1986 [cited 2012 Oct 16]. Available from: http://www.who.int/healthpromotion/conferences/previous/ottawa/en/index.html

40. Forneris T, Fries E, Meyer A, Buzzard M, Uguy S, Ramakrishnan R, et al. Results of a Rural School-Based Peer-Led Intervention for Youth: Goals for Health. J Sch Health 2010;80(2):57–65.

41. Huang C-M, Chien L-Y, Cheng C-F, Guo J-L. Integrating Life Skills Into a Theory-Based Drug-Use Prevention Program: Effectiveness Among Junior High Students in Taiwan. J Sch Health 2012;82(7):328–35.

42. Eisen M, Zellman GL, Murray DM. Evaluating the Lions–Quest 'Skills for Adolescence' drug education program: Second-year behavior outcomes. Addict Behav 2003;28(5):883–97.

43. Tobler NS, Roona MR, Ochshorn P, Marshall DG, Streke AV, Stackpole KM. School-Based Adolescent Drug Prevention Programs: 1998 Meta-Analysis. J Prim Prev 2000;20(4):275–336.

44. Eccles JS. The Development of Children Ages 6 to 14. Future Child 1999;9(2):30–44.

45. Flay BR. School-based smoking prevention programs with the promise of long-term effects. Tob Induc Dis 2009;5(1):6.

46. Yankah E, Aggleton P. Effects and Effectiveness of Life Skills Education for HIV Prevention in Young People. AIDS Educ Prev 2008;20(6):465–85.

47. Maruska K, Morgenstern M, Isensee B, Hanewinkel R. Influencing antecedents of adolescent risk-taking behaviour in elementary school: results of a 4-year quasi-experimental controlled trial. Health Educ Res 2010;25(6):1021–30.

48. Bühler A, Schröder E, Silbereisen RK. The role of life skills promotion in substance abuse prevention: a mediation analysis. Health Educ Res 23(4):621–32.

49. Wardle J, Brodersen NH, Cole TJ, Jarvis MJ, Boniface DR. Development Of Adiposity In Adolescence: Five Year Longitudinal Study Of An Ethnically And Socioeconomically Diverse Sample Of Young People In Britain. BMJ 2006;332(7550):1130–2.

50. Cox M, Schofield G, Kolt GS. Responsibility for children's physical activity: parental, child, and teacher perspectives. J Sci Med Sport Sports Med Aust 2010;13(1):46–52.

51. Ziff MA, Conrad P, Lachman ME. The Relative Effects of Perceived Personal Control and Responsibility on Health and Health-Related Behaviors in Young and Middle-Aged Adults. Health Educ Behav 1995;22(1):127–42.

52. Fonzi J, Ritchie K. The Leader in Me - Research Literature Review [Internet]. 2011 [cited 2012 Sep 5];Available from: http://www.theleaderinme.org/uploads/Documents/results/RochesterLitRev.pdf

53. Covey SR. The leader in me: how schools and parents around the world are inspiring greatness, one child at a time. 1st Free Press trade pbk. ed. New York: Free Press; 2009.

2 Validation of leadership questions for elementary school children

2.1 Introduction

General psychosocial competencies and interpersonal skills, termed life skills, have been frequently identified as central to youth development.[1] Life skills have been identified as critical for the ability of children to effectively engage and cope with their environment in a healthy manner,[2] and recognized as central to health promotion.[3] Yet despite the longstanding recognition of the importance of life skills to health promotion and that improving health interventions requires comprehensive research to evaluate and inform their development,[4] there are no common tools with which to evaluate life skills.[5,6] Where evaluations of life skills have been included in research literature, only a narrow scope of skills are often assessed[7] using ad-hoc tools geared to a specific intervention.[8] We aim to investigate the validity of a set of questions developed in response to the Leader in Me, as a construct to measure leadership and general life skills in grade 5 students.

2.2 Methods

Data Source

REAL Kids Alberta (Raising healthy Eating and Active Living Kids in Alberta) is an ongoing research project begun in 2008 and designed to evaluate

the effect of the Healthy Weights Initiative in Alberta. Annual surveys of grade 5 students and their parents in Alberta are conducted, which include a broad range of topics related to health. All data for this study were collected as part of the 2012 survey administration. 141 schools comprising a stratified random sample of all public and Catholic elementary schools were invited to participate. 4,957 home surveys were distributed, with 2,732 (55%) returned and 2,483 (50%) granting parental consent for student participation. 2,314 (46.7%) grade 5 students were present and consented to participate during data collection, comprising the sample for this study. Student surveys were administered during school visits by trained assistants. Survey materials and addition information is available online at www.realkidsalberta.ca.

2.2.1 Variables

Leadership Questions

Questions were designed for the REAL Kids Alberta survey to reflect the 7 Habits model of leadership from *The Leader in Me*. The developed items were reviewed by experts and tested on a small sample of age-appropriate subjects prior to inclusion in the survey.

Students were prompted to choose the answer that best reflects themselves for the following behaviour items:

a) You do the right thing without being asked.

b) You set goals and plan ahead.

c) You do your homework before play.

d) You try to find solutions when others don't agree with you.

e) You listen when others are talking to you.

f) You work well in groups.

g) You take care of your health by choosing healthy snacks.

h) You take care of your health by exercising.

i) You take care of your health by getting enough sleep.

Each response was on the following scale: never or rarely, sometimes, regularly, most of the time, always or almost always, unsure. An analogous set of items following the same response scale was asked of the parent in the home survey to describe their grade 5 child. Each of the first 6 items (a-f) had a single matching item in the home survey, while the final 3 items in the student survey (g-i) were combined into a single item in the parent survey. In the home survey, parents were prompted to choose which answer, using the same response scale as the questions in the student survey, best describes how often their grade 5 child:

j) Does the right thing without being asked.

k) Sets goals and plans ahead.

l) Does her/his homework before play.

m) Tries to find alternative solutions when in conflict with others

n) Listens when others are talking to her/him.

o) Works well in groups

p) Takes care of her/his physical health by choosing healthy snacks, exercising, and getting enough sleep.

Outcome Items

The correlation with direct measures of the health behaviours in the final 3 items of the student survey (diet quality, physical activity, and sleep), and 5 items relating to self efficacy (4 for physical activity and 1 for sleep) is used to gauge the construct and criterion validity of select leadership items.

Diet quality is measured on the Diet Quality Index-International (DQI-I) from student responses from the Harvard Youth-Adolescent Food Frequency Questionnaire. The DQI-I is an extensively validated and widely used measure of comprehensive diet quality, with higher scores on the range of 0 to 100 indicating better diet quality. Physical activity is assessed with the Physical Activity Questionnaire for Children (PAQ-C), which assesses the frequency and duration of moderate to vigorous physical activity over the preceding week. Also an extensively validated and widely used comprehensive measurement tool, higher PAQ-C scores on the range of 0 to 5 indicate greater physical activity. Sleep duration was calculated based on parent responses in the home survey of when their child usually gets into bed and wakes up on weekdays and weekends, and how long it takes their child to fall asleep.

Self efficacy was assessed according to the student's confidence to perform certain activities outside of school hours, which included (a) be physically active no matter how tired they may be, (b) be physically active even if they have a lot of homework, (c) ask their parent or another adult to play a physical activity or sport with them, (d) be physically active most days of the week, and (e) go to

bed on time. Responses were indicated on the scale not at all confident, a little bit confident, quite confident, or very confident.

2.2.2 Analytic Approach

Responses of 'unsure' to all leadership items were excluded from statistical analyses in order to preserve the ordinal natural of the response scale. All analyses were performed using the psych package, version 1.3.2 (2013-2-26), in R, version 3.0.0 (2013-04-03).

Reliability

Reliability of the questions was assessed based on the agreement between student and parent responses on analogous leadership questions. The degree of agreement was scored using weighted kappa coefficients (κ),[9] which accounts for degrees of partial agreement based on the magnitude of difference between responses. Standard quadratic weighting was used to account for partial agreement. Each of the final 3 student leadership items were individually compared to the single final item in the home survey.

