RURAL SCHOOLCHILDREN'S GROWTH AND NUTRITION

RURAL SCHOOLCHILDREN'S GROWTH AND NUTRITION: A STUDY OF OBESITY, DIET AND THE SCHOOL ENVIRONMENT IN GREY AND BRUCE COUNTIES, ONTARIO, CANADA

By

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A Thesis

Submitted to the School of Graduate Studies

In Partial Fulfillment of the Requirements

For the Degree

Doctor of Philosophy

McMaster University

DOCTOR OF PHILOSOPHY (2008) McMaster University

(Anthropology) Hamilton, Ontario

TITLE: Rural Schoolchildren's Growth and Nutrition: A Study of Obesity, Diet and School Environment in Grey and Bruce Counties, Ontario, Canada

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NUMBER OF PAGES: xix, 386

ABSTRACT

This thesis reports findings of a biocultural study of the growth and nutrition of children attending schools in rural Ontario, Canada. The objectives of the research were fourfold: (1) to evaluate the growth and nutrition status of a sample of rural Canadian schoolchildren; (2) to explore the school context of children's nutrition; (3) to build knowledge useful for the development and implementation of nutrition policy and programs; and (4) to conduct nutrition workshops with children and parents in school and community settings.

Methods:

Measures of height and weight were obtained for 504 children ages 7-13 years. Height for age and body mass index scores were calculated and compared with 2000 data from the Centers for Disease Control (Kuczmarski *et al.* 2002). Weekday 24-hour dietary recall was conducted on a subsample of 352 children and the results compared with Canada's Food Guide (Health Canada 1997) and dietary reference data from the US Institute of Medicine (2000). Focus groups were conducted with 144 schoolchildren ages 8-13 years. Open-ended questions were used to encourage students to describe the physical and social environments in which they consume school snacks and lunches.

Results:

Prevalence of overweight and obesity were high in this sample, with 17.7% of children classified as overweight and 10.9% of children classified as obese. Fifteen percent of boys were classified as obese, compared to 6.8% of girls. Boys consumed significantly more servings from the grain and meat food groups than girls. While mean daily intake of fibre and micronutrients was significantly low for both boys and girls, there were significant gender differences in nutrient

intake, with boys consuming greater energy, protein, carbohydrate, calcium, iron, phosphorus, and sodium than girls. The results of focus group analysis suggest that a wide range of rules and restrictions are imposed on children's activities during school meals. The majority of these rules govern the physical location, movement, and social interaction of students, suggesting a significant degree of institutionalized control over children's bodies and interactions. Few of the rules and restrictions were perceived by children to relate to their nutrition or health. And the imposition of these rules and restrictions occurs in a gendered fashion, creating a gendered climate in which school and societal stereotypes about boys' and girls' behaviour are normalized. In addition, food rewards constitute an important avenue for the communication of values and norms around food and children's behaviour.

Discussion:

The results of the present study describe high prevalence of overweight in both boys and girls. This finding is consistent with data on childhood obesity in other rural North American settings, where socioeconomic factors such as income, employment and education contribute to elevated obesity risk in both adults and children. In addition, children in this sample are generally consuming less than optimal servings from the four food groups outlined in Canada's Food Guide to Healthy Eating (Health Canada 1997), resulting in widespread nutritional inadequacies. Interventions for this population of rural children should target overall dietary inadequacies and replacement of existing caloric intake with nutrient-rich foods from across all four food groups. Boys have higher obesity prevalence and consume significantly greater levels of dietary energy and nutrients than girls. This finding is less common in the literature on child nutrition and may be evidence of gendered dietary patterns in this rural population. In addition, the results of focus group analysis indicate that educators and health workers need to be cognizant that school-based programs and policies aimed at decreasing childhood obesity prevalence occur in a wider context of institutional rules and practices that communicate powerful messages about food and children's bodies. Based on a biocultural analysis that examines biological outcomes in the context of social processes, the present study sheds light on factors in the school environment that impact child nutrition. It also offers new directions for investigation into the tractability of schoolchildren's eating behaviours, which constrain public health approaches to obesity prevention programs in schools.

ACKNOWLEDGEMENTS

I would like to express my sincere thanks to the children and adults who participated in this research. I owe a debt of gratitude to MaryAnne Alton. Superintendent of Elementary Schools for the Bluewater District School Board and to Lynda Bumstead, Public Health Dietician for the Grey Bruce Health Unit; their clear vision and commitment to public service are an inspiration to me.

As mentors and teachers, my committee members have been consistently supportive and encouraging. My thanks to Dr. Ann Herring, for her unwavering support and unflinching commitment to excellence, and to Dr. Wayne Warry for his example of anthropology in the service of community. And my sincere gratitude to Dr. Tina Moffat, my Supervisor and mentor, whose tireless efforts on my behalf constitute a debt I can never repay. I hope I may do half as much for a student someday.

Finally, I would like to thank my family for their unending patience and understanding through my graduate and post-graduate education and beyond. To Geoff, Leslie, Heather and Sheila – I appreciate all your love and support.

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AUTHOR'S NOTE

It is increasingly common in many disciplines to present for defense a thesis consisting of material that has been prepared for publication in peer-reviewed journals. This thesis has been prepared according to guidelines for the "sandwich thesis" published by the School of Graduate Studies, McMaster University (2003). In accordance with those guidelines, I have provided three manuscripts prepared for publication. These are accompanied by additional context in the form of an expanded literature review, a methods chapter, and a chapter on the research setting.

The benefits of this format to the candidate are many, not the least of which is the advancement of goals related to publication. However the sandwich thesis imposes a number of challenges on the reader. The most significant of these is the challenge of presenting the research as a complete story, from conception through ethics review and establishment of the field sites to fieldwork, analysis, interpretation and evaluation. In order to enhance the readability and theoretical flow of the work, I have also enveloped the published papers with prefaces and afterwords that provide additional information about the field, expand discussion limited by journal page length restrictions, and draw on additional concepts and literatures which assist interpretation of findings.

Although each of the manuscripts contains a literature review and methods section, these are necessarily brief and extremely focused, owing to publishers' page limit restrictions. I have therefore provided a separate and extensive literature review which explores the wide range of theoretical perspectives from which anthropologists have conducted research on child growth and nutrition. I have also provided a methods chapter which examines the study's methodology and methodological limitations in detail. This chapter includes an exploration of the ethical challenges arising from research with children in schools. Another substantial addition is the chapter 6 afterword that examines the applications of the research to the community under study.

An advantage of the sandwich format is that through the process of article submission and review the author receives constructive feedback from anonymous peer reviewers which benefits thesis drafts. I am pleased to acknowledge that the thesis has benefited from reviewers' comments and criticisms, some of which have been included in the chapter afterwords and in the concluding chapter. These comments and criticisms enhance the discussion of theoretical and conceptual issues central to the research.

Due to manuscript preparation guidelines which differ between periodicals, there are minor differences in layout and style between chapters. I have attempted to provide a measure of uniformity to the content by applying consistency in presentation and writing style. It is my hope that what the thesis lacks in fluidity is made up for in breadth and quality.

Chapter 1 Introduction

1.1 Introduction

Physical anthropology has long been concerned with variation in growth between populations. However, for many years, the focus of growth research was exclusively the growth deficits experienced by children in developing contexts. As an anthropologist studying child nutrition, growth and health, I have observed with interest the recent burgeoning of research on childhood obesity, first in North America and subsequently in Europe, Australia, New Zealand and Japan. Due to a confluence of factors – population density, socioeconomic disparity, urban poverty, the location of universities and colleges in urban centres and the availability of large sample pools – the majority of studies of childhood obesity are conducted in urban settings.

As an anthropologist living in rural Ontario, Canada, I felt both a natural curiosity as to whether these studies are representative of the obesity prevalence of rural children and a desire to engage rural communities in the process of research. As the mother of two schoolchildren, I have ample daily exposure to the wide range of growth and developmental outcomes experienced by children living in a rural North American community. Many of these outcomes run counter to perceived notions of rural childhoods: we imagine hearty, rosy-cheeked children who live on farms; they are well-nourished on locally-grown produce, with large amounts of fresh dairy and meat products in their diets; they are extremely physically active, through a combination of outdoor farm-related chores and proximity to safe, green play spaces; and their numerous opportunities for outdoor play, combined with geographic distance from fast food outlets, serve to insulate them from the harmful effects of advertising and modern media exposure.

This "rural idyll" persists in the imagination largely because there is little evidence to supplant it. But for those of us living in rural communities, the truth is unavoidable. Low household income, high adult unemployment, and low parental educational attainment, are widespread phenomena. Rural out-migration draws young adults in their income-earning years away from rural communities, leaving the burden of municipal taxes on the remaining residents, many of whom are seniors on fixed incomes (Dupuy *et al.* 2000). As a result, rural communities lack the infrastructure and services to support young families and teens (James 1999). The cultures of healthy eating inculcated in high-income families with highly educated parents are less evident in communities where household finances and geographic distance limit opportunities for post-secondary education (Greenhalgh 2005; Reilly *et al.* 2005). The majority of rural families live in small residential communities or in rental accommodation on increasingly large farms, where smaller homesteads are now subsumed by commercial operations with absentee landlords and migrant labour (Paquette and Domon 2003; Quandt *et al.* 2002). The impact of out-migration, economic decline and centralization of services on rural communities has been significant.

But the story of how this project began is a personal one. In August 2001 I attended Watershed III, a fundraising concert held in Walkerton, Ontario, in order to raise funds for the victims of the Walkerton Water Tragedy. In May 2000, Walkerton's municipal drinking water system became contaminated with *E. coli* 0157:H7 and *Campylobacter*, causing seven deaths and more than 2300 cases of waterborne disease (Ontario Ministry of the Attorney General 2005). Among those infected, 27 individuals, the majority of them children aged 1-4 years, developed haemolytic uremic syndrome, requiring dialysis and long-term medical follow-up.

The Walkerton tragedy is a classic story in which provincial downloading of services onto municipalities resulted in the failure of checks and balances needed to prevent illness and death due to human error and small-town cronyism. Watershed III was the third and last of the fundraising concerts. Held in the Bruce County town of 5,000 residents, it attracted over 45,000 fans, many of them residents of the surrounding rural counties: Huron, Perth, Waterloo and Grey. As I stood in the crowd that day, it appeared to me that the average body size of concert-goers was extremely high. A quick check with the local health unit confirmed my suspicions: adult obesity rates in rural Ontario were high, as were rates of associated metabolic illness such as diabetes and cardiovascular disease (Grey Bruce Health Unit 2003a, 2003b).

A number of questions arose in my mind: Was this high obesity prevalence in adults the result of recent or longer-term conditions in the environment? Were obesity rates also high in rural children? Did obesity prevalence among rural children follow a pattern similar to that observed in urban North American communities? What was the contribution of diet to obesity prevalence?

1.2 Research on Adult and Child Obesity in Canada

In 1986 a report published by the Canadian Heart Health Initiative called for a comprehensive cardiovascular disease prevention strategy in Canada (Health and Welfare Canada 1986). The first step in that strategy was the collection of surveillance data on cardiovascular disease risk. The Canadian Provincial Heart Health Surveys were conducted in all ten Canadian provinces[1]

[1] The target population for the surveys was defined as individuals aged 18-74 years. Persons residing in the Yukon and Northwest Territories were excluded, as were residents of federal Indian reserves, military camps, and federal institutions such as correctional facilities (MacLean *et al.* 1992). In effect, this sampling structure excluded many Aboriginal residents, despite contemporary data on Canadian Aboriginal communities documenting cardiovascular

between 1986 and 1992 (MacLean *et al.* 1992). Results indicated that obesity, and abdominal obesity in particular, was a significant risk factor for cardiovascular disease (Reeder *et al.* 1992). Obesity was reported in 35% of men and 27% of women and was significantly associated with high blood pressure, high levels of low density lipoprotein (LDL) and triglycerides, high total cholesterol, and high ratio of total cholesterol to high density lipoprotein (HDL) in blood (MacDonald *et al.* 1992; Reeder *et al.* 1992). Ontario figures followed a similar pattern, with obesity prevalence of 34% in men and 23% in women.

Throughout the 1990s, attention was increasingly focused on obesity rates among Canadians. Researchers tracked the rise in obesity prevalence among Canadian adults from 5.6% in 1985 to 14.8% in 1998 (Katzmarzyk 2002). Alarmingly, this trend was also demonstrated in data on Canadian children, whose obesity prevalence more than doubled between 1981 and 1996 (Tremblay *et al.* 2002). The 1996 National Longitudinal Survey of Children and Youth[2] reported obesity rates as high as 14% in children 7-13 years (Tremblay and Willms 2000).

The most recent surveillance data comes from the 2001 Canadian Community Health Survey, which reports an obesity prevalence of 15% for Canadian adults (Statistics Canada 2002). Among children obesity prevalence has risen to 18% (Shields 2005), a finding which has prompted researchers to call for the ongoing collection of surveillance data on body composition (Tremblay 2004; Willms 2004). In addition, concerned groups, such as the Heart and Stroke Foundation of Canada, are lobbying government for increased attention to health and education policy around physical activity and diet.

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disease risk and obesity prevalence in excess of those in the overall Canadian population (McIntyre and Shah 1986). This limitation is not listed in the project report (Canadian Heart Health Surveys Research Group 2001).

[2] The data on children's body size was collected through parent report (Statistics Canada 1996).

1.3 Research on Obesity in Rural Canada

The recognition of increased obesity risk for rural Canadians has come slowly. The Canadian Provincial Heart Health Surveys found no significant differences in obesity prevalence between rural and urban adults (Reeder *et al.* 1997). However in western Canada rural men and women were found to be at significantly greater risk of obesity than their urban counterparts. In Ontario, there were only small regional variations in body mass index, although the highest mean measures of body mass index were found in residents of rural northeastern Ontario. An analysis of the 1996 National Longitudinal Survey of Children and Youth anthropometric data indicates a west-to-east gradient in childhood obesity prevalence, with the greatest obesity prevalence reported in the Atlantic provinces (Willms *et al.* 2003). Although the authors speculated that this gradient might be attributable to increased obesity risk in rural Quebec and the Atlantic provinces, they were unable to provide substantive evidence to this effect.

There is mounting evidence from regional and local studies that rural Canadians experience disproportionately high obesity risk. Adult obesity prevalence above the Canadian average has been reported in rural residents of Quebec (Huot *et al.* 2004), British Columbia (Self *et al.* 2005; Thommasen *et al.* 2005), and the Keewatin District of the Northwest Territories (Orr *et al.* 1998). Plotnikoff *et al.* (2004) found higher rates of overweight and obesity among rural Albertan high school students compared with their urban counterparts. And while there is little data on school-age and preschool-age children in Canada, Canning *et al.* (2004) report obesity prevalence of roughly 10% in 3-5-year-old children living in Newfoundland and Labrador.

In September 2006, the Public Health Agency of Canada published findings from its rural health surveillance initiative (Canadian Institute for Health Information 2006). Across Canada, combined overweight and obesity prevalence was significantly greater for individuals living in rural, small-town and non-metropolitan census areas (57%) than for those living in census metropolitan areas (47%)[3]. This report underscores a decade of local research on the burden of health disparities borne by Canada's rural residents. Dr. Peter Hutten-Czapski, a former President of the Society of Rural Physicians of Canada, views the report as fundamental to policy change in the area of rural health: "hopefully, this will serve as an impetus, a reminder anyway, that rural citizens...have particular needs that are not being adequately met" (in Kondro 2006:1195).

1.4 Ontario Health and Education and Policy Targeting Obesity

The data on rising obesity prevalence have not gone unnoticed by provincial governments. In 2004, Ontario's Chief Medical Officer of Health, Dr. Sheila Basrur, released a report entitled *Healthy Weights, Healthy Lives* (Ontario Ministry of Health and Long Term Care 2004). The report was a thoroughgoing review of the existing research on obesity in Canada and contained recommendations for government action to reverse rising obesity prevalence. Among the recommendations were calls to increase public health surveillance, increase research funding, phase out trans-fat from processed foods, broaden mandatory nutrition labeling, implement a national fruit and vegetable strategy similar to the US 5 A Day for Better Health[4] program, and fund a national physical activity strategy similar to the ParticipACTION[5] program of the 1970s.

[3] The data on body size was collected through self-report (Canadian Institute for Health Information 2006).

[4] Implemented in 1991, the US 5 A Day for Better Health Program is a public awareness campaign that seeks to increase consumption of fruits and vegetables to 5 or more servings each day. "Through its unique national public-

In response to the Chief Medical Officer's report, the Ontario government developed Ontario's Action Plan for Healthy Eating and Active Living (Ontario Ministry of Health Promotion 2006). With $10 million in funds jointly provided by the Ministry of Health and Long Term Care and the Ministry of Health Promotion, the Action Plan includes initiatives to reduce obesity risk at all ages through healthy public policy and the promotion of public awareness. One of its key initiatives is designed to change the eating behaviours of Northern Canadians. Modelled on the US 5 A Day Program, the Northern Fruit and Vegetable Pilot Project is a public-private partnership between the Ministries of Health, the Public Health Research and Development Program, and the Ontario Fruit and Vegetable Growers Association (Porcupine Health Unit 2008). Its location in Northern Ontario schools is a response to literature documenting low fruit and vegetable consumption among children and youth living in the north (Cancer Care Ontario 2007).

A second component of Ontario's Action Plan is the implementation of an internet- and telephone-based dietitian advisory service to provide families and health care providers with timely and reliable nutrition information (Ontario Ministry of Health Promotion 2006).

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private partnership", the program is led by a steering committee which includes representatives from The National Cancer Institute, the Produce for Better Health Foundation, the Centers for Disease Control and Prevention (CDC), the United States Department of Agriculture, United Fresh Fruit and Vegetable Association, Produce Marketing Association, and Dole Food Co., Inc. (CDC 2007a). Studies have shown that 5 A Day has been overwhelmingly unsuccessful in increasing the fruit and vegetable consumption of Americans (Guenther *et al.* 2006; Nanney *et al.* 2007; Reynolds *et al.* 2000; Reynolds *et al.* 2004). Critics cite the failure to link consumption patterns with underlying socioeconomic causes as the root of 5 A Day's failure (Thomas 2006). The program is currently being replaced by the Fruits and Veggies Matter Program (CDC 2007b).

[5] ParticipACTION is a private, not-for-profit corporation originally established in 1971. It operated for nearly 30 years and was a leading proponent of healthy, active living for Canadians. In late 2006, ParticipACTION received renewed commitment from the government (Sport Canada and Public Health Agency of Canada) and was revitalized in February 2007 (Participaction 2007).

There has also been a response to the Chief Medical Officer's report by the Ontario Ministry of Education and Training. In 2005, Education Minister Gerard Kennedy launched the Liberals' "Healthy Schools Program", an initiative aimed at reducing childhood obesity through daily physical activity and further restrictions on school vending (Ontario Ministry of Education and Training 2005a, 2005b). The initiative was supported by $39 million in funds dedicated to hiring specialist teachers to implement the mandated quality daily physical activity for Ontario schoolchildren. While the goal of increasing physical activity is laudable, critics have observed that rural elementary school children are less likely to benefit from this program than their urban counterparts. Rural elementary schools and schools with smaller populations tend not to have full-time physical education specialists on staff (Cameron *et al.* 2003).

There have also been changes in school funding arrangements which reflect attention to the issues of child nutrition and obesity. Under previous provincial governments, lucrative and lengthy school vending contracts were awarded to soft drink companies in return for funds for resources (Henry and Garcia 2004). In 2004, Liberal Education Minister Gerard Kennedy addressed public outcry over these contracts by releasing provincial recommendations for school vending machines based on criteria from the Dieticians of Canada (Ontario Ministry of Education and Training 2004a, 2004b, 2004c; Ontario Society of Nutrition Professionals in Public Health School Nutrition Workgroup 2004).

More recently, Ontario Liberal Education Minister Kathleen Wynne announced the Healthy Schools Challenge (Ontario Ministry of Education and Training 2006). Participation in the program is voluntary. Schools that accept the challenge are eligible for recognition by the ministry, but not for additional funding to carry out the tasks required by the program, which include establishing a healthy menu for the school lunch program, purchasing a refrigerator for storing healthy food during the school day, and starting a school vegetable garden.

1.5 Anthropology in Obesity Research

One of the challenges of understanding child growth in the rural Canadian context is locating a theoretical tradition sufficiently broad to incorporate the myriad factors influencing it. With its emphasis on both biological and socio-cultural processes, and its historical roots in comparative auxology, the discipline of anthropology is well-suited to the task of identifying and connecting the factors influencing child growth and nutrition in rural Canada.

There has been little research of this kind in Canada to date. A notable exception is Moffat *et al.*'s (2005) comparative study of obesity prevalence in socioeconomically contrasting neighbourhoods, which employs both political economy and environmental risk theory in its analysis of the variables influencing child growth.

In the US, there have been anthropological studies of rural children's obesity risk such as Crooks' (1999a, 2000, 2003) study of child growth and nutrition in rural Appalachian Kentucky, Demerath *et al.*'s (2003) study of obesity prevalence in rural West Virginian children, and Gallo and Schell's (2005) biocultural study of body mass index in Akwesasne Mohawk youth. These US studies employ a political economy framework by examining growth outcomes in rural communities whose low socio-economic status confers increased risk of obesity compared with the general population.

Using a similar theoretical framework, the present study undertakes an anthropological analysis of child nutrition and growth in a rural Canadian setting. Located in the rural Ontario counties of Grey and Bruce, this research seeks to understand the interaction of both biological and socio-cultural processes that produce particular growth and nutrition outcomes in this population.

1.6 Objectives

In the fall of 2002 I contacted Mary Anne Alton, Superintendent of Elementary Schools for the Bluewater District School Board and Lynda Bumstead, Public Health Dietician for the Grey Bruce Health Unit. They enthusiastically endorsed their agencies' participation in a study of rural child growth and nutrition. In the spring of 2003, we met with school principals and health unit officials. Through a collaborative process this group developed a set of research objectives that suited the needs of the research partners, including myself.

The objectives of the research, at its outset, were fourfold:

1. To evaluate the growth and nutrition status of a sample of rural Canadian schoolchildren.
2. To explore the school context of children's nutrition.
3. To build knowledge useful for the development and implementation of nutrition policy and programs.
4. To conduct nutrition workshops with children and parents in school and community settings.

In the spirit of community-based applied health research, the objectives blend the academic goal of gathering high-quality data on child growth and nutrition with the applied goal of supporting positive change in school and community nutrition policy and practice. The applicability of the research was strengthened by the participation of school board administrators, school principals and public health dieticians from the project's earliest stages through dissemination of findings. This model of partnering with community organizations is endorsed by public health scholars seeking shared learning and action around health prevention goals (Aronson *et al.* 2006; Seifer 2006) and has the added benefit of developing local capacity and resources that can be marshalled for future community efforts.

In addition, it was recognized from the outset that children would benefit from participation in multiple stages of the research, including the processes of consent, data collection, analysis, and dissemination (Alderson 2000). For this reason, significant time and resources were devoted to newsletters, classroom workshops and media presentations, in the hope of engaging children and their families in the process of research.

1.7 Research Questions

The research set out to answer the following research questions:

1. What is the prevalence of overweight and obesity in this sample? How do those results compare with findings from other studies?
2. What are the results of nutritional analysis in this sample? How do those results compare with recommendations from Canada's Food Guide to Healthy Eating (Health Canada 1997) and to the Dietary Reference Intakes (Institute of Medicine 2000)?

3. How do conditions in the school environment affect children's nutrition and growth? Do food-related policies, rules and practices in the school environment support the curriculum objectives of communicating positive nutrition messages based on Canada's Food Guide to Health Eating (Health Canada 1997)?

1.8 Structure of the Thesis

The thesis is organized into two distinct types of chapters: the first are chapters that summarize content areas (theoretical frameworks, research setting and methodology); the second are chapters that consist of manuscripts prepared for publication in scholarly journals. Although the manuscripts themselves contain content from these areas, the thesis requires stand-alone chapters addressing these areas.

Chapter 2 is a review of theoretical and conceptual frameworks employed in research on child growth and nutrition. The chapter describes the existing anthropological research on growth, nutrition and obesity as well as other theoretical perspectives that inform the present study: studies of health and place; school studies; socioeconomic analyses including social determinants of child health; and the anthropologies of the body and childhood. The chapter locates the present study in a biocultural theoretical framework, defining key terms and constructs significant to the research, and connects it with the tradition of applied anthropological research.

Chapter 3 provides a cultural, political and economic history of the research setting. As well, it includes an overview of definitions of "rural" and locates the study area within its larger

Canadian context. It then provides socioeconomic profiles of the six school communities, brief sketches of the schools themselves, and a section describing fieldwork in schools.

Chapter 4 is a detailed description of the methods used in the research. It contains a detailed examination of the process through which methods were selected and then applied in the field. The limitations of the methodology are discussed. This chapter also contains a discussion of the ethical challenges that arose during fieldwork, with particular emphasis on issues of consent arising from doing research with children.