Composite Score

Overall summary measures of leadership according to student and parent responses are investigated. The number of components needed to extract to adequately represent the response data was assessed first using Horn's parallel analysis:[10] The number of observed eigenvalues for the decomposition matrix of responses that were above the 95th percentile of eigenvalues from simulated

random data determined the number of components to extract. Cronbach's alpha coefficients were then calculated to assess the internal consistency and unidimensionality of item sets.[11] Composite scores were then constructed though principal component analysis. The Pearson's product-moment correlation coefficient (r) and the ANOVA F-test are used to assess the agreement between composite leadership scores for students and parents

Construct Validity

Correlation between individual leadership items and corresponding direct measures of behaviour are assessed using polyserial correlation coefficients (r) to correct for the use of an ordinal variable to represent an underlying continuous latent variable, and ANOVA F-tests to assess significance. Data is illustrated in side-by-side boxplots according to student response, including the unsure category.

Criterion Validity

Polychoric correlation coefficients (r), to account for both variables being an ordinal construct representing a continuous latent variable, and Pearson's chi-squared tests are used to assess the correlation between responses to leadership items and self-efficacy items and its significance.

2.3 Results

Reliability

Distribution of student and parent responses to the leadership questions, as well as weighted kappa coefficients to assess agreement, are presented in Table 2-1. All κ values range between 0.22 and 0.38, which falls into the range described as Fair (0.21-0.40).[12] Some rightward skew is evident in the student distributions for the listening when others speak (question e), working well in groups (f), and exercising (h) leadership items, and in the parent distribution for the working well in groups (f) leadership item.

Composite Score

Horn's parallel analysis suggested a single component was sufficient to summarize the parent and student leadership scores, and both sets had an alpha coefficient of 0.84, which indicates good evidence of internal consistence.[13] The correlation coefficient between the two composite leadership scores of 0.38 indicates good agreement ($p < 0.01$).

Construct Validity

Construct validity is strongly supported for the exercise leadership item (h), by the correlation coefficient of 0.52. The relationship was only moderate for the choosing healthy snacks leadership item (g) and diet quality, and the getting enough sleep leadership item (i) and average sleep duration on weekdays. While correlation was weak for the getting enough sleep leadership item (i) and average sleep duration on weekends, it was statistically significant at $p = 0.01$.

All other relationships were highly significant with p-values < 0.01 (Table 2-2). The distributions of all direct measures demonstrate a steady, increasing relationship according to survey response (Figures 2-1, 2-2, 2-3, 2-4), though the overall spread of scores within each response category is broad.

Criterion Validity

The correlations with self-efficacy scores, however, are uniformly strong. The weakest correlation was between the exercise leadership item (h) and self-efficacy for asking a parent to engage in physical activity (self-efficacy sub-question c) at 0.37, and the strongest was between the exercise leadership item (h) and self-efficacy for being physically active no matter how tired (a) at 0.5. All relationships were highly significant, with $p < 0.01$ (Table 2-2).

2.4 Discussion

The investigation demonstrates some evidence in support of the validity of the leadership questions. Student responses were supported by parental assessments, and the correlation of items with related direct measures and self-efficacy items was generally, though not universally, strong. The presence of a single latent general life-skills factor, and consequently the use of a single summary measure of leadership/life skills, was clearly demonstrated.

The case for validity of the construct would be improved by addressing the non-normal distribution in a few items. Objective and associated measures to assess the construct and criterion validity of the first 6 leadership items would also be beneficial. Whether the tool is equally effective and unbiased with regard

to common covariates like gender and socioeconomic status would be useful to investigate.

2.5 Tables

Table 2-1: Leadership item response distribution for parents and students, and weighted agreement between them

	Response Distribution (N = 2293)						
	Never or rarely	Sometimes	Regularly	Most of the time	Always or almost always	Unsure/no response	κ*
Do the right thing without being asked							
Parent	1.1%	18.7%	17.0%	36.5%	26.0%	0.7%	
Student	3.3%	22.8%	24.2%	27.0%	20.1%	2.7%	0.23
Set goals and plan ahead							
Parent	9.0%	38.1%	19.3%	21.1%	11.3%	1.3%	
Student	12.6%	27.5%	19.3%	21.6%	16.0%	3.1%	0.27
Do homework before play							
Parent	7.5%	29.0%	17.9%	22.1%	22.2%	1.3%	
Student	10.6%	22.0%	16.2%	16.4%	33.2%	1.7%	0.38
Try to find solutions when others don't agree							
Parent	6.0%	29.0%	20.8%	25.3%	16.1%	2.8%	
Student	7.5%	22.2%	20.4%	24.8%	22.0%	3.1%	0.22
Listen when others are talking							
Parent	1.1%	14.6%	21.1%	34.3%	28.1%	0.8%	
Student	1.0%	8.7%	13.5%	24.5%	49.4%	2.9%	0.23
Work well in groups							
Parent	0.5%	8.9%	14.5%	30.9%	43.3%	1.8%	
Student	2.2%	10.2%	15.0%	28.0%	41.1%	3.5%	0.30
Take care of health by (1) choosing healthy snacks, (2) exercising, and (3) getting enough sleep							
Parent	2.9%	21.4%	22.0%	32.4%	20.5%	0.8%	
Student(1)	2.6%	17.5%	21.1%	28.0%	28.4%	2.4%	0.27
Student(2)	2.4%	12.9%	17.1%	22.8%	41.2%	3.6%	0.25
Student(3)	4.1%	16.1%	20.0%	28.3%	27.3%	4.1%	0.22

* kappa coefficient calculated with quadratic weightings, excluding the unsure/no response category

Table 2-2: Correlation and significance between leadership health behaviours and direct measures or self-efficacy scores

Leadership Item take care of health by:	**Direct Measure**	**r***	**p***
choosing healthy snacks	DQI-I	0.15	<0.01
exercising	PAQ-C	0.52	<0.01
getting enough sleep	Weekday sleep duration	0.19	<0.01
	Weekend sleep duration	0.08	0.01
Leadership Item take care of health by:	**Self-Efficacy Item** student's confidence to:	**r'**	**p'**
exercising	be physically active when tired	0.50	<0.01
	be physically active with a lot of homework	0.38	<0.01
	ask an adult to play/be physically active	0.37	<0.01
	be physically active most days of the week	0.41	<0.01
getting enough sleep	go to bed on time	0.49	<0.01

DQI: Diet Quality Index – International; PAQ-C: Physical Activity Questionnaire for Children
Correlation coefficients and significance tests exclude unsure/no response category

* polyserial inferred Pearson correlation (r) and ANOVA F-test (p)

' polychoric inferred Pearson correlation (r) and Pearson Chi-squared test (p)

2.6 Figures

Figure 2-1: Distribution of diet quality score according to self report of healthy snacking

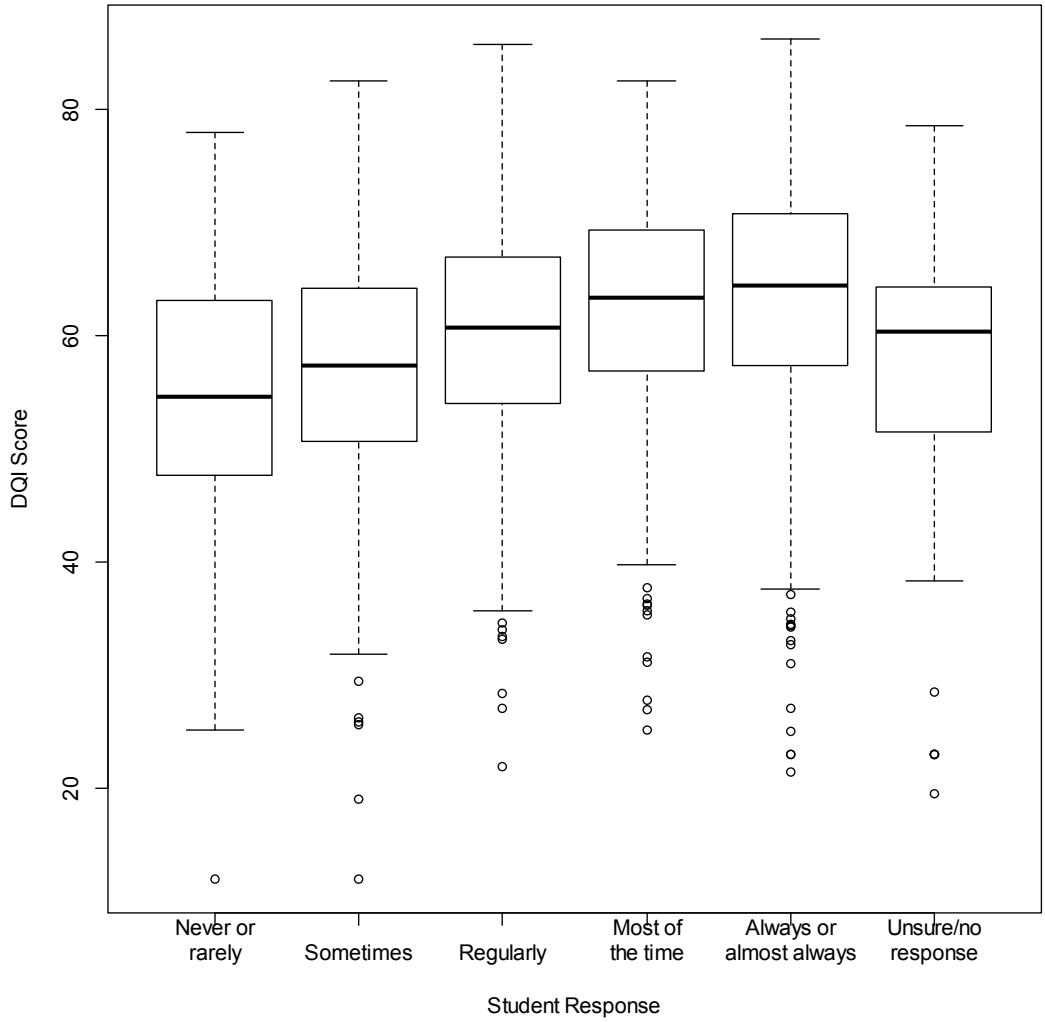


Figure 2-2: Distribution of physical activity score according to self report of exercise

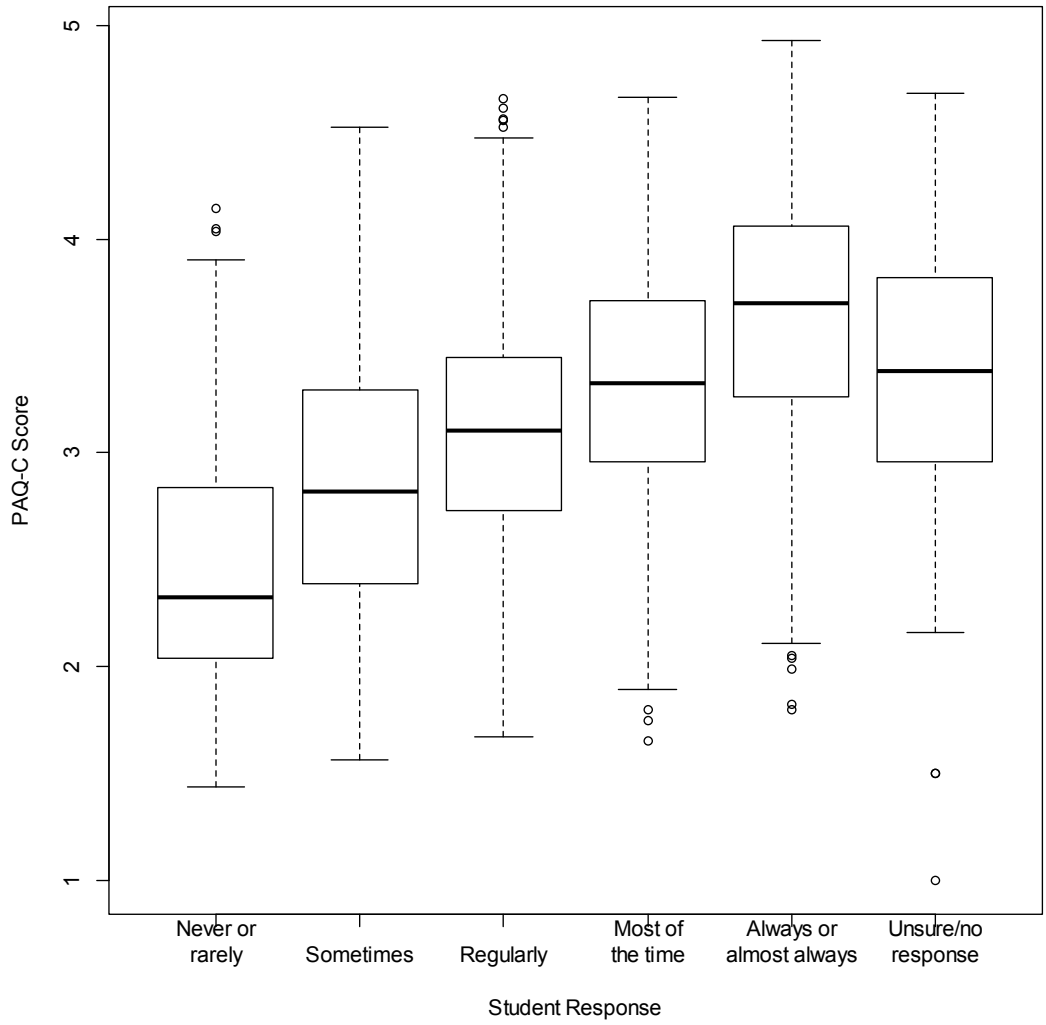


Figure 2-3: Distribution of weekday sleep duration according to parental report of sleep