Chapters 5, 6 and 7 are manuscripts. Chapter 5, entitled "Obesity rates among rural Ontario schoolchildren", was published in the *Canadian Journal of Public Health* (Galloway 2006). It presents findings from the anthropometry portion of data collection only. Chapter 6, entitled "Gender differences in growth and nutrition in a sample of rural Canadian schoolchildren", was published in the *American Journal of Human Biology* (Galloway 2007). It presents findings from both the anthropometry and dietary recall portions of data collection and emphasizes the gender differences in obesity prevalence and dietary intake observed. As the journals' editors limited the length of discussion of research findings, an afterword is provided which addresses more thoroughly the gender differences in growth and nutrition observed in the study. A second afterword to Chapter 6 describes the application of the anthropometry and dietary intake data by the school board and public health unit.

Chapter 7, entitled "Children's school mealtime experiences: controlling children's bodies and behaviour through food rules and rewards", was prepared for *Social Science and Medicine.* It focuses on the results of qualitative data collection, primarily through focus groups with children, and explores the influence of institutional processes, such as school rules and mealtime practices, on the nutrition environment of children. An afterword to Chapter 7 discusses aspects of the school and community environments that may influence child nutrition and growth, drawing on additional literature to discuss the issues of children's social worlds, body image and self-esteem.

Chapter 8 concludes the thesis by evaluating the extent to which the research questions were answered and the goals of the research were met, and by summarizing the study's contribution to the literature on child nutrition and growth. A discussion of the conceptual underpinnings of the thesis reveals limitations in the ability of biocultural theory, as it is conceived here, to address the issues raised by the results. Suggestions for future research directions are provided.

1.9 Conclusion

The present research stems from curiosity about the childhood antecedents of adult obesity risk in rural Canadian communities. There is mounting evidence that rural Canadians are at disproportionately high risk of obesity (Huot *et al.* 2004; Orr *et al.* 1998; Østbye *et al.* 199; Self *et al.* 2005; Thommasen *et al.* 2005) and its concomitant metabolic effects (MacLean *et al.* 1992; MacDonald *et al.* 1992; Reeder *et al.* 1992). There are indications that Canadian children are at increasing risk of obesity (Canning *et al.* 2004; Plotnikoff *et al.* 2004; Tremblay and Willms 2000). This has provoked provincial governments to examine nutrition and physical activity policy in schools, prompting numerous recent policy announcements. However to date there have been few studies that examine the obesity prevalence of rural children, and even fewer that examine the contribution of the school environment to children's growth and nutrition. Existing studies of obesity prevalence in rural children come from the anthropology literature and focus on the growth of children living in economically-disadvantaged rural US communities.

The present study is an anthropological analysis of child nutrition and growth in a rural Canadian setting. Located in the rural Ontario counties of Grey and Bruce, the research seeks to understand the interaction of both biological and socio-cultural processes that produce particular growth and nutrition outcomes in this population.

Chapter 2 Studies of Child Growth and Nutrition: Theoretical and Conceptual Frameworks

2.1 Introduction

The following chapter identifies the theoretical orientation of the present study and locates it within the wider anthropological literature. It explores the range of theoretical and conceptual approaches to the study of child growth, obesity and nutrition in North America and identifies those that particularly inform the present research. From the tradition of auxological anthropology through to contemporary studies of variability in child growth, anthropologists have consistently explored the link between environmental quality and growth outcomes in children. This research has been supported by studies that demonstrate the impact of nutritional quality on growth, as well as the significance of socio-cultural processes in shaping the dietary patterns of humans.

There is evidence of variation in human growth and nutrition within the North American context. Children living in different neighbourhoods and socioeconomic conditions experience varying levels of obesity and nutrition. The impact of both neighbourhood and socioeconomic factors on child growth and nutrition has been widely demonstrated, and yet the processes through which place and class affect growth and nutrition have not yet been traced.

The present study employs a biocultural theoretical orientation (McElroy 1990; Thomas 1998), in that it endeavors to describe the relationship between biological outcomes and the environment in which these occur. The research is located in rural Ontario schools where both socioeconomic conditions and cultural factors mediate the bodily expression (growth, obesity, nutrition), or embodiment, of numerous physical, social and cultural forces. This process can be understood through Lock and Kaufert's (2001) concept of "local biologies" wherein biological outcomes are embedded in the physical and social conditions particular to the rural schools and communities under study. The research is both child-centered and applied, founded on the complementary models of children's agency and community-centered research.

2.2 Anthropology of Growth

Human growth is determined by the interplay of genetic and environmental factors (including but not limited to nutrition, physical work and infectious disease), resulting in a wide range of growth outcomes in a given population (Tanner 1990). It is precisely this diversity of outcomes which makes growth a central area of focus to physical anthropologists (Hoppa and Fitzgerald 1999). Theoretical debates in the discipline have included the relative contributions of genetic and epigenetic factors to growth (Ellison 2005), the heritability of environmental factors that limit growth (Frisancho 2000), and the role of prenatal and early childhood environments in mediating the phenotypic expression of growth (Kuzawa 2005; McDade *et al.* 2001a, 2001b; McDade 2005).

The tradition of auxological anthropology is founded on the pioneering work of Franz Boas (1916, 1920, 1928, for examples) whose seminal studies of North American populations set the standard for modern technical and analytic excellence in research that withstands modern re-analysis (Gravlee *et al.* 2003). Boas' contemporary, Ales Hrdlička, was a prolific researcher and author who published auxological studies of both living and extant populations in North and

South America, Africa and Europe (Hrdlička 1906, 1908, 1916, for examples). Scientists like Boas and Hrdlička collected empirical data that challenged the typological assumptions of 19th century armchair anthropologists such as Edward B. Tylor (1871) and Lewis Henry Morgan (1877). Under the guidance of these leaders and others, the physical anthropology of growth burgeoned into its current form, a wide-ranging field of inquiry into questions about the variability and plasticity of human growth.

Gabriel Lasker dominated the field of auxological anthropology for much of the 20th century. His early work mirrored Boas', in that it illustrated the plasticity of growth in Chinese-born immigrants to the US (Lasker 1946). His work with Mexican-American migrants continued to demonstrate the role of environmental quality in improving growth outcomes (Lasker 1953; 1954). More recently, his collaboration with Nicholas Mascie-Taylor explored the relative contribution of socioeconomic variables to child growth in a British cohort study (Lasker and Mascie-Taylor 1996; Mascie-Taylor and Lasker 1995). Despite the collection of a wide range of biological and social markers, the stature of the cohort children was most consistently linked to socioeconomic status, in this case family size, housing tenure (owned or rented) and the occupation and educational attainment of the father. Following in this tradition, studies of historic (Murray 1993; Steegmann 1985, 1986; Steegmann and Haseley 1988) and contemporary populations (Carson 2005; Norgan 1995; Ulijaszek 1994, 2001a, 2001b, 2003a, 2003b, 2003c) consistently demonstrate the positive association between socioeconomic status and outcomes in growth and nutrition.

The work of Barry Bogin has been profoundly influential in demonstrating the influence of the quality of the lived environment on children's growth. Bogin's study of Guatemalan Mayan migrants illustrates the plasticity of childhood growth in a variety of environmental contexts, and the range of growth outcomes possible for individuals in a population with limited genetic variability. Within Guatemala itself, the children of residents of Guatemala City had anthropometric status that was strongly correlated with parental birthplace (Bogin and MacVean 1981b). Children of migrants to the city were smaller and shorter than children of urban-born parents. Anthropometric status was strongly associated with socioeconomic status (Bogin and MacVean 1981a; Bogin 1991; Bogin and MacVean 1983, 1984). Comparison with non-Mayan Ladino children indicates that differences in growth and nutritional status are related to historic, political and socioeconomic factors affecting Mayans in Guatemala, rather than genetic ones (Bogin 1991; Bogin *et al.* 1992; Bogin and Keep 1999).

Bogin comes to similar conclusions in his studies of growth among Mayan immigrants to the US cities of Indiantown, Florida and Los Angeles, California. The US-born children of Mayan immigrants to the US experience substantially greater growth than their counterparts living in Guatemala (Bogin and Loucky 1997; Bogin *et al.* 2002; Smith *et al.* 2003b). The difference in mean stature between 1992 Guatemalan-Mayan children and 2000 US-Mayan children was 8.9 cm, the largest such increase in linear growth ever recorded in a migrant population. As Bogin *et al.* (2002:759) observe, "the change in stature is a testament to the dreadful conditions for growth that existed in Guatemala...prior to the arrival of the Maya immigrants to the US." Change in stature of this magnitude within a population is an eloquent demonstration of the role of the lived environment in shaping children's developmental biologies. In addition, the wealth of evidence on the costs of poor nutrition and growth faltering (see Beaton 1989; Messer 1989, for examples) challenges theoretical paradigms that view constrained growth as an adaptive response to environmental stress.

While human biologists since Boas' time have explored environmental constraints on growth, Bogin was the first to attempt to explain growth faltering in explicitly political economic terms. "Eight thousand years of economic and political history in Latin America revealed by anthropometry" (Bogin and Keep 1999) placed the biologies of childhood within a historico-political framework that examined growth as the outcome of large-scale geopolitical forces. Similarly William Leonard makes explicit the role of political economic forces in the growth outcomes of economically marginalized Andean population (Leonard 1989a, 1989b, 1991, 1995, 2000) and indigenous Siberian populations in post-Soviet Russia (Leonard 1999; Leonard 2002; Snodgrass *et al.* 2006). For the Siberian *Evenki*, relative poverty is associated with the negative growth outcomes of stunting and low weight-for-age in children. The decline in linear growth is more pronounced in girls, suggesting an interaction between gender and environment that has greater biological costs for girls in terms of nutrition, work or exposure to infectious disease (Leonard 2002).

Much anthropological research on growth centers on developing nation contexts, where growth serves as a measurable proxy for social class markers, which variously expose groups to conditions in the environment such as poor nutrition and infectious disease. In industrial and post-industrial contexts such as North America, these processes may be viewed historically, as in Hoppa and Garlie's (1998) study of the growth of Toronto children. Based on published data, the oldest of which is an 1891 study by Boas, the authors document secular trend in linear growth dating from a period of severe economic depression through improvements in economic and living conditions to the relative prosperity of present-day Toronto (Garlie 2000; Hoppa and Garlie 1998). Variability in growth associated with socioeconomic conditions can also be found in studies in post-industrial nations by examining growth in disadvantaged or marginalized populations. Anthropological studies of childhood obesity prevalence in low income communities by Demerath *et al.* (2003), Crooks (1999a, 1999b, 2000) and Moffat *et al.* (2005) represent political economic approaches to understanding variability in growth. Gallo *et al.* (2005, 2007) and Schell *et al.* (2003) examine growth outcomes in Akwesasne Mohawk youth whose diets are affected by the conflict of local ecosystem deterioration (due to toxic pollutants) versus cultural identity which privileges wild caught foods. As in developing nations, studies based in North America illustrate the importance of examining human growth within the environmental context.

2.3 Nutritional Anthropology and the Anthropology of Food

Since diet and nutrition are key factors in studies of children's growth, nutritional anthropology and the anthropology of food is an important field of interest to biological anthropologists studying growth and development. Anthropologists whose subject is food have a long tradition of incorporating biological, cultural, sociological, ecological, and feminist theoretical perspectives on human diet and foodways. These perspectives facilitate understandings of food and food use that are derived from both local and global socioeconomic processes and contribute greatly to our knowledge of diet and foodways. The challenge facing contemporary anthropologists is to merge the anthropologies of nutrition and foodways in order to produce analyses that examine biological aspects of nutrition in their larger socioeconomic contexts.

Cultural materialist approaches to the study of food, such as Harris' (1974) research on food proscriptions and Rappaport's (1968) work on food practices examined the ecological role of foods such as the pig in various cultural contexts. Eaton and Konner (1985) and Eaton *et al.* (1988) famously suggested that many health concerns, such as cardiovascular disease and diabetes, were caused by a mismatch between a modern Western diet and a human biology that evolved in times of intermittent food scarcity. More recently, scholars have approached obesity research from the perspective of evolutionary ecology, describing human food procurement as "foraging" (Lieberman 1987) and examining factors in the environment, such as colourful advertising and supersized meals, that appeal to "prehistoric and historic feeding patterns" (Lieberman 2006:7). These ecological and evolutionary approaches are predicated on the idea that foodways are adaptive. Armelagos (1987) points out, however, that many longstanding food systems or traditions are not nutritionally "adaptive", in that they may produce serious nutritional deficiencies. Feminist scholars such as Counihan (1999), moreover, go further in their critique of these approaches, claiming the emphasis on food procurement represents a "masculinized" analysis of the role of food in society and obscures the power relations inherent in the everyday practices of food preparation, exchange and consumption within households, families, or even individuals.

Symbolic (Douglas 1966, 1984) and structuralist (Barthes 1961; Levi-Strauss 1970) approaches explore the symbolism conveyed in the language and rituals surrounding food preparation and consumption. These analyses, such as Douglas' (1966:52) work on the sexual taboos communicated by cultural food rules and restrictions, emphasize the meanings conveyed by seemingly inconsequential aspects of the "common meal":

> It would seem that whenever a people are aware of encroachment and danger, dietary rules controlling what goes into the body would serve as a vivid analogy of the corpus of their cultural categories at risk.