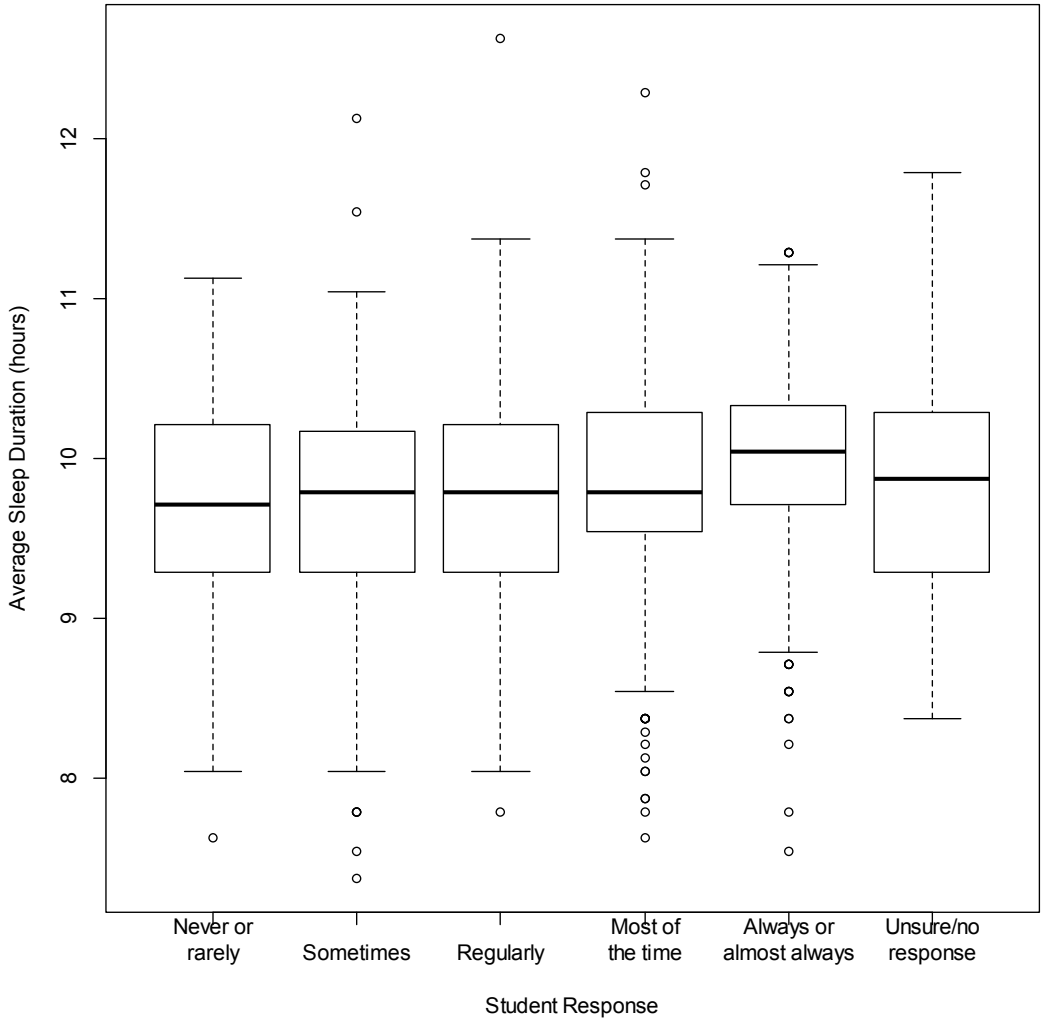
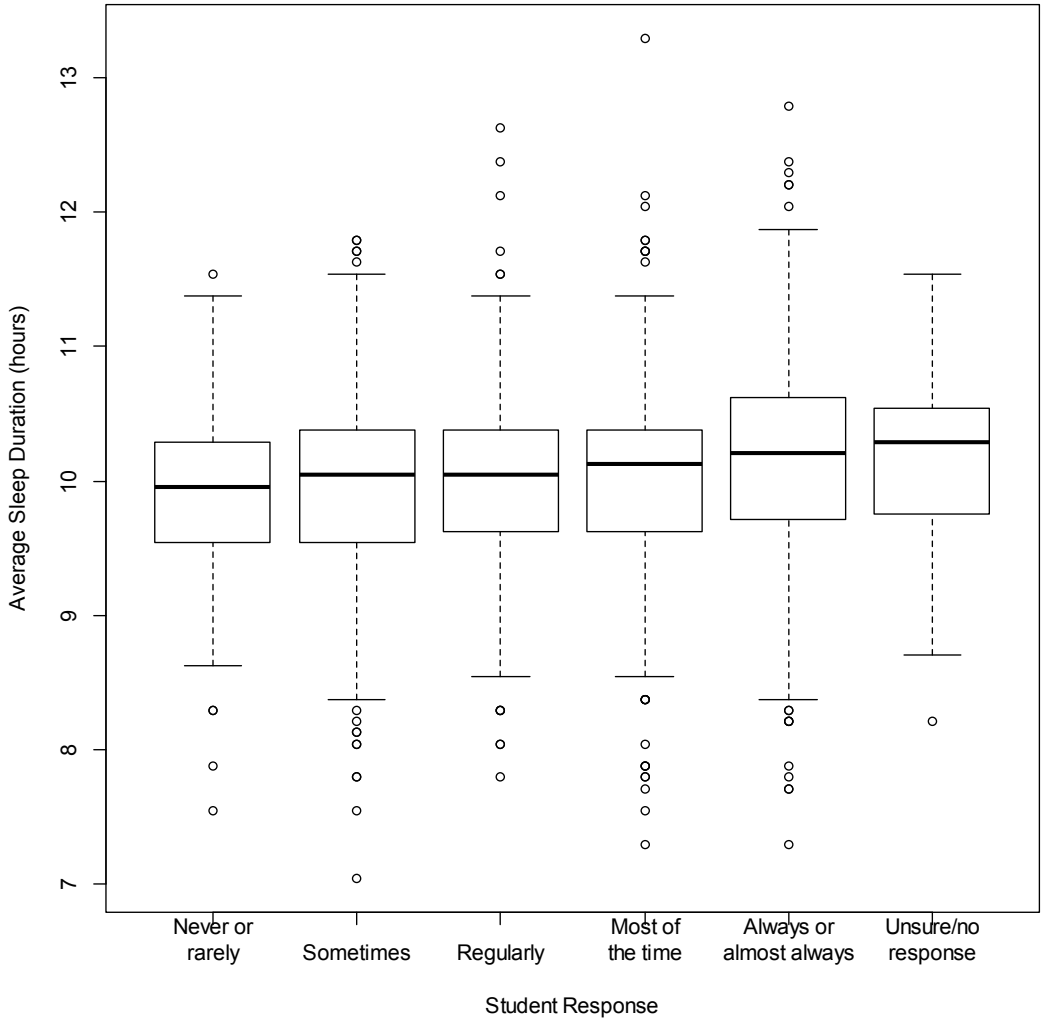


Figure 2-4: Distribution of weekend sleep duration according to parental report of sleep



2.7 References

1. WHO. Skills for Health: Skills-based Health Education Including Life Skills: An Important Component of a Child-friendly/Healthpromoting School. [Internet]. World Health Organization; 2003 [cited 2012 Oct 16]. Available from: http://www.who.int/school_youth_health/media/en/sch_skills4health_03.pdf

2. Breton JJ. Complementary development of prevention and mental health promotion programs for Canadian children based on contemporary scientific paradigms. Can J Psychiatry 1999;44(3):227–34.

3. WHO. The Ottawa Charter for Health Promotion [Internet]. Ottawa: World Health Organization; 1986 [cited 2012 Oct 16]. Available from: http://www.who.int/healthpromotion/conferences/previous/ottawa/en/index.html

4. Glasgow RE, Vogt TM, Boles SM. Evaluating the public health impact of health promotion interventions: the RE-AIM framework. Am J Public Health 1999;89(9):1322–7.

5. Andrews AB, Ben-Arieh A. Measuring and monitoring children's well-being across the world. Soc Work 1999;44(2):105–15.

6. Maruska K, Morgenstern M, Isensee B, Hanewinkel R. Influencing antecedents of adolescent risk-taking behaviour in elementary school: results of a 4-year quasi-experimental controlled trial. Health Educ Res 2010;25(6):1021–30.

7. Sharma S. Measuring life skills of adolescents in a secondary school of Kathmandu: an experience. Kathmandu Univ Med J (KUMJ) 2003;1(3):170–6.

8. MacKillop J, Ryabchenko KA, Lisman SA. Life Skills Training Outcomes and Potential Mechanisms in a Community Implementation: A Preliminary Investigation. Substance Use & Misuse 2006;41(14):1921–35.

9. Cohen J. Weighted kappa: Nominal scale agreement provision for scaled disagreement or partial credit. Psychological Bulletin October 1968 1968;70(4):213–20.

10. Horn JL. A rationale and test for the number of factors in factor analysis. Psychometrika 1965;30(2):179–85.

11. Cronbach LJ. Coefficient alpha and the internal structure of tests. Psychometrika 1951;16(3):297–334.

12. Landis JR, Koch GG. The Measurement of Observer Agreement for Categorical Data. Biometrics 1977;33(1):159–74.

13. Bland JM, Altman DG. Cronbach's alpha. BMJ 1997;314(7080):572.

3 Leadership skills are associated with health behaviours among Canadian children[1]

3.1 Introduction

Obesity is a significant public health concern, with many known associations to problematic co-morbidities.[1] Despite significant attention to the growing obesity epidemic, the prevalence of obesity continues to rise among adults and increasingly in children.[2] Data indicated that 14.7% of Canadian children aged 5-11 are overweight and 7.9% are obese,[3] with corresponding deterioration in comparable measures of fitness and health.[4] Excess weight is directly caused by an imbalance between energy intake and expenditure.[5] The primary behavioural determinants of energy balance have been recognized as diet and physical activity,[5,6] and recently, duration of sleep has been increasingly implicated as an important factor determining bodyweight.[7,8] Social and environmental factors are commonly recognized as important aspects influencing health behaviours in children,[9–11] and interventions targeting these factors have shown promising results.[11,12]

However, while interventions focusing on social and environmental characteristics have been proven effective,[12,13] the effects of personal choices remain a significant determining factor of risk for obesity that cannot be ignored. An understanding of the individual characteristics that inform these choices,

[1] A version of this chapter has been submitted for publication. Ferland AF, Chu YL, Veugelers PJ *Health Promotion International*.

such as having the life skills to make these choices, are essential to further inform obesity prevention efforts. Life skills, defined by the World Health Organization (WHO) as "abilities for adaptive and positive behaviour that enable individuals to deal effectively with the demands and challenges of everyday life",[14] was identified as a component of a core area for action in The Ottawa Charter for Health Promotion,[15] and has since been reaffirmed as a priority for school health promotion by the WHO.[14,16] Consequently, life skill development has been included as a core component in the comprehensive school health framework.[17,18]

Despite this growing recognition of its value for obesity prevention interventions, personal characteristics and life skills still receive little attention. Interventions which recognize and target life skills have shown effectiveness in improving negative health behaviours related to substance abuse[19,20] and sexuality,[21] whereas efforts to address individual choices focusing primarily on education have been ineffective. Building leadership skills competency may also prove to be efficacious in improving health behaviours such as diet and physical activity. Therefore, this study aims to determine whether fundamental leadership skills are associated with the determinants of bodyweight (diet quality, physical activity, and sleep duration), and bodyweight status among grade 5 children in Alberta.