However critics of symbolic approaches suggest that they perpetuate a cultural relativism that is apolitical, in the sense that it does not challenge the geopolitical forces that shape food distribution and consumption (Singer and Baer 1995). I would add that, while extremely useful, these approaches separate food from its biological context and thus fail to address the biological dimensions of human foodways.

Since the 1980s, there has been a shift in nutritional anthropology toward feminist and political economic theoretical approaches that challenge the powerful forces shaping food production, distribution and consumption. Numerous authors have studied the interaction between interpersonal, societal and global factors as they relate to food. Some explore the role of commodities in establishing and perpetuating colonial power relations (Mennell 1997; Mintz 1985, 1996; Pelto and Pelto 2000); many explore the role of food in maintaining or resisting the social order (Allison 1997; Counihan 1999; Deck 2001; Dusselier 2001; Hughes 1997; Neuhaus 2001; Parkin 2001); others trace the linkages between food and poverty, hunger and discrimination (Fitchen 1997; Glasser 1988; Van Esterik 1997). Informed by feminist anthropology, many studies trace the impact of dominant ideologies on the health and nutritional practices of women and children. For example, Van Esterik and Greiner (1981) and Van Esterik

(1994) explore the tension between women's employment and breastfeeding practices. Their analysis strikes at the core of theoretical debates in the anthropology of gender, including women's productivity and reproductivity, sexual division of labour, and the role of women's biology in defining gender. These theoretical issues are intrinsically linked to nutrition through the practice of breastfeeding, in which the issues of motherhood and nutrition, conceptualized as "domestic" in Western contexts, are tied to power relations in the "masculinized" sphere of employment. This type of analysis is also valuable in examining the political, social and cultural underpinnings of bodily image and disordered eating, such as Nichter's (2000) examination of girls' and parents' understandings of dieting.

Political economic studies of human foodways reveal the structural inequalities that constrain growth and nutrition. Changing dietary patterns have led to the coexistence of under- and over-nutrition and their concomitant health effects in many communities (Popkin 1994; Popkin and Gordon-Larsen 2004). At the local level, these processes are augmented by exigencies such as unemployment and local school policies. Crooks' (2000, 2003) study of dietary intake in Appalachian Kentucky schoolchildren is an illustration of this process. In a regional context of high unemployment and limited school funding, local school policy permits the sale of nutritionally-suspect snack foods in order to provide revenues for sports, recreation and artistic programs (Crooks 2003). This trade-off creates "obesogenic" school environments in the very communities already at highest risk for obesity and undernutrition due to their socioeconomic status. This use of political economy to examine biological outcomes, known as biocultural anthropology, is emerging as a significant theoretical avenue for nutritional anthropologists (Crooks 1999a, 2000, 2003; Demerath *et al.* 2003; Moffat *et al.* 2005).

There is another emerging thread in nutritional research that traces the rhetoric of "risk" as it relates to food production and consumption. Nestle (2002) asserts that the separation of food producers and consumers is integral to the success and profitability of the multinational corporations that control food production and distribution. On a political level this separation produces tension between the known and unknown, or disclosed and undisclosed knowledge about food. This tension is at the root of federal food policy (Nestle 2002; Sims 1998), corporate marketing strategy (Nestle 2002) and public debate about food safety issues such as genetically modified food or bovine spongiform encephalopathy (BSE) (Haukanes 2004; Heller 2004). I would suggest that anthropological studies of nutrition in North America have not yet incorporated this theoretical thread, especially as it relates to obesity. There is significant evidence that the health risks of mass-produced food, including obesity, have been deliberately concealed by marketers in order to maximize profits and market share (Brownell and Battle Horgen 2004; Critser 2003; Waldman and Lamb 2004; Winson 2004). Led by journalists such as Schlosser (2002) and Spurlock (2005), anthropologists may soon examine the historical processes behind mass consumption of convenience foods known to pose significant risk of obesity and poor health.

2.4 Anthropological Studies of Obesity

A number of anthropologists have studied cross-cultural perspectives on obesity. In reviews of this research Brown and Konner (1987) and Powdermaker (1997) recall the high social value placed on corpulence in pre-industrial societies such as the Pacific Islanders studied by Malinowski and Radcliffe-Brown. The strong association between fatness and fertility is demonstrated in the gendered language of South African tribal groups (the slim new moon is male and the round full moon is female) and in the East African fattening huts described by Roscoe (in Powdermaker 1997). Becker (1995) has documented a preference for fatness among Fijians who associate fat with fertility, hardiness, power, good nurturance and love. Sobo (1997: 259) has described the association between "plumpness" and the social production of health and fertility through food sharing and exchange in rural Jamaica: "weight loss signals social neglect…in the ideal Jamaican world, mothers feed their children, kin feed kin, and lovers feed each other." These associations reflect a set of shared social norms around body size which are based at least partially on the biological constraints on growth and fertility experienced by small-scale rural economies such as subsistence herders and horticulturalists (Brown and Konner 1987) and by physiologic adaptations to periodic food scarcity (Ulijaszek and Lofink 2006). Normative values of body size are reinforced by cultural values around food sharing and reciprocity (Becker 1995; Sobo 1997).

In post-industrial societies, the prevailing social norm idealizes slimness and leanness (Brown and Konner 1987; Shroff and Thompson 2006): "in mainstream US culture, obesity is socially stigmatized even to the point of abhorrence" (Brown and Konner 1987:39). However, Powdermaker (1997) argues that cross-cultural ideals favouring plumpness continue to permeate industrialized culture and are the source of tension around gender and status, especially for women: "the desire for health, for longevity, for youthfulness, for sexual attractiveness is a powerful motivation (while) consciously, or unconsciously, our symbolism for a maternal woman is on the plump or obese side;…the image for mother and for mate may be in conflict" (Powdermaker 1997:207). Ritenbaugh (1982) observes that current North American standards for identifying obesity have been informed by such disparate forces as commercial marketing and the insurance industry. Over time, obesity cutoffs for men and women have not reflected either secular trend in stature (and consequently body mass) or actual health risks that are significant for people of both very high and very low adiposity (Keys 1980). Ritenbaugh (1991) comments on the symbolic value of body size in a culture where many aspects of the body are treated as infinitely malleable. Obesity in women can limit both economic and social mobility, leading to a form of positive feedback where body size is both caused by and leads to a lack of resources.

The theme of gender is a common thread of anthropological research on obesity. The phenomenon of increased obesity in women of low socioeconomic status has been observed by anthropologists studying populations undergoing economic transition. In reviews of studies of obesity, Brown and Konner (1987) and Sobal and Stunkard (1989) report a consistent inverse relationship between obesity and socioeconomic status in women. While no evidence of such a relationship exists in girls, a series of British cohort studies documents the development of this inverse relationship in adolescent girls (Sobal and Stunkard 1989). Garn and Ryan (1981, in Sobal and Stunkard 1989:265) term this transition the "socioeconomic reversal of fatness." These studies describe an interaction between gender and socioeconomic status among adult women that appears to be nearly universal.

More recently, anthropological studies of obesity have employed theoretical approaches that examine cultural and socioeconomic processes underlying high prevalence in populations. A number of studies explore the development of obesity in communities that have undergone rapid economic transition. Cameron (2003) and Cameron *et al.* (2003, 2005) have documented rising obesity rates in children living in post-apartheid South Africa. Snodgrass *et al.* (2006) and Sorensen *et al.* (2005) report high obesity prevalence among subsections of a rapidly-modernizing indigenous Siberian population. In these cases the social and economic changes brought about by modernization have placed some people at disproportionate risk of obesity and ill health. Frisancho (2003) seeks to understand the metabolic processes which underlie obesity in developing nations, namely a preferential shift toward carbohydrate metabolism rather than fat oxidation brought about by chronic undernutrition during fetal development and early childhood. In contrast, Brewis (2003) explores the physical and psychosocial correlates of obesity in relatively privileged Mexican children, in whom obesity is a cultural marker of wealth and good health.

Other recent studies examine the prevalence of obesity in North American communities. Sherry *et al.* (1992), Demerath *et al.* (2003) and Crooks (1999a, 2000) report high prevalence of obesity in children living in economically-depressed rural US communities. In these low income communities, children are at elevated risk of obesity, poor diet and ill health.
Greater obesity risk for low income children has also been reported by Moffat *et al.* (2005), in a comparison of children's obesity prevalence and dietary patterns in high- and low-socioeconomic status urban neighbourhoods, and by Gallo *et al.* (2005, 2007) and Schell *et al.* (2003), in a study of Aboriginal youth from the Akwesasne Mohawk Nation. These studies emphasize the profound influence of the lived environment on the growth outcomes of children.

Explorations of the environmental correlates of obesity have included the effects of economic factors and social class. Dressler (2006) urges anthropologists to define environment even more broadly, incorporating cultural aspects such as collective ideals and normative values in our conceptualization of environment. Ulijaszek (2007) has responded to this call by advancing a framework for understanding obesity in terms of cultural consensus, whereby biologies (in this case obesity prevalence) are expressions of local collective ideologies, including understandings of body size and nutrition. Ulijaszek's (2007) cultural consensus model is an attempt to broaden epidemiologic approaches to understanding obesity causation, which tend to centre either on behavioural aspects such as eating and physical activity or on locational studies of obesogenic environments.

2.5 The Role of Place

(i) Area-Level Variation in Growth and Nutrition

As seen from the research cited above on the variability of childhood obesity in relation to place, studies of geographic variation in health indicate that area-level indicators have a significant effect on children's nutrition and growth. The role of place in the production of health holds promise for researchers and practitioners:

> If the systematic patterning of an individual's health status is shaped partly by the contexts, places and locations in which individuals live, in addition to their own individual attributes, this may open up new avenues of intervention, over the long run, that differ fundamentally from traditional individually based interventions. (Dunn *et al.* 2006)

The burgeoning of studies of health and place, assisted in recent years by development of global information systems (GIS) technology, is broadening understandings of the production of health.

Like those studying the social determinants of health, researchers studying geographic variability in health outcomes have sought to reveal the pathways through which factors in the physical and social environment influence community health. Literature from the United Kingdom indicates that fast food may be more prevalent than healthy, nutritious food, which is more costly and less available in low-income neighbourhoods (Cummins *et al.* 2005; Cummins and MacIntyre 2002). North American studies indicate such disparities exist in both Canada (Latham and Moffat 2007) and the US (Austin *et al.* 2005; Powell *et al.* 2006). Swinburn *et al.* (1999) coined the term "obesogenic environment" to describe those neighbourhoods where physical, economic, political and socioecultural factors constrain the availability of low-cost, nutritious foods and physical activity for residents. Molnar *et al.* (2004) report that parents' perceptions of neighbourhood safety are significantly associated with physical activity in urban Chicago teens. In a study of urban US teens, Romero (2005) reports that obesity risk factors such as sedentism are associated with neighbourhood characteristics such as parks, after-school programs, walking distances, transportation and perceived safety. Ewing *et al.* (2003) suggest that more research is needed to examine area-level influences on diet and physical activity that may influence the risk of overweight and obesity and related health outcomes.

Little research of this kind has been undertaken in rural areas. An exception is a recent study of health indicators in the rural Quebec county of Portneuf, population 45,000 (Pampalon *et al.* 2007). Portneuf is an administrative area comprised of three small towns and their hinterlands. A previous study demonstrated significantly poorer health indicators (lower life expectancy, fewer years of disability-free life expectancy) in Portneuf residents compared to residents of nearby Quebec City (Pampalon *et al.* 2006). When examined at a local level, there was significant variability in socioeconomic and health indicators among smaller neighbourhood units within the county (Pampalon *et al.* 2007). Residents of the small town where life expectancy was highest tended to be younger, wealthier and more educated than residents of the hinterland, where the older, poorer and less well-educated population also had the lowest disability-free life expectancy. This local variability was obscured in the larger rural-urban comparison.

Instead of measuring area-level variation in health or socioeconomic indicators that contribute to obesity, researchers have begun to measure area-level variation in obesity itself. A study of obesity prevalence by ZIP code area reveals pronounced geographic variability in obesity prevalence that is only partially explained by socioeconomic factors such as income and education (Drewnowski *et al.* 2007). This finding lends support to recent claims in the literature that traditional socioeconomic indicators, such as income, education and employment status, may give an incomplete picture of the elements that contribute to obesity (Braveman *et al.* 2005; Marmot 2000). In order to explain geographic variability in obesity prevalence, at both the global and local level, researchers require a conceptualization of environment that is at once more encompassing and more nuanced.

(ii) School-Based Studies of Child Growth and Nutrition

The majority of studies of child growth and nutrition are located in schools for the convenience of collecting data from children. During school terms, North American children spend up to one-third of their waking hours in a school environment. Schools provide centralized locations where large numbers of children of similar ages congregate. As a result, school-based studies have a long history in anthropology (Bogin 1995; Bogin and Loucky 1997; Bogin *et al.* 2002; Brewis 2003; Crooks 1994, 1999a, 1999b, 2000; Demerath *et al.* 2003; Garlie 2000; Malina 1983; Moffat *et al.* 2005; Pena Reyes *et al.* 2003).

But beyond facilitating research, school offers an interesting site for the study of child growth and nutrition. There is abundant sociological literature on the role of school in shaping children's lives. School is a social institution wherein normative values are inculcated by means of the rules and rituals associated with learning. Christensen and James (2001b) have described the role of schools in promoting conformity to societal rules and expectations. These include normative values about authority and power (Ennew 1994; Mayall 1994; Messner 2000), work and productivity (Haydon 1997; Willis 1977) and gender roles (Haydon 1997; Corteen and Scraton 1997). In addition, there is an extensive literature on the process of socialization that occurs at school (Hirsch and Dubois 1989; Mayall 1994; Oswald *et al.* 1994; Salzinger and Hammer 1988) and its effects on social interaction throughout the lifespan.

Indeed school may be viewed as both a physical and social context for studies of child growth and nutrition. Schools are physical environments that influence children's biology through a broad range of determinants, including spatial and temporal constraints on eating and physical activity, food marketing and sales, and nutrition policy and programs. Schools can also be viewed as social environments in which messages about body image, body size, food, nutrition and health are conveyed through social means. Because North American systems of education are organized, centralized and highly institutionalized, schools share many of the physical and social attributes interesting to researchers. This means that research on the influence of school environments has broad appeal to educators and public health planners. At the same time, the influence of local historic, economic and demographic processes on school communities shape children's growth and nutrition in particular ways, providing opportunities for exploration of local processes influencing children's biologies.

Few anthropological studies explicitly explore the link between child growth and the school environment. A significant exception is Crooks' (1999b) exploration of the paradox contained in school nutrition programming: an ideology and policy which promote nutrition; and a culture which considers food a marketable commodity, to be advertised and sold to children for profit.

Beyond anthropology, school is becoming an increasing focus of public health research on childhood obesity and nutrition. Carter and Swinburn (2004) examine physical, economic, policy and social factors in the school environment that contribute to childhood obesity. Kubik *et al.* (2005b) report school nutrition practices such as snacking and soft drink sales that have negative effects on children's diet. With its history of school-based studies, the discipline of anthropology has the opportunity to provide leadership in this area. The present study offers a number of recommendations regarding research conducted in schools, particularly in the areas of methodology and ethics (Chapter 4).

2.6 Socioeconomic Determinants of Child Growth and Nutrition

In the North American setting, the majority of contemporary research on child growth and nutrition is epidemiologic: it examines patterns of growth and dietary consumption in selected populations. In the United States, much of this research focuses on inter-ethnic disparities in obesity prevalence (see Bachar *et al.* 2006; Freedman *et al.* 2005, 2006; Graham 2005; Hoelscher *et al.* 2004; Kimbro *et al.* 2007; Kimm *et al.* 2002; Zephier *et al.* 2006, for examples). There is evidence that some portion of the variability in obesity prevalence is related to genetic (Frisancho 2000; Herbert *et al.* 2006; Sookoian *et al.* 2007) and epigenetic factors (Dulloo *et al.* 2006; Gluckman *et al.* 2005), and much recent research emphasizes these theoretical directions. However I would argue that there is a preponderance of research from the nutritional and medical sciences which favours socioeconomic explanations for variability in diet and growth.

In 1987, Gortmaker *et al.* published the results of a longitudinal analysis of triceps skinfold thicknesses in US children age 6-11 years. The authors documented a 54% increase in childhood obesity between 1963 and 1980. In 2000, Flegal and Troiano reviewed four decades of body mass index data from the National Health and Nutrition Examination Surveys of the US population. The percentage of obese children nearly tripled from 1963 to 1994. The rapidity and pervasiveness of increased body size in the American population during that period suggested that "environmental causes are likely responsible" (Gortmaker *et al.* 1987:535). Subsequent research has borne out this claim.

Within the overall trend toward increased obesity prevalence in the US, researchers have identified populations whose risk is disproportionately high. These include children from low income and food-insufficient families and children whose parents have low levels of educational attainment. Mei *et al.* (1998) observe an increase in obesity prevalence among preschoolers 2-4 years of age from low-income families in 18 states. Vieweg *et al.* (2007) report "robust and highly significant correlations" (8) between socioeconomic status and obesity among school-age children in Virginia. Goodman *et al.* (2003) report that overweight prevalence among Ohio schoolchildren is inversely related to household income and parental education.

Similarly, Martin and Ferris (2007) find that children aged 2-12 years living in low-income Connecticut households are more likely to be overweight than their middle- and high-income counterparts. However, the authors report differences in obesity risk associated with the extent of poverty. Children with the lowest family incomes are less likely to be overweight than those with family incomes nearer the poverty line, indicating that children in extreme poverty may not be exposed to sufficient caloric intake for obesity to arise.

Using national data, Alaimo *et al.* (2001) report that children from low-income and food-insufficient families have significantly greater obesity prevalence than children from high-income, food-sufficient families. Wang (2001) documents significantly greater obesity risk in US 10-18-year-olds from low-income households compared to those from middle- and high-income households. In a survey of US teens, Goodman *et al.* (2003) report that obesity risk is inversely associated with both household income and parental educational attainment, with parental education accounting for the largest proportion of the influence of socioeconomic variables on obesity risk. Whitaker and Orzol (2006) report similar findings among 3-year-olds from 20 US cities; maternal education, household income and food security are all strongly and negatively associated with preschool children's obesity prevalence.

Children's diet is also closely connected with socioeconomic status. National-level data from the US shows that among households with children, 3% experience food insufficiency, while 7.5% of low income households with children are food-insufficient (Casey *et al.* 2001). Compared with children in higher-income households, low income children consume significantly fewer calories, carbohydrates and fruits and had higher cholesterol intake. Bowman *et al.* (2004) have documented greater fast food consumption in low-income children aged 4-19 years in six US states. In addition, low-income children consume significantly more energy, fat, carbohydrate, added sugars, sugar-sweetened beverages and less milk, fruit and non-starchy vegetables than their higher-income counterparts. Nutritionists have documented lower milk and calcium intake (O'Connor *et al.* 2006; Storey *et al.* 2004), greater juice intake (Melgar-Quinonez and Kaiser 2004), greater soft drink consumption (Warner *et al.* 2006) and increased snacking behaviours (Kaiser *et al.* 2001) in children from low socioeconomic status households in the US.

Drewnowski and Specter (2004) draw a direct link between poverty and obesity in the economic cost of various energy sources consumed by individuals and families. In a review of US and European databases and laboratory research on food cost and composition, the authors claim that energy-dense foods marketed on the basis of low cost tend to be highly palatable and to encourage "passive overcomsumption" of fats and sweets through low water content and diminished satiation (Drewnowski and Specter 2004:8). Studies have demonstrated that, in terms of relative economic cost, fruit and vegetables contribute only 8% of dietary energy, but account for 17% of the total cost or price of a day's food consumption (Maillot *et al.* 2007). Meat contributes only 18% of total daily energy but accounts for 35% of total cost. In contrast, starches and grains contribute 23% of dietary energy at a cost of only 9% of the price of the day's food supply. As a result, individuals tend to vastly overconsume starches and grains, while underconsuming foods from the vegetable, fruit and meat food groups. According to this economic or "econometric" (Maillot *et al.* 2007) model of energy consumption, consumers' preference for foods which make them overweight is a rational response to both unconscious (satiety) and conscious (cost) influences on decision-making.

There is limited Canadian literature on the socioeconomic determinants of child growth and nutrition. With the publication of Canadian data on secular trend in obesity prevalence (Katzmarzyk *et al.* 1999; Willms *et al.* 2003), Canadian nutritionists and epidemiologists have documented the disproportionate burden of obesity risk on socioeconomically disadvantaged communities. Evers and Hooper (1995) reported increased overweight prevalence and low energy intake in children living in eleven Ontario communities characterized as disadvantaged on the basis of high proportions of families living in subsidized housing, on social assistance, and with lone or unemployed parents. In a longitudinal study of 9-12-year-old children living in low-income neighbourhoods in Montreal, researchers found that 39.4% of children were overweight, and that the quality of dietary intake was directly proportional to socioeconomic status (Johnson-Down *et al.* 1997). Dietary intake of fat was higher in lone-parent families and intake of iron and vitamins A, C and folate was associated with income sufficiency (Johnson-Down *et al.* 1997). Participation in organized sports and activities was found to reduce weight gain in children (O'Loughlin *et al.* 2000) and was inversely related to socioeconomic factors such as household income, parents' employment status, and parental educational attainment (O'Loughlin *et al.* 1999).

In a comparative study of children attending schools in low- and high-socioeconomic (SES) status Hamilton, Ontario neighbourhoods, Moffat *et al.* (2005) found significantly higher mean body mass index in children attending low-SES status schools. Compared with an obesity prevalence of 3.6% in the high-SES school, children attending low-SES schools had an obesity prevalence of 12.3%. In a study of grade 5 students in Nova Scotia, Veugelers and Fitzgerald (2005) found that children living in high-income neighbourhoods were only half as likely to be obese as children living in low-income neighbourhoods. In a cohort study conducted in the province of Quebec, obesity risk at age 4.5 years was strongly and negatively associated with family income, maternal education and family food sufficiency (Dubois and Girard 2006; Dubois *et al.* 2006). The experience of food insufficiency at any point during the first 4.5 years of a child's life more than doubled the risk of a child being overweight and tripled a child's risk of obesity (Dubois *et al.* 2006).

There is abundant European literature on socioeconomic influences on child growth and nutrition. Frye and Heinrich (2003) report a significant negative correlation between parental education and childhood obesity in East German schoolchildren. Similarly, Danielzik *et al.* (2004) found that parental education was significantly associated with childhood obesity prevalence. While children with university-educated parents had an obesity prevalence of 28%, children whose parents had nine or fewer years of education had an obesity prevalence of 45% (Danielzik *et al.* 2004). In a study of Italian schoolchildren 7-10 years of age, both paternal employment and maternal educational attainment were found to influence children's obesity risk (Valerio *et al.* 2006).

In an interesting comparison of obesity prevalence in Canada, Norway and the United States, Phipps *et al.* (2006) report that both child poverty and obesity are lower in Norway than in the US or Canada. For both Canada and the US, the prevalence of childhood obesity is greatest among children living in poverty, with child poverty and obesity rates highest in the US. The authors suggest that both policy and future research need to focus on "how to develop policies which can mediate solutions in the pathways from poverty to obesity in children" (Phipps *et al.* 2006:8). Suggestions include income support and employment strategies, affordable high-quality child care, physical education in schools, and alternative food pricing strategies which make lean meats, fish, and fresh fruits and vegetables more affordable than energy-dense, nutrient-poor foods.

2.7 Social Determinants of Child Health

The link between poverty and poor health in children has perhaps been most prevalent in the literature on social determinants of health. In recent years, public health organizations, traditionally concerned with lifestyle/behavioural approaches to risk prevention and health promotion (Raphael 2006), are exploring a broader conceptualization of health which includes psychosocial and sociopolitical analyses. The past decade has seen a flourishing of analyses linking individual health outcomes with conditions in the lived environment. The term "social determinants of health" was first used by Tarlov (1996) to describe how material conditions (income, education, employment, quality of housing) and the cognitive appraisal of those conditions relative to others combined to influence health. The Canadian Institute of Advanced Research lists the determinants of health as: income and social status, social support networks, education, employment and working conditions, physical and social environments, biology and genetic endowment,[1] personal health practices and coping skills, healthy child development, and health services (Evans *et al.* 1994).

The broad appeal of social determinants of health as a paradigm for population health research prompted the World Health Organization (WHO) in 2005 to convene the Commission on Social Determinants of Health, whose goal is to marshal forces not traditionally involved in health promotion, such as government finance ministries, civil society organizations as well as representatives from education, labour and transportation sectors, in order to address both global and local health inequalities (Irwin *et al.* 2006).