3.2 Methods

Study Population

The analysis was conducted using data collected as part of the 2012 iteration of the Raising healthy Eating and Active Living Kids in Alberta (REAL Kids Alberta) project, a survey administered to evaluate health and behavioural outcomes among a provincially representative population of grade 5 students in Alberta, Canada. Schools were selected using a one-stage stratified random sampling design with stratification according to residential geography (metropolitan, city, or rural-town) to ensure proportional regional representation. All elementary schools with grade 5 students in Alberta, with the exception of francophone, charter, private, and on-reserve federal schools were included in the sampling frame, and then randomly selected within each stratum. A total of 143 schools agreed to participate. Of the 4,957 home surveys and parent consent forms sent home, 2,732 (55%) were returned and parental consent was obtained for 2,483 (50%) students to participate. Trained evaluation assistants visited each school to administer student surveys and to obtain height and weight measurements. After excluding students who were absent during data collection and who declined participation, a total of 2,314 (46.7%) completed surveys were collected. The University of Alberta Human Research Ethics Board approved all study procedures.

3.2.1 Measures of Interest

Leadership Skills

The 2012 REAL Kids Alberta student survey included a series of 9 questions that may provide a framework for measuring leadership skills in children. These questions were developed based on the 7 habits of *The Leader in Me* process.[22] *The Leader in Me* is an implementation process of an educational model based on Steven R. Covey's *The Seven Habits of Highly Effective People*, which promotes the development of personal leadership and responsibility in students.[22,23] The 7 habits of the model, as summarized in Table 3-1, demonstrate substantial congruence with models of life skills including Social and Emotional Learning.[16] Given the scarcity of reliable instruments for assessing life skills,[24,25] an instrument based on these leadership traits may be an effective model for evaluating life skills. Students were asked to indicate the frequency of performing representative behaviours for each habit, on an ordinal scale of ‘never or rarely’, ‘sometimes’, ‘regularly’, ‘most of the time’, and ‘always or almost always’, with an additional 'unsure' response. Response scores for the 6 questions corresponding to habits 1-6 of *The Leader in Me* were aggregated by principal component analysis, and accordingly categorized into tertiles by aggregate leadership score. The 3 questions corresponding to habit 7 were excluded from this analysis due to co-linearity of responses to health outcome measures. Students selecting unsure or missing a response to any of the 6 leadership questions were separately categorized as unsure/missing. All survey instruments are available on the survey website.[26]

Determinants of Bodyweight

Diet quality was measured using the Diet Quality Index – International (DQI-I),[27] calculated based on student responses on the Harvard Youth-Adolescent Food Frequency Questionnaire (FFQ).[28,29] The DQI-I is a composite score (range 0 – 100) measuring diet variety, adequacy, moderation, and overall balance.[27] Total energy intake was also calculated based on FFQ responses and from information on the Canadian Nutrient Files.[30] Students with calculated energy intake below 500kcal/day or above 5,000kcal/day were excluded from dietary analyses due to unreliability of the responses.[31]

Physical activity was assessed using the Physical Activity Questionnaire for Children (PAQ-C), a validated instrument to measure frequency and duration of moderate to vigorous physical activity.[32,33] The PAQ-C is a composite score with a range of 0 to 5, with higher scores indicating greater physical activity.

Sleep duration was calculated based on parent responses in the home survey. Parents indicated in the home survey when their child usually (i) gets into bed and (ii) wakes up on, on weekdays and weekend-days, as well as how long it takes their child to fall asleep at night. Sleep duration was calculated based on the mid-point of response ranges for when the child gets into bed and wakes up, subtracting the time it takes the child to fall sleep.

Student height without shoes was measured to the nearest 0.1cm, and weight to the nearest 0.1kg using calibrated digital scales, by trained assistants during the school visits to administer student surveys. Weight status was classified as 'normal', 'overweight', or 'obese' by applying the International Obesity Task

Force's cut-offs for children to the body mass index (BMI) calculated from the direct height and weight measurements.[34]

Other covariates

Household income and parental education were each assessed by a single question in the home survey. Household income is categorized as '≤$50,000', '$50,001 - $75,000', '$75,001 - $100,000', '>$100,000', or 'not reported'; parental education is categorized as 'secondary or less', 'college', or 'university/graduate'.

Geographic residency was determined based on school location, classified as 'metropolitan' for the cities of Edmonton and Calgary, 'urban' for other municipalities with a population greater than 40,000, and rural for localities with fewer than 40,000 residents.

3.2.2 Data Analysis

Association with health outcomes was assessed using multilevel regression models, with students clustered by school and weighted to account for the design effect of the stratified randomization. Adjusted models included all covariates: gender, household income, parental education, and geographic residency, plus energy intake for the diet quality model. Diet quality, physical activity, and sleep duration were modelled as continuous outcomes using linear regressions, while overweight and obesity were separately modelled as binary outcomes relative to normal bodyweight status using logistic regressions. All analyses were performed using the survey package version 3.29-4 in R version 3.0.0.

3.3 Results

Between covariates, leadership score varied significantly according to gender and parental education, but not household income or geographic residency (Table 3-2). Boys showed significantly lower leadership scores than girls, and higher parental education levels were associated with higher student leadership scores.

Leadership correlated strongly with both diet quality and physical activity, but not sleep duration or bodyweight status, in both crude and adjusted models (Table 3-3). DQI-I scores were 2.08 points higher on average in the middle leadership tertile than in the low tertile, and 3.70 points higher on average in the top leadership tertile, after adjusting for covariates. Similarly, the mean PAQ-C score in the mid and high leadership groups were 0.22 and 0.51 higher than in the low leadership group, respectively, after adjusting for covariates. Leadership showed no association with sleep duration, with mean duration varying by less than 5 minutes between groups. The correlation with bodyweight status was suggestive, though not statistically significant, with the mid and high leadership groups having 0.91 and 0.93 times the odds of overweight compared with the low leadership group, and students in the mid leadership group having only two-thirds the odds of being obese than those in the low leadership group.

The relationship between leadership and each of the outcomes remained consistent between crude and adjusted models. Adjustment for covariates induced minimal changes in the odds-ratios for bodyweight status, and moderate

reductions in the ß coefficients for diet quality, while the adjustment slightly increased the ß coefficients for physical activity.

3.4 Discussion

The present study demonstrates that greater leadership is strongly associated with improved diet quality and physical activity in grade 5 students. These associations were observed independent of personal and family characteristics, despite the fact that children often have limited autonomy to make defining choices in this aspect of their lives.[35,36] These findings suggest an important role for self-leadership skills in helping children make healthier lifestyle choices. The relationship between leadership and bodyweight status, though potentially suggestive of higher leadership being associated with reduced odds of excess bodyweight, were not statistically significant. However, parental and early life factors are important determinants of bodyweight status at this age,[37] while behavioural autonomy development peaks further into early adolescence.[38] Thus, the association of leadership with bodyweight status may follow later in adolescence. A similar explanation may account for the lack of association with sleep duration at this age.

While there has been some research demonstrating the efficacy of life skills interventions to prevent risky health behaviours, these studies have predominantly examined adolescents and have focused on domain-specific life skills in interventions targeted targeted at substance abuse and risk taking behaviours.[19–21,25] Nevertheless, there is some indication from these studies that

the intervention effect is mediated by general life skills. For instance, the effectiveness of a substance abuse prevention program was significantly enhanced by the promotion of general life skills such as communication and problem solving.[25] To the best of our knowledge, the present study is the first to link general life skills to specific health behaviours outside of a targeted intervention program, and is unique in assessing positive health behaviours as an outcome of life skills in pre-adolescents.