In North America and Europe, numerous approaches to the social determinants of health exist: studies of material deprivations which contribute directly to poor health; cognitive studies of vulnerability and social exclusion; and life course approaches, which document individuals' exposure to socioeconomic disadvantage at various stages of the lifespan (Raphael 2002, 2006). Materialist studies have documented the contribution of rural poverty to ill health (Kondro 2006; Pampalon 2006; Ross *et al.* 2006). This relationship is perhaps most clear in the link between

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[1] The inclusion of genetic endowment as a social determinant of health is an acknowledgement of the interrelatedness of heritable and environmental determinants of health. A critique of many researchers is that the current climate of enthusiasm for molecular research into disease causation obscures the complexity of "physical, chemical, biological, social, economic and personal factors interacting over the life course to cause disease" (Frank *et al.* 2006). Molecular research lends itself well to controlled study in some populations. However interventions based on genetic screening offer limited hope for widespread improvements in population health. Frank *et al.* (2006:12) assert that "the actual determinants of health at the population level – and especially the role of social structure, environment, and lifestyle – should lead to modest expectations of a "genetic silver bullet" approach to improving population health status."

food security and the health of rural populations: in the UK, for example, the problem of food insecurity can be traced to high food prices in rural areas (Dubois 2006).

Lifecourse studies have demonstrated that poverty and deprivation during fetal development and childhood constrain growth and impact health throughout the lifespan, even if material conditions improve after a period of constraint (Raphael 2002). For example, researchers have demonstrated a positive relationship between level of education in women of childbearing age and folic acid levels, which can directly impact fetal development (Dubois 2006). Measures of social status are directly proportional to nutrition-related health indicators such as the initiation and duration of breastfeeding in the US (Dubois 2006). The vulnerability of children to social determinants of health has prompted the WHO Commission to make improving living and learning conditions in early childhood its number one priority (Irwin *et al.* 2006).

2.8 Anthropology of the Body and Embodiment

One theoretical area which has yet to be integrated fully into the study of childhood obesity is the anthropology of the body. This is a promising avenue of inquiry for biological anthropologists seeking to explain the intractability of negative health behaviours such as poor diet and physical inactivity.

Kleinman (1995), Martin (1987) and others have observed that North American attitudes toward the body are characterized by a categorical separation of mind and body. Bordo (1993) describes how this mind/body dualism is itself gendered, privileging masculine cognition over feminine bodily function and reproduction. Further, Counihan (1999) suggests that in a climate of consumer capitalism North Americans define their bodies, and especially women's bodies, as objects to be worked on or improved. The practice of dieting is an example of this "improvement". Another aspect of North American culture as it relates to the body is its definition of the body as individual, rather than social. Counihan (1999:178) observes that the North American body is predominately a "vehicle of the self", in contrast to other Western cultures where the social body is privileged (see Counihan's 1999 work on the body as connection in Florence, Italy, for example).

I would suggest that cultural conceptions of the body lie at the core of the current biomedical and media attention on the obesity epidemic in North America. The overwhelming majority of obesity research is biomedical, with interventions directed at changing the behaviour of children and adults at risk. This behaviourist orientation is a direct result of an individualist conception of the body. The body is viewed as predominantly under the influence of self. Recent obesity research on dietary restraint takes this individualist conception to extremes, suggesting that propensity toward obesity is manifest in some individuals as a lack of dietary restraint or willpower leading to disinhibited eating (Bisset *et al.* 2007; Martins *et al.* 2008). Researchers have begun to counter cognitive behaviourist interventions that cognitive strategies such as thought suppression may actually backfire by increasing individuals' "willingness and desire to eat" (Soetens *et al.* 2006:655) and "burdensome food-related thinking" (Soetens and Braet 2006:309).

Though it is not explicitly stated, much research into socioeconomic and area-level variation in health (including social determinants of health theory) is built on the concept of embodiment.

Embodiment is defined by Krieger (2005) as the literal incorporation, biologically, of the material and social world in which we live. According to Krieger (2005:352), embodiment is "a multilevel phenomenon, integrating soma, psyche, and society, within historical and ecological context." This concept has long been the basis of anthropology's critical medical anthropology, which explores the influence of political and economic forces on health, illness and health care (Singer 1992; Singer and Baer 1995). In fact Scheper-Hughes and Lock (1987) advanced the concept of the "three bodies" in their seminal work, *The Mindful Body.* Critical medical anthropology is especially concerned with the exercise of power and its effects on the experience of health and illness. This perspective has the potential to expand the social determinants of health framework beyond its current cataloguing of socieconomic forces into a more critical approach that examines the upstream sociopolitical determinants of health (Cook 2005). At present, epidemiologic research, particularly that built on a social determinants of health framework, is somewhat hampered by its historical association with public health and biomedicine. The incorporation of a more critical perspective would deepen analyses and further the goal of the WHO Commission, that of reducing disparities in economic and social resources "including power and prestige" (WHO 2007).

2.9 Biocultural Theory: Bridging Biology and Environment

The present research draws on the theoretical tradition of biocultural anthropology, examining the effect of socioeconomic and cultural factors on biological processes. Biocultural theory has been in existence for decades in the form of research that considers environmental influences on human biology (Dufour 2006). However until recently biocultural theory lacked an explicit articulation of epistemology. This was provided in a collection of papers by Goodman and

Leatherman (1998) which incorporates political economy into biocultural approaches. The editors urge human biologists to consider the interactions between inequality and human biology and to explore the avenues through which material and social deprivation produce biological effects.

According to Thomas (1998), biocultural research seeks to: (1) identify the biological adjustments to the array of local conditions; and (2) begin the process of revealing the environmental and social stressors that contribute to those biological adjustments. Thomas and others (Armelagos *et al.* 1992; Levin and Browner 2005; McElroy 1990; Singer 2001; Ulijaszek 2007) acknowledge that to date anthropologists have contributed more effectively to the first, than to the second, goal. This fact arises, in part, from the challenge of defining and operationalizing strategies to reveal multiple causal pathways (Dufour 2006).

Despite the holism that is the trademark of anthropology relative to other disciplines, historical specialization within the discipline of anthropology has meant that anthropologists have tended to approach research from either a biological or a sociocultural perspective. The result, as described by Goodman and Leatherman[2] (1998:7), is a crisis of fragmentation:

> Biological anthropologists' interpretations of the human condition, too often empty of social content, and often reductionistic, appear irrelevant or simply wrong to many cultural anthropologists. Many of the recent theoretical directions in cultural

[2] Goodman and Leatherman's (1998) description draws heavily on Holden's (1993) inflammatory "Failing to cross the biology-culture gap." Holden is a staff writer for the journal *Science*. The article presents her reflections following the 1993 meeting of the American Anthropological Association where the polarization of biological and cultural streams of anthropology was evident.

> anthropology are seen by biological anthropologists as excessively relativistic navel gazing, unimportant, and unscientific.

Although researchers have long sought to bridge this divide, to some extent the same can be said regarding biocultural research. It is largely biological in both theory and methodology, with only a nod to the rich, contextual knowledge gained through ethnographic methods: "a few well-chosen cultural variables are often simply built into the research design without requiring extensive ethnographic research" (McElroy 1990:253). According to Thomas (1998:57):

> Most biological anthropologists stop short of providing answers to these more socioeconomic-oriented questions. By so doing, we leave our data in a form that is inaccessible or uninteresting to most social anthropologists and deny ourselves a glimpse of the real consequences of biological dysfunction.

In contrast, critical medical anthropology, which seeks to integrate the body within its social context, examines social processes either wholly disconnected from their biological effects: "nowhere is the biological, organic body mentioned or allowed a reality or history"[3] (Wiley 1992:222) or with those effects described in experiential rather than material ways.

McElroy (1990) has catalogued the barriers to biocultural study: huge investment of resources required to collect biological data; lack of resources such as the time and person-power needed for ethnographic fieldwork; and lack of funding relative to research built on other theoretical paradigms. To this list Dufour (2006:1) adds the conceptual challenges of defining key constructs such as socioeconomic status and operationalizing variables in order to describe the processes by which environment and biology interact. Dressler (2006:258) has argued that the

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[3] Here Wiley (1992) refers to Scheper-Hughes and Lock's (1987) "The mindful body" in which the authors explore the experiential, social and political aspects of bodily experience.

current concept of culture in use by biocultural anthropologists is "so broad, general, and vague that it is difficult to make the essential links from the cultural, to the individual, to the biological that are required conceptually and empirically." I agree with this statement in the empirical sense: in practice, the current concept of culture (broadly-defined) is rarely linked conceptually with biology; and when it is, the link is in simplistic cause-and-effect terms (poverty leads to obesity) rather than the complex interplay of both social and biological conditions[4].

However the breadth of the current definition of culture by bioculturalists is intentional: it is an attempt to acknowledge the multiplicity of processes through which biology and environment interact, the "multiple causal pathways" described by Dufour (2006:1). But herein lies the paradox of biocultural research: according to its proponents, it is the only theoretical framework broad enough to encompass the full range of cultural and environmental influences that interact with biology; however the implementation of a biocultural framework requires expertise in diverse fields as well as competence in describing processes linking biology and environment that are to date poorly described in the literature. The present research is representative of these challenges in that it explores child growth and nutrition not only in empirical terms but as the result of numerous social and cultural and processes acting in the local environment. In the following section I provide a theoretical foundation for the present study, defining and operationalizing the concepts through which I link biology with the environment.

[4] Notable exceptions to this are Schell's (1997) risk focusing hypothesis and Wiley's (1992) use of the concept of adaptability.

2.10 The Present Research: An Applied Biocultural Study of Child Growth and Nutrition in a Rural School Setting

In the present research, I use the term "environment" in its broadest sense, encompassing the "lived" physical environment and those aspects of environment commonly defined by "culture": interpersonal, household, family and community experiences as well as the social relations and institutions one experiences throughout a lifetime (Cook 2005; Dressler 2001; McElroy and Townsend 2004; Schell 1997). In particular the present research examines the influence of culture on schoolchildren, and in this instance I am drawing on the model of culture defined by Kuper (1999) as a general system of meaning or "collective cast of mind". This definition of culture draws on cognitive theory, as it posits that information important at a societal or collective level is internalized by the individual through cognitive means (Dressler 2006).

I operationalize the concept of environment through the use of Krieger's (2005) construct and process of embodiment. Krieger (2005) rejects aetiological hypotheses of disease causation based on the epidemiologic constructs of "behaviours" and "exposures." She argues for a more contextualized approach in which the biological body "tells stories about – and cannot be divorced from – the conditions of our existence" (Krieger 2005: 350). Embodiment is defined as the literal incorporation of societal experiences into the physiology of the individual. "Biological characteristics across populations...are not immediately assumed to reflect innate biological differences; instead, it encourages asking what might be different about the populations' societal contexts that in turn is expressed in their bodily characteristics" (Krieger 2005:351). A focus on the process of embodiment directs the researcher to focus on inequalities that produce variability in bodily expression in different populations and locations.

In order to locate the processes through which culture and biology interact I utilize Lock and Kaufert's (2001) construct of "local biologies", wherein the "continuous feedback" of biological and cultural factors occurs within a highly localized context that reflects "the very different social and physical conditions of (people's) lives from one society to another" (2001: 494). My use of the construct of local biologies requires some clarification. In their work on menopause in Japanese and American women, Lock and Kaufert (2001) define "local" in the geographic sense for the purpose of comparing the biological experiences of women living in two disparate locations: the United States and Japan. However there is a sociocultural aspect to the definition of "local" that provides the context for women's disparate experiences of menopause, in that the social processes that give rise to biological symptoms (or lack thereof) are embedded in societal values, expectations and evaluations that are particular to the specified location. More recently, Lock *et al.* (2006:62) define local biologies as "the way in which biosocial interactions produce local regularities in human physiology" and reiterates the geographic nature of these local biologies. My use of this construct is therefore somewhat altered from the authors', in that I assert that, on the basis of shared institutional culture explored in chapter 7, the rural Ontario schools under study can be described as localities or sites of action where local biologies are constituted. This particular use of the construct is, to my knowledge, new. But I believe it reflects an interpretation that is harmonious with Lock and Kaufert's (2001) intentions. These constructs make it possible to relate children's body size and food consumption to the environment in which they spend roughly one-third of their waking hours: school.

As constructs, embodiment and local biologies are welcome additions to the literature on child nutrition and growth, where the concept of environment has been extremely problematic (Ulijaszek 2007). Bindon and Dressler (1992:62) observe that the majority of growth research is characterized by a positive association between socioeconomic/lifestyle variables and growth: "any indication of higher status suggests better nutrition and growth." The rise in obesity prevalence in post-industrial countries has caused a re-examination of that assumption. Throughout the developed world researchers are realizing that socioeconomic variables alone, as employed in the social determinants of health model, have proven to some extent inadequate to describe the range of effects influencing growth outcomes. For example, in studies of the growth outcomes associated with social class, measures of education, employment, income and housing cost account for only a small portion of the health differences experienced within a population (Braveman *et al.* 2005; Marmot 2000). Individuals' own cognitive assessment of their social conditions, their perception of relative status, their feelings of power or powerlessness, their personal histories and lived experiences, their patterns of interaction with the people and institutions around them: these variables are, in the main, impossible to quantify yet account for much of the influence of social class on health. So too do variables such as social cohesion and collective efficacy (the willingness of community members to support one another) (Cohen *et al.* 2006).