Promotion of leadership skills was identified as a core area for action in The Ottawa Charter for Health Promotion,[15] and a priority for school health promotion by the WHO.[14,16] The present study reinforces the importance of leadership skill promotion as an avenue to promote healthy eating and active living, which may benefit the curbing of the obesity epidemic in the short term, and prevention of chronic diseases and mounting healthcare costs in the long term.[39] Further research is needed to assess the degree to which these interventions will improve specific health behaviours and to assess the benefits of incorporating leadership skills development in school health promotion initiatives. The cross sectional design of the present study limits the ability to infer temporal causality from study results. As such, an intervention study design to evaluate a school-based leadership skill development program is indicated to further investigate this association.

This study was conducted among a large provincially representative population. However, this study was limited by the use of self-reported information on diet, physical activity, and sleep. A validated FFQ shown to be

comparable to 24-hour recalls in measuring typical food intake over the past year[28,29] and a validated measure of physical activity[32,33] were used in order to minimize potential bias.

3.5 Tables

Table 3-1: Description of the 7 habits of the Leader in Me process

Habit	Description	Corresponding survey question*
Be proactive	Ability to take initiative, make the right choices without being asked, and to take responsibility for consequences	You do the right thing without being asked
Begin with the end in mind	Ability to set goals and plan ahead	You set goals and plan ahead
Put first things first	Ability to prioritize tasks based on importance	You do your homework before play
Think win-win	Ability to make mutually beneficial decisions, and to resolve conflicts by looking for alternative solutions	You try to find solutions when others don't agree with you
Seek first to understand, then to be understood	Ability to listen to other viewpoints, and to empathize with others	You listen when others are talking to you
Synergize	Ability to work well as a team by utilizing everyone's strengths	You work well in groups
Sharpen the saw	Ability to make healthy lifestyle choices by eating right, exercising, and getting enough sleep	You take care of your health by choosing healthy snacks
		You take care of your health by exercising
		You take care of your health by getting enough sleep

* Students were asked to read statements and to indicate frequency of performing each behavior from the response options "never or rarely", "sometimes", "regularly", "most of the time", "always" or "unsure"

Table 3-2: Characteristics of Grade 5 students in REAL Kids Alberta 2012 survey[1]

	Overall	Student Leadership Tertile				
		Low	Mid	High	*p**	Unsure/ missing
Population (n)	2314	681	680	680		273
Gender					< 0.01	
Boys	47.2	56.0	46.2	37.6		52.6
Girls	52.8	44.0	53.8	62.4		47.4
Parental Education					< 0.01	
Secondary or less	25.3	32.6	23.5	20.0		24.8
College	37.2	38.5	37.8	37.5		31.8
University/Graduate	37.6	29.0	38.7	42.5		43.5
Household Income					0.29	
<$50,000	19.7	21.1	17.4	18.4		24.8
$50,001 - $75,000	12.9	13.5	13.7	11.1		13.9
$75,001 - $100,000	13.7	15.2	13.7	12.9		12.2
>$100,000	28.2	24.6	28.1	32.7		26.2
Don't Know or Prefer Not to Answer	25.5	25.6	27.1	24.9		22.8
Regional					0.69	
Rural/town	34.7	36.6	37.3	33.3		27.7
City	16.3	17.1	15.4	16.0		17.3
Metropolitan	49.0	46.3	47.3	50.7		55.0
Weight Status					0.49	
Normal	73.1	70.1	73.9	72.4		80.0
Overweight	19.6	20.8	19.8	19.8		15.6
Obese	7.3	9.1	6.3	7.8		4.5
Diet Quality					< 0.01	
Mean (DQI-I score)	60.8	58.3	61.2	63.6		59.1
Physical Activity					< 0.01	
Mean (PAQ-C score)	3.33	3.13	3.32	3.58		3.22
Weekday Sleep Duration					0.27	
Mean (hours)	9.82	9.79	9.84	9.85		9.80
Weekend Sleep Duration					0.25	
Mean (hours)	10.03	9.98	10.05	10.04		10.06

DQI-I: Diet Quality Index - International; PAQ-C: Physical Activity Questionnaire for Children

Numbers presented are percentages unless otherwise stated

[1] Results weighted to account for regional stratification

* Adjusted Wald test for significance of difference between leadership groups, excluding unsure/missing

Table 3-3: Association of leadership skill scores with health behaviours and bodyweight status among grade 5 children in Alberta, Canada (n = 2,328)

Leadership:	Mid[1]		High[1]		
	ß	95% CI	ß	95% CI	*p**
Diet Quality (DQI-I)					
Crude	2.82	(1.61; 4.03)	5.23	(3.85; 6.61)	<0.01
Adjusted[2,3]	2.08	(0.98; 3.17)	3.70	(2.58; 4.79)	<0.01
Physical Activity (PAQ-C)					
Crude	0.19	(0.10; 0.28)	0.44	(0.36; 0.53)	<0.01
Adjusted[2]	0.22	(0.13; 0.30)	0.51	(0.43; 0.59)	<0.01
Weekday Sleep (hours)					
Crude	0.05	(-0.03; 0.14)	0.07	(-0.01; 0.14)	0.25
Adjusted[2]	0.05	(-0.03; 0.14)	0.06	(-0.02; 0.14)	0.30
Weekend Sleep (hours)					
Crude	0.07	(-0.02; 0.16)	0.06	(-0.02; 0.14)	0.27
Adjusted[2]	0.05	(-0.04; 0.14)	-0.02	(-0.09; 0.06)	0.17
	OR	**95% CI**	**OR**	**95% CI**	*p**
Overweight					
Crude	0.94	(0.72; 1.23)	0.94	(0.68; 1.30)	0.88
Adjusted[2]	0.91	(0.69; 1.19)	0.93	(0.67; 1.29)	0.79
Obese					
Crude	0.68	(0.45; 1.03)	0.85	(0.57; 1.26)	0.19
Adjusted[2]	0.66	(0.41; 1.08)	1.00	(0.67; 1.47)	0.20

DQI-I: Diet Quality Index - International; PAQ-C: Physical Activity Questionnaire for Children

Multi-level regression models with children nested within schools

[1] All regression coefficients and odds-ratios relative to the low leadership group as reference

[2] Analyses adjusted for gender, household income, parental education, and geographic region

[3] Analysis additionally adjusted for total energy intake

*Adjusted Wald test for overall significance of leadership

3.6 References

1. Daniels SR. Complications of obesity in children and adolescents. International Journal of Obesity Apr2009 Supplement 1;33:S60–S65.

2. Belanger-Ducharme F, Tremblay A. National Prevalence of Obesity: Prevalence of obesity in Canada. Obesity Reviews 2005;6(3):183–6.

3. Roberts KC, Shields M, de Groh M, Aziz A, Gilbert J-A. Overweight and obesity in children and adolescents: results from the 2009 to 2011 Canadian Health Measures Survey. Health Rep 2012;23(3):37–41.

4. Tremblay MS, Shields M, Laviolette M, Craig CL, Janssen I, Gorber SC. Fitness of Canadian children and youth: results from the 2007-2009 Canadian Health Measures Survey. Health Rep 2010;21(1):7–20.

5. Sparling PB, Franklin BA, Hill JO. Energy balance: the key to a unified message on diet and physical activity. Journal of Cardiopulmonary Rehabilitation 2013;33(1):12–5.

6. Story M, Sallis JF, Orleans CT. Adolescent Obesity: Towards Evidence-Based Policy and Environmental Solutions. Journal of Adolescent Health 2009;45(3, Supplement):S1–S5.

7. Chahal H, Fung C, Kuhle S, Veugelers PJ. Availability and night-time use of electronic entertainment and communication devices are associated with short sleep duration and obesity among Canadian children. Pediatric Obesity 2013;8(1):42–51.

8. Chaput J-P, Lambert M, Gray-Donald K, McGrath JJ, Tremblay MS, O'Loughlin J, et al. Short sleep duration is independently associated with overweight and obesity in Quebec children. Can J Public Health 2011;102(5):369–74.

9. Tandon PS, Zhou C, Sallis JF, Cain KL, Frank LD, Saelens BE. Home environment relationships with children's physical activity, sedentary time, and screen time by socioeconomic status. International Journal of Behavioral Nutrition and Physical Activity 2012;9:88.

10. Trapp GSA, Giles-Corti B, Christian HE, Bulsara M, Timperio AF, McCormack GR, et al. Increasing Children's Physical Activity Individual, Social, and Environmental Factors Associated With Walking to and From School. Health Educ Behav 2012;39(2):172–82.

11. Wordell D, Daratha K, Mandal B, Bindler R, Butkus SN. Changes in a Middle School Food Environment Affect Food Behavior and Food Choices. Journal of the Academy of Nutrition and Dietetics 2012;112(1):137–41.

12. Veugelers PJ, Fitzgerald AL. Effectiveness of school programs in preventing childhood obesity: a multilevel comparison. Am J Public Health 2005;95(3):432–5.

13. Veugelers PJ, Schwartz ME. Comprehensive School Health in Canada. Canadian Journal of Public Health 2010;101:S5–8.

14. WHO. Skills for Health: Skills-based Health Education Including Life Skills: An Important Component of a Child-friendly/Healthpromoting School. [Internet]. World Health Organization; 2003 [cited 2012 Oct 16]. Available from: http://www.who.int/school_youth_health/media/en/sch_skills4health_03.pdf

15. WHO. The Ottawa Charter for Health Promotion [Internet]. Ottawa: World Health Organization; 1986 [cited 2012 Oct 16]. Available from: http://www.who.int/healthpromotion/conferences/previous/ottawa/en/index.html

16. WHO. Jakarta Declaration on Leading Health Promotion into the 21st Century [Internet]. Jakarta: World Health Organization; 1997 [cited 2013 Jun 27]. Available from: http://www.who.int/healthpromotion/conferences/previous/jakarta/declaration/en/index3.html

17. Joint Consortium for School Health. Comprehensive School Health Framework [Internet]. [cited 2013 Aug 1];Available from: http://www.jcsh-cces.ca/index.php/school-health

18. Centers for Disease Control and Prevention. Coordinated School Health [Internet]. [cited 2013 Aug 1];Available from: http://www.cdc.gov/HealthyYouth/CSHP/

19. Flay BR. School-based smoking prevention programs with the promise of long-term effects. Tobacco Induced Diseases 2009;5(1):6.

20. Spaeth M, Weichold K, Silbereisen RK, Wiesner M. Examining the Differential Effectiveness of a Life Skills Program (IPSY) on Alcohol Use Trajectories in Early Adolescence. Journal of Consulting 2010;78(3):334–48.

21. Yankah E, Aggleton P. Effects and Effectiveness of Life Skills Education for HIV Prevention in Young People. AIDS Education and Prevention 2008;20(6):465–85.

22. Franklin Covey. The Leader in Me [Internet]. [cited 2013 Aug 1];Available from: http://www.theleaderinme.org/

23. Covey SR. The 7 habits of highly effective people. New York, NY: Free Press; 2004.

24. Maruska K, Morgenstern M, Isensee B, Hanewinkel R. Influencing antecedents of adolescent risk-taking behaviour in elementary school: results of a 4-year quasi-experimental controlled trial. Health Educ Res 2010;25(6):1021–30.

25. Bühler A, Schröder E, Silbereisen RK. The role of life skills promotion in substance abuse prevention: a mediation analysis. Health Educ Res 23(4):621–32.

26. REAL Kids Alberta. REAL Kids Alberta [Internet]. [cited 2013 Aug 1];Available from: http://www.realkidsalberta.ca/

27. Kim S, Haines PS, Siega-Riz AM, Popkin BM. The Diet Quality Index-International (DQI-I) Provides an Effective Tool for Cross-National Comparison of Diet Quality as Illustrated by China and the United States. J Nutr 2003;133(11):3476–84.

28. ROCKETT HR., WOLF AM, COLDITZ GA. Development and Reproducibility of a Food Frequency Questionnaire to Assess Diets of Older Children and Adolescents. Journal of the American Dietetic Association 1995;95(3):336–40.

29. Rockett HRH, Breitenbach M, Frazier AL, Witschi J, Wolf AM, Field AE, et al. Validation of a Youth/Adolescent Food Frequency Questionnaire. Preventive Medicine 1997;26(6):808–16.

30. Health Canada. The Canadian Nutrient File [Internet]. 2005 [cited 2013 Aug 1];Available from: http://www.hc-sc.gc.ca/fn-an/nutrition/fiche-nutri-data/cnf_aboutus-aproposdenous_fcen-eng.php

31. Willett W. Nutritional epidemiology [electronic resource]. 3rd ed. Oxford: Oxford University Press; 2013.

32. Crocker PR, Bailey D, Faulkner R, Kowalski K, McGrath R. Measuring general levels of physical activity: preliminary evidence for the Physical Activity Questionnaire for Older Children. Medicine & Science in Sports & Exercise October 1997 1997;29(10):1344–9.

33. Kowalski KC. Validation Of The Physical Activity Questionnaire For Older Children. Pediatric Exercise Science 1997;9:174–86.

34. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing A Standard Definition For Child Overweight And Obesity Worldwide: International Survey. BMJ: British Medical Journal 2000;320(7244):1240–3.

35. Birch LL, Davison KK. Family environmental factors unfluencing the developing behavioral controls of food intake and childhood overweight. Pediatric Clinics of North America 2001;48(4):893–907.

36. Brug J, Tak NI, te Velde SJ, Bere E, de Bourdeaudhuij I. Taste preferences, liking and other factors related to fruit and vegetable intakes among schoolchildren: results from observational studies. British Journal of Nutrition 2008;99(Supplement S1):S7–S14.

37. Kuhle S, Allen AC, Veugelers PJ. Perinatal and childhood risk factors for overweight in a provincial sample of Canadian Grade 5 students. International Journal of Pediatric Obesity 2010;5(1):88–96.

38. Eccles JS. The Development of Children Ages 6 to 14. The Future of Children 1999;9(2):30–44.

39. Tran BX, Nair AV, Kuhle S, Ohinmaa A, Veugelers PJ. Cost analyses of obesity in Canada: scope, quality, and implications. Cost Effectiveness and Resource Allocation 2013;11(1):3.

4 Discussion

4.1 Overview

Life skills have been commonly identified as a central component in the improvement of childhood health and the amelioration of health inequity across the world,[1] particularly in the role of schools and health education.[2] Research on life skills, however, has been lacking to advance the role of these primary competencies as a determinant of behaviour development and health. Limited investigation has examined the role of context-specific skills related to preventing risky behaviours like substance abuse,[3] and that primarily in adolescents and young adults, but the influence of general life skills in determining positive health behaviours in younger children has not been examined. As the childhood obesity epidemic continues to advance with dire consequences both beginning to emerge and projected to expand dramatically,[4] addressing this widespread threat to health and wellness is of critical concern, yet interventions have to date shown limited capacity to halt or reverse this trend.[5] Enhancing the life skills of children may augment their ability to make healthy choices and complement the effectiveness of existing health interventions.

This thesis research was undertaken to assess whether life skills are a promising prospect as an important determinant of the diet quality, physical activity, sleep duration, and bodyweight status of children. Questions designed for and included in the REAL Kids Alberta (Raising healthy Eating and Active

Living Kids in Alberta) survey in 2012, modelled after the 7 habits of *The Leader in Me*,[6] were investigated as a construct of life skills. The questions were analyzed for their agreement with parental responses to analogous questions about their child, and their correlation to objective measures and related self efficacy of a subset of the questions. Further, a summary leadership score was constructed, and this composite score was split into tertiles and investigated as a determinant of children's diet quality, physical activity, sleep duration, and bodyweight status. Relationships between leadership and health outcomes were modelled using weighted random effects models clustered by school and adjusted for geographic residency, household income, parental education, and gender, with the model for diet quality additionally adjusted for total caloric intake.[7]

4.2 Major Findings

Student responses to the set of leadership questions included in the survey demonstrated fair agreement with analogous parental responses,[8] demonstrating that grade 5 children can reliably appraise their leadership behaviours. Student responses of their frequency getting adequate sleep and exercise correlated well with measures of self-efficacy for sleep and exercise, demonstrating criterion validity of the subset of questions analyzed. Additionally, student responses of healthy snacking, exercising, and getting adequate sleep correlated well with extensively validated comprehensive measures of diet quality, physical activity, and sleep duration, which supports the criterion validity of the subset of

leadership questions analyzed. The entire set of questions also demonstrated good internal consistency, validating the use of a single composite score to measure life skills.