While in this study I do not collect socioeconomic data on the rural environment or school communities *per se*, it is not due to a failure to recognize the significance of political economy to the production of health. As discussed earlier, rural communities tend to exhibit greater obesity prevalence than urban communities, a fact which has been linked to rural poverty through social, economic and infrastructural barriers to nutrition, physical activity and health care (Crooks 1998, 1999a; Sherry *et al.* 1992). Where useful, I incorporate statistical data on the socioeconomic context of the study communities. I also draw on the wider literature on socioeconomic determinants of nutrition and obesity in children in order to help paint a clearer picture of the environment in which children are living, eating and growing.

In a systematic review of studies of environmental correlates of diet and obesity in children, van der Horst *et al.* (2007) found that household socio-cultural factors (parenting practices, parental intake) and household socioeconomic factors (parental income, educational attainment and employment) formed the bulk of environmental determinants. Few studies explored beyond the household to measure the influence of environmental factors in schools, neighbourhoods and community centres, and even fewer attempted ethnographic studies of children's environments. The same was true for research on diet and obesity in adults: studies examined association between socioeconomic factors and food consumption and posited only simplistic linear pathways between diet and obesity. In a recent review of studies of the environmental correlates of high energy and fat intakes in adults, the authors stated: "no study provided a clear conceptualization of how environmental factors may influence dietary intakes" (Giskes *et al.* 2007:1005).

The present research follows Thomas' goals for biocultural study in that it: (1) measures biological outcomes, i.e. obesity prevalence and patterns of diet within a rural population of children; and (2) explores the environmental determinants or influences on those biological outcomes, .i.e. the rural school context of children's growth and diet. Crooks (1998:351) has observed that "the challenge now is to find ways to combine quantitative and qualitative techniques with statistical and ethnographic methodologies to better understand the paths by which upstream processes affect local and household-level behaviours and the consequences thereof." By collecting data on children's body size, diet and school meal experiences, the present study examines the processes linking the local environment and biological outcomes. This approach follows recommendations that a combination of disparate methods is needed in order to study complex public health problems such as obesity: numerous authors urge researchers to avoid simplistic linear theories that describe specific pathways for health production because health is actually produced at a nexus of factors: individual, household, community, population, and global (Cook 2005; Worthman and Kohrt 2005). According to Worthman and Kohrt (2005:872), biocultural analyses offer the opportunity to understand the production of health from the bottom up: "the bedrock of health is largely transparent, embedded in the conditions and actions of everyday life, and is dynamically produced by these ongoing conditions and actions." The way in which conditions and actions in the environment become embedded in one's biology - how the environment gets under the skin (Hertzman and Frank 2006) – is the subject of biocultural study.

The present research examines patterns of growth and body size and a population of children living in rural Southwestern Ontario. It measures food consumption and nutrition, which are bio-environmental determinants of growth. Having developed an understanding of the biological processes at work, the research then explores the context of food and eating in the locality of rural schools. It examines schools as locations where the social and institutional world is embedded in the biologies of children. Though at first glance school would appear an unlikely culprit for the influence of social processes on child nutrition and growth, in comparison to the influential role of family, this research illustrates the profound impact of institutional authority and the culture of schools on children's diet and therefore growth. It is, I believe, a biocultural study in the true sense, probing deeply into a small slice of children's experience to produce a rich understanding of biocultural process.

The local biologies produced are not local in the rural sense; although the study takes place in a rural setting, it is localized to the school environment. For that reason, this thesis examines the schools themselves as the loci of biological action. At times the lens is widened to accommodate the larger rural context and supporting data is provided in order to describe the socioeconomic context of the research where possible. The incorporation of a rural perspective is necessary to the understanding of some of the results of the study. For example, a gender difference in obesity prevalence among rural schoolchildren is something that has, to date, only been observed in obesity studies of rural, North American communities. Pampalon *et al.* (2007) urge researchers to explore health issues among rural Canadians through the use of rural, rather than comparative studies. In this way, the authors contend that health experiences of rural residents will be revealed in a way they are not in large, rural-urban comparative studies.[5]

2.11 Child-Centered Research

My research is child-centred in that the qualitative portion of the study derives from children's perceptions of the school food environment. The majority of studies which examine the

[5] The majority of studies of rural health describe rural areas by comparing them to cities. This is problematic in that comparisons are made between a few large rural groups, which are composed of areas many km distant from each other. For example, in a Quebec study of health inequalities, the smallest rural subset of the study population consisted of more than 325,000 individuals from opposite ends of the province (Pampalon *et al.* 2006).

environmental context of diet are observational in method (Giskes *et al.* 2007; van der Horst *et al.* 2007; Ulijaszek 2007). The voices of children are largely absent from this literature. Children's descriptions of school rules surrounding food consumption provide information on their experiences during snacks and meals, the ways in which they interpret and internalize the language and meanings conveyed in the rules, and the everyday practice of conforming to and negotiating with adults' and peers' expectations in the school environment.

Within the social science literature, there has been a repudiation of research models based on an *a priori* distinction between children and adults (Christensen and James 2001a). Children are viewed as social actors and active participants in the social world. While there is general agreement that this principle informs recent sociological research on children and childhood (Christensen and James 2001a; Hoyles 1989; Jenks 1996, 2000), anthropology is perhaps behind-the-times in adopting this approach.

Cultural anthropologists have called for child-centered approaches to research with children (Corsaro 1997; Christensen and James 2001a; Mayall 2000). Methodological studies document the reliability of children in interviews and focus groups (Fine and Sandstrom 1988; Lytle *et al.* 1993; Mauthner 1997). Despite this fact, much research fails to incorporate children's voices or perspectives. Numerous authors observe that child informants are under-utilized in child-centred research (Corsaro 1997; Christensen and James 2001a; Mayall 2000). Jenks (2000) suggests this lack of children's agency and perspective reveals a fundamental bias in the research process which privileges adult forms of knowing over those of children. This view is echoed in the wider literature on children and childhood (Hendrick 2000; James 1998; James and Prout 1990; Mayall 1996; Qvortrup 2000; Schwartzman 2001).

Within physical anthropology, there is a shift toward a more child-centred approach to research.The recent trend toward biocultural studies means that researchers are incorporating qualitative forms of data collection such as interviews, observation and ethnography and much work of this type has been undertaken with children (Brewis 2003; Brewis and Gartin 2006, for examples). The subdiscipline of bioarchaeology has made considerable efforts to include children's perspectives in archaeological interpretations (Lewis 2007; Park 2005; Perry 2005). Anthropologists are representative of the wider social sciences in their efforts to view children as social actors capable of functioning in complex physical and cultural environments.

2.12 Applied Anthropology

The present research is also firmly rooted in the tradition of applied anthropology. Rylko-Bauer *et al.* (2006) claim that the earliest academic anthropology departments had as their goal the production of practitioners capable of understanding cultural variation in the service of social reform. While this goal was no doubt tainted by early anthropology's close affiliation with colonialism (Scheper-Hughes and Bourgois 2004), it was also motivated by a sincere desire to improve the human condition (Ervin 2000).

Singer (1990) and others envision applied anthropology along a continuum, with the far end characterized by anthropology in the pursuit of broad disciplinary goals such as understanding human diversity, to a middle ground where research uncovers the social inequalities experienced by marginalized populations, and to a near end characterized by anthropology in the direct service of communities and individuals whose health, integrity or security is directly threatened: "all positions on this continuum represent opportunities for the application of knowledge, although the beneficiaries differ" (Rylko-Bauer *et al.* 2006). The present study can be located both in the mid-range of this continuum of applied anthropology, as it has applications for understanding growth and nutrition in rural communities, and at the nearer margin with direct application to the population under study. Goodman and Leatherman (1998) suggest that biocultural studies in particular lend themselves well to "an anthropology of praxis" in which collaboration and application guide the production of knowledge in the service of goals defined by the research partners. In the present study, the research serves as a form of needs assessment that informs both local- and larger-level health policy (Ervin 2000:69).

Bennett (2004:2) urges applied anthropologists to make their value orientations explicit: "you believe you are doing some good for (the subjects of your research) even though you are aware that you may be doing them a disservice...one must take this risk, for better or worse." Let me, then, be clear about the value orientations of myself and my research partners.

From the outset, the research was designed, implemented, and evaluated with input from two key community stakeholders: the Bluewater District School Board and the Grey Bruce Health Unit. As the providers of education and health services for children living in Grey and Bruce Counties, Ontario, these organizations viewed the research as an opportunity to advance their goals in the area of nutrition policy change, obesity prevention and health promotion. I viewed their participation, at every stage, as conducive to the production of knowledge that would be useful to the population under study, through the implementation and funding of policies, programs and workshops that would improve child health in the counties. I was also aware at every stage that the location of the research in a school setting required, and was facilitated by, a strong relationship with the school board, which is in a very real sense gatekeeper to the study population.

Hampshire *et al.* (2005) have studied the ways in which research is shaped by shifts in power relationships between stakeholders. The symbolic and cultural capital held by institutional stakeholders can affect the democracy of exchange of information in ways that are detrimental to true collaboration. In the present research, I would say that authority was shared equally between the community partners. If anything, the symbolic capital of community partners was consciously marshaled toward policy and program change. Should future research efforts seek to explore household- or community-level processes contributing to childhood obesity in this community, a more participative strategy would be desirable, in which participants themselves inform the research process in an iterative process (Ervin 2000; Warry 1992).

The three-way partnership between school board, health unit and myself not only functioned well for the duration of the research (aspects of dissemination are still ongoing) but had the added benefit of strengthening the collaborative machinery which already existed between the school board and health unit. As community-institutional partnerships gain popularity with researchers and national funding agencies, there is hope for a flourishing of similar collaborative machinery in communities and institutions across Canada (Austin 2003; Seifer 2006).

I should make clear that while there was significant collaboration between the research partners, the study was not built on a participatory action research (PAR) model. From the outset I had a clear idea of the type of data I wished to collect (anthropometry, dietary intake). When I approached the organizations that became study partners it was with the intention of locating community agencies for whom the study data could prove useful. In PAR, the community under study defines the research problem and proceeds to inform the entire methodology and analysis (Ervin 2000). In the case of the present study, the research process was directed by myself and the community agencies involved (school board and health unit) rather than the community under study, in this case the educators and schoolchildren.

The collection of data on body size and dietary intake, as well as on food rules and restrictions at school, more closely mirrored the risk assessment models used in applied environmental anthropology (Ervin 2000), where the researcher provides data on the biological and social impacts of environmental change. There is also precedent for this type of process in the community needs assessments performed by health researchers working with Aboriginal or First Nations communities (Gallo *et al.* 2005; Hanrahan 2002; Paluck *et al.* 2006; Schell 1986; Towle *et al.* 2006). Documentation of the biological outcomes of poverty and rural residence assists community agencies such as public health units to lobby for funds to support local initiatives that improve the health of rural residents.

In the health science literature, this practice would fall under the umbrella of application described by the phrase "knowledge translation" or "KT". The Canadian Institutes of Health Research (CIHR 2005:2) define knowledge translation as:

> the exchange, synthesis and ethically sound application of knowledge - within a complex system of interactions among researchers and users - to accelerate the capture of the benefits of research for Canadians through improved health, more effective services and products, and a strengthened health care system.

In its policy statement, the CIHR (2005:2) emphasize that KT is an active process of exchange between "those who create new knowledge and those who use it." Among applied anthropologists, knowledge translation is embedded in the research process. KT often goes beyond planned deliverables such as reports and oral presentations to include opportunities for further collaboration and research (Austin 2003).

2.13 Conclusion

In summary, the present research is built on a biocultural model of biological processes mediated by conditions in the local environment. Environment is defined broadly, incorporating the entire range of physical and cultural processes that can become embedded in the biologies of children. The present study explores the contribution of diet to growth and body size in the particular context of rural Ontario schools, which are locations where various social forces create an experience of the environment that shapes the diet and bodies of children. These forces are explored in detail through qualitative research into the culture of school meals through the eyes of children.

The research draws on biocultural anthropology to understand growth and nutrition as expressions of the lived environments of children. Where useful, such as in exploration of gender differences in growth and nutrition, the study incorporates a socioeconomic analysis of growth and nutrition in rural communities. Through the use of Lock and Kaufert's (2001) construct of "local biologies," the concept of "place is conceived in terms of both geography and society, as the research describes the "rural school" environment which interacts with children's biology. Krieger's (2005) construct of embodiment is employed to describe the process through which environmental conditions become internalized and expressed bodily.