A composite measure of the leadership behaviours excluding those directly related to health behaviours showed a strong and positive relationship with both physical activity and diet quality, though no relationship was evident between leadership and sleep duration on either weekdays or weekends. There was some variation in bodyweight status according to leadership which was suggestive of a mixed, though not significant, association. These results demonstrate that life skills are strongly associated with healthy behaviours, even before adolescence when children are only first developing some degree of autonomy and personal responsibility for their actions in these areas.[9]

4.3 Implications

This research shows that life skills must be recognized as an important factor in fostering healthy habits and behaviours; interventions should not focus solely on the knowledge and actions of children, but must take into account their personal capacity to engage in these healthy behaviours. Recognizing this facet of development and developing interventions which promote growth in life skill competencies has the opportunity to both improve health directly by promoting the ability to make healthier choices, as well as complement the impact of existing interventions by improving the capacity of children to effectively engage with and respond to them. There is additionally the opportunity for

interventions building life skills, as a general pathway, to simultaneously impact multiple domains of health and wellness. As life skills have also been linked to parental education levels, a known determinant of child health,[10] they may play a mediating role in this health inequality, and thus a modifiable target for interventions to selectively address a risk factor for a disadvantaged segment of society.

These findings demonstrate a critical need, and some direction, for further investigation to characterize the details of the role life skills play in these and other domains of health behaviour. While skills pertaining to specific interventions and behaviours have been shown to be modifiable,[11] the extent of plasticity for general life skills, as well as the critical periods of development when they can be cultivated most effectively, is not known and will be crucial to maximizing their opportunity for improved health. The degree to which there is an interactive benefit of interventions targeting general life skills as well as health behaviours, as well as the mediating role of life skills in the pathway between environmental determinants and health behaviours, are additional aspects opened to investigation by this research.

4.4 Strengths

The research benefits from the use of a high quality data source. The REAL Kids Alberta survey provides a large, representative sample of most grade 5 children in Alberta, with a history of effective community engagement promoting high compliance among subjects. Student surveys contain a broad

array of information, are administered by trained assistants, and are linked to similarly broad home surveys and directly measured bodyweight variables. This affords the opportunity to ensure that models are adjusted for important covariates as potential confounders, and high quality, validated outcomes. An additional strength is its novel subject of investigation, providing valuable information on a topic of importance that has not received adequate attention. The survey implement investigated, which is newly developed, is also concise and easily implemented, which makes it a feasible tool to implement for use in other research projects.

4.5 Limitations

As this research, and the survey questions assessing leadership in the REAL Kids Alberta survey, are preliminary investigations into the role of life skills in bodyweight and health behaviours, there are many opportunities for improvement. The selection methodology did exclude certain forms of schools, which may have influenced the analyses due to selection bias, and validating the data as a reliable sample of grade 5 students in Alberta has not been completed. Comparing the data to provincial estimates will be a valuable next step to assess the potential distortion of the data due to selection procedure, as well as due to participation bias.

The response distributions all showed some level of negative skew, and substantial ceiling effects for ‘you listen when others are talking to you’ in students, and ‘you work well in groups’ in both students and parents; adjusting

the response scale to provide a more even distribution would improve the quality of the implement. Further, though the concise nature of the tool does make it more manageable to implement, a larger range of questions for each of the habits could have allowed for an investigation of the internal structure of the leadership trait, and any sub-factors that may comprise it. Validation of the questions would have benefited from objective measures of all the behaviours to reveal the construct validity of every question. A significant limitation of the validation component is the lack of a test-retest analysis to elucidate the repeatability of the implement. Additionally, agreement between student and parent responses was only fair, so an examination of the discrepancy between responses, and whether there are any significant determinants affecting agreement, would have been useful.

Limitations of the study assessing leadership as being associated with health behaviours arise primarily from it deriving from a single cross-sectional survey. This prevents any temporal relationship between leadership and any of the health behaviours from being investigated, which severely limits its contribution to establish life skills as causally associated with health behaviours. Similarly, the stability or volatility of the trait is not possible without a time course analysis that measures leadership at multiple time points for individual subjects. The research also only provides an initial and basic analysis of the relationship between leadership and the health behaviours studied. Other determinants have demonstrated effect modification based on covariates like gender[12] and socioeconomic status,[13] a more thorough analysis of potential

relationships and interactions between covariates is needed to further clarify the relationship identified.

4.6 Conclusions

The leadership skills of The Leader in Me have been shown to be strongly associated with diet quality and physical activity in children. These results demonstrate the importance of emphasizing life skills in the development and implementation of interventions targeting health behaviours and bodyweight status. Life skills may also be a mediator of other determinants, and could be an opportunity to modify other correlates of bodyweight status and reduce health inequalities. Focusing on developing life skills in health interventions could profoundly improve the capabilities of children to develop healthy behaviours, and reduce the tremendous impact of overweight and health inequality. The potential to broadly affect improvements in childhood health, and specifically to address the childhood obesity epidemic, will depend on further research to characterize life skills and health, and must be a priority.

4.7 References

1. WHO. Jakarta Declaration on Leading Health Promotion into the 21st Century [Internet]. Jakarta: World Health Organization; 1997 [cited 2013 Jun 27]. Available from: http://www.who.int/healthpromotion/conferences/previous/jakarta/declaration/en/index3.html

2. WHO. Skills for Health: Skills-based Health Education Including Life Skills: An Important Component of a Child-friendly/Healthpromoting School. [Internet]. World Health Organization; 2003 [cited 2012 Oct 16].

Available from: http://www.who.int/school_youth_health/media/en/sch_skills4health_03.pdf

3. Botvin GJ, Kantor LW. Preventing alcohol and tobacco use through life skills training. Alcohol Res Health 2000;24(4):250–7.

4. Flynn M a. T, McNeil DA, Maloff B, Mutasingwa D, Wu M, Ford C, et al. Reducing obesity and related chronic disease risk in children and youth: a synthesis of evidence with 'best practice' recommendations. Obesity Reviews 2006;7:7–66.

5. Birch LL, Ventura AK. Preventing childhood obesity: what works? International Journal of Obesity Apr2009 Supplement 1;33:S74–S81.

6. Covey SR. The leader in me: how schools and parents around the world are inspiring greatness, one child at a time. 1st Free Press trade pbk. ed. New York: Free Press; 2009.

7. Willett WC, Howe GR, Kushi LH. Adjustment for total energy intake in epidemiologic studies. Am J Clin Nutr 1997;65(4):1220S–1228S.

8. Landis JR, Koch GG. The Measurement of Observer Agreement for Categorical Data. Biometrics 1977;33(1):159–74.

9. Eccles JS. The Development of Children Ages 6 to 14. The Future of Children 1999;9(2):30–44.

10. Patrick H, Nicklas TA. A Review of Family and Social Determinants of Children's Eating Patterns and Diet Quality. J Am Coll Nutr 2005;24(2):83–92.

11. Pick S, Givaudan M, Poortinga YH. Sexuality and Life Skills Education: A Multistrategy Intervention in Mexico. [Miscellaneous Article]. American Psychologist March 2003 2003;58(3):230–4.

12. Cardon G, Philippaerts R, Lefevre J, Matton L, Wijndaele K, Balduck A-L, et al. Physical activity levels in 10- to 11-year-olds: clustering of psychosocial correlates. Public Health Nutrition 2005;8(07):896–903.

13. Parsons T j., Powers C, Logan S, Summerbell C d. Childhood predictors of adult obesity: a systematic review. International Journal of Obesity & Related Metabolic Disorders Nov1999 Supplement;23:S1–S107.