Childhood obesity, as a particular outcome of growth, is an increasing focus of public health planning and policy. The present study combines the broad goal of describing obesity prevalence and dietary patterns in a rural population of children with the specific goal of understanding the school context of food consumption. The research is applied in the sense that the goals of the research include the development of policy and program initiatives targeting child nutrition in schools and the participation of children and parents in workshops aimed at preventing and ameliorating childhood obesity in the research population.

Chapter 3 Research Setting

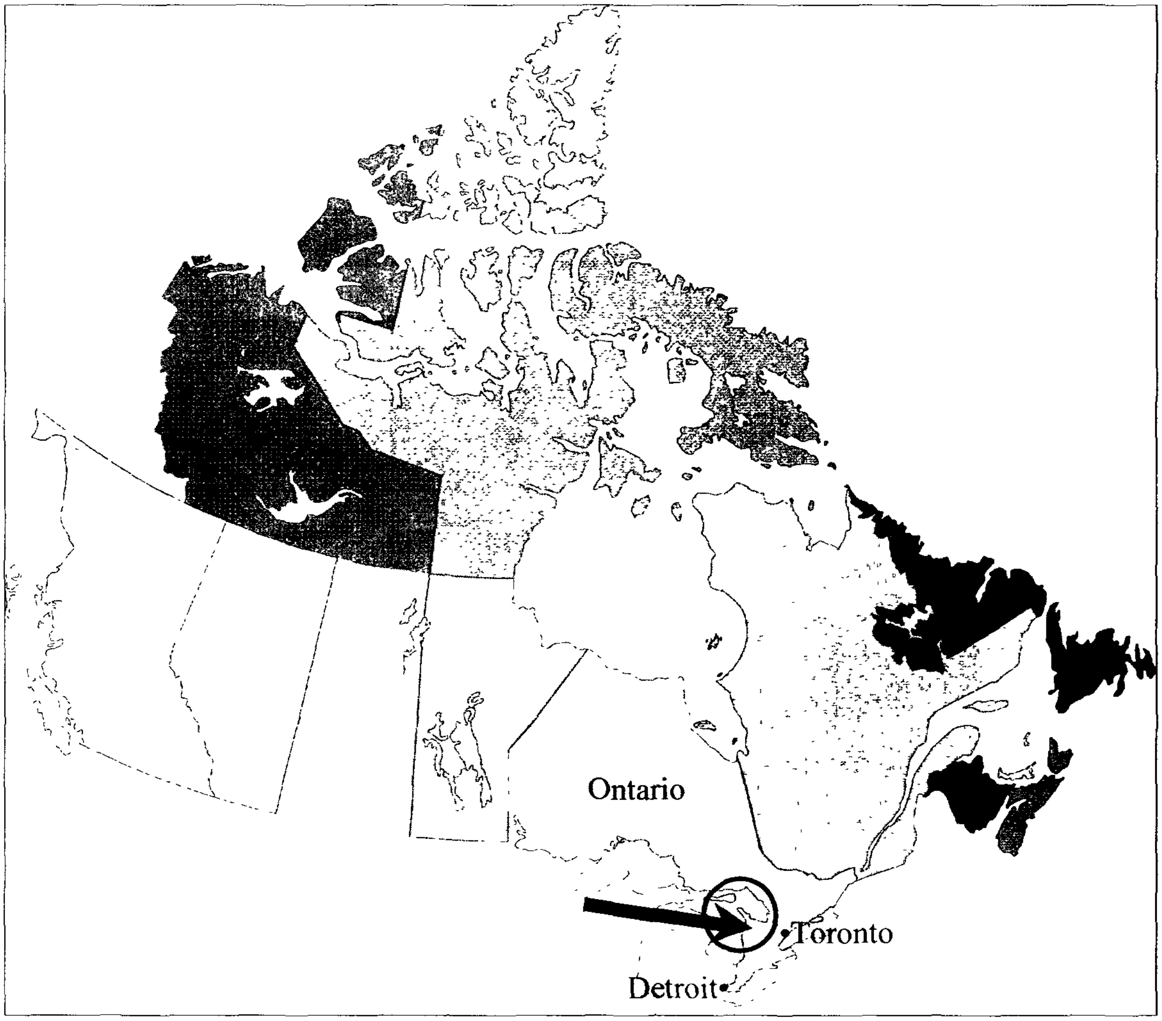
3.1 Introduction

This chapter presents information on the research setting which is excluded from published material due to restrictions on space or word count. It includes data on the demographic and socioeconomic aspects of the study population. The first section explores the socioeconomic history of the region and describes the extent to which Grey and Bruce Counties typify contemporary rural Canadian communities. The second section discusses definitions of rural and the variability within existing census definitions based on population aggregation. The third section provides socioeconomic profiles of each of the six school communities. Comparison data are provided at the level of the province, due to broad variability within and between jurisdictions in Ontario. Canada's largest province, Ontario (population 12 million) contains both Canada's largest city (Toronto) and Canada's largest rural population (1.7 million or 15.3%) (Statistics Canada 2001). It serves as a useful backdrop to illustrate socioeconomic processes in the rural Canadian population. The fourth section presents ethnographic sketches of the six study schools and is followed by a final section describing my experiences as a researcher "in the field."

3.2 A Brief Historic and Socioeconomic Sketch of Grey and Bruce Counties

The research is located in Bruce and Grey Counties, Ontario, Canada. These two counties lie approximately 150 kilometers northwest of Toronto, Canada (Figure 3.1) between Lake Huron and Georgian Bay. The area occupied by Grey and Bruce is bounded to the west by Lake

Figure 3.1: Location of Bruce and Grey Counties in Ontario, Canada (circled area)



Huron, to the north by Georgian Bay, and to the east and south (in clockwise order) by Simcoe, Dufferin, Wellington and Huron Counties (Figure 3.2).

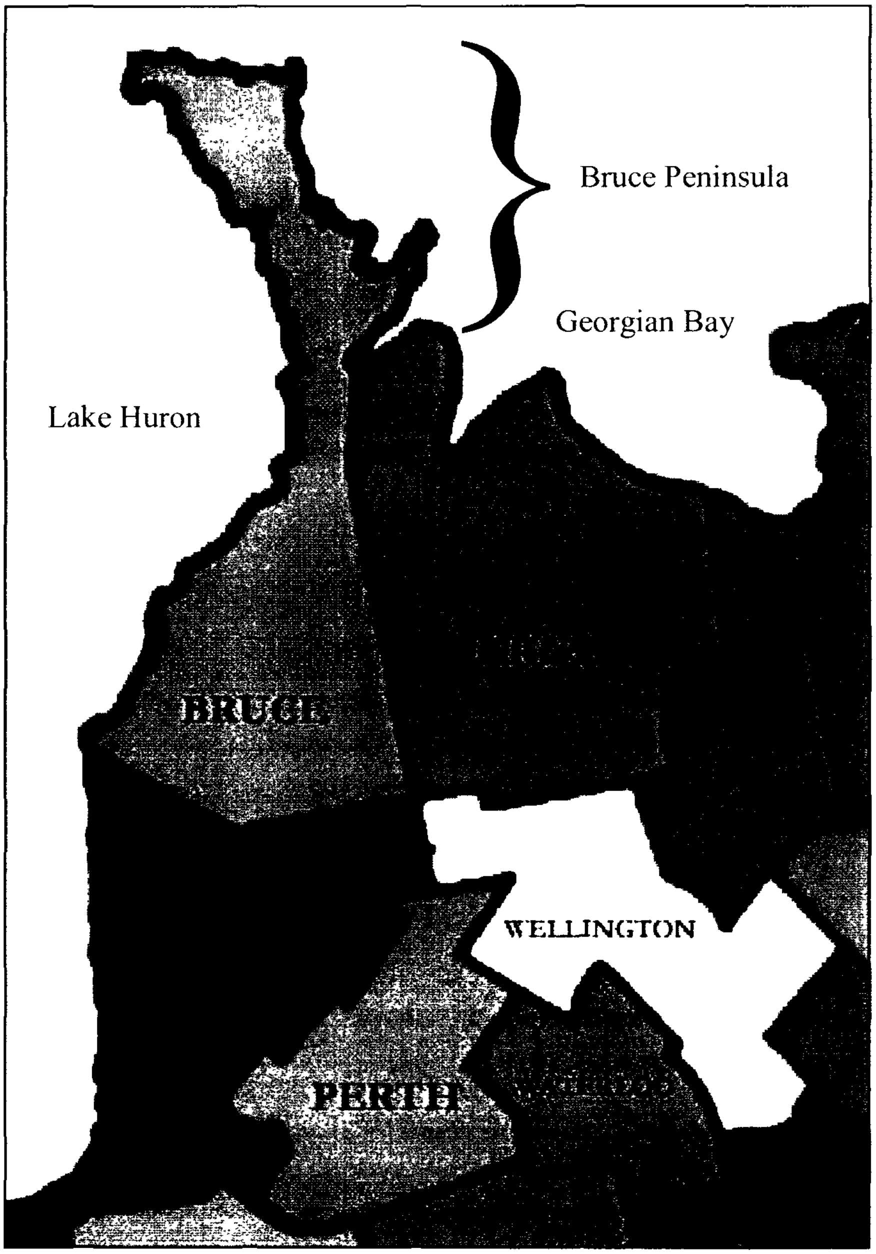
Grey-Bruce's most prominent geographic feature is the Niagara Escarpment, a ridge of exposed limestone that crosses southern Ontario from northwest to southeast. It was formed by sedimentation some 400,000 years ago along the edge of a depression (the Michigan Basin) that covered the Michigan and Lower Great Lakes region of North America (Niagara Escarpment

Commission 1979). The Escarpment runs the length of the Bruce Peninsula, a narrow strip of land which extends north from mainland to divide Lake Huron from Georgian Bay, and continues, though less prominently, through the farm fields of present-day Bruce and Grey Counties.

The Saugeen Ojibway First Nation traces its roots in Bruce County to both the Middle Woodland Saugeen and Iroquoian cultures (Ellis 1990; Fox 1986; Saugeen First Nation 2000). The Saugeen identity pre-dates a major influx of Ojibway-speaking Aboriginal residents to the area from Ohio and New York State following the War of 1812. Part of this influx is a group that later formed the Chippewas of Nawash First Nation, named for Chief Nawash who was an ally of Tecumseh and Sir Isaac Brock against the Americans (Chippewas of Nawash Unceded First Nation 2007) . Chief Nawash and his followers establish numerous communities along the Georgian Bay shore, the population increasing substantially after 1835 when a number of Chippewa holdings in the US were deeded to the government in return for cash (Davidson 1972). Dissatisfaction with the settlement led to waves of migration to Canada across the St. Clair River and northward along the Lake Huron shore. Those who traveled as far as Bruce County found the shoreline occupied by Saugeen villages and so moved inland to the Nawash villages in northern Grey County.

Records of early French occupation of the area were lost in 1649 when Ste. Marie Among the Hurons, a 17th century French Catholic mission, was destroyed by fire (Davidson 1972). On his 1615 voyage, Samuel de Champlain travelled as far east as Lake Huron, bringing with him a number of French Catholic priests that remained in the Huron settlements along the Georgian Bay shore (Morison 1972).

Figure 3.2: Location of Bruce and Grey Counties, Ontario



European settlement of Grey and Bruce Counties occurred more slowly than in areas to the south. From 1825 onward, the Huron Tract, located directly south of Bruce County, was offered to British settlers by the Canada Company in 100-acre parcels of hardwood forest (MacFarlane

Lizars and MacFarlane Lizars 2006). Land cleared for cultivation provided settlers with valuable timber revenue at a crucial early stage in the establishment of farms. The first British surveys of the Grey-Bruce were conducted in 1836. A. M. Stephens, an Owen Sound business owner, recorded his travels (on foot) in Grey County in the summer of 1843 (Davidson 1972). He recounted a meeting with a Mr. Eaton, at that time the only settler in Grey's Euphrasia Township. Mr. Eaton blamed the sparse settlement of Grey County not on the lack of roads (there were none) but on the fact that, during the 1836 survey, British land agents accompanied the Crown surveyors, selecting and registering the best tracts (Davidson 1972). Only the poorer and marginal land was available to settlers negotiating their purchases directly with the crown. As a result, timber revenues were much lower from the mixed evergreen forests in Grey-Bruce and the rocky soil proved less productive than in the south (Smith 2006). However the Crown adhered to its policy of offering settlers 100-acre lots in the hope of encouraging larger populations. Consequently, many Grey-Bruce homesteads proved unsustainable to early pioneers. The Crown also gave preference to British immigrants, resulting in a fairly homogenous early pioneer population.

Bruce County was created in 1851 and named for James Bruce, then Governor-General of the Province of Canada (McLeod 1969). Grey County was formed in 1852 and named for Charles, 2nd Earl of Grey and Prime Minister of England in the 1830s (Davidson 1972). In 1861-62 the first gravel roads were constructed and linked to southern roads from Toronto (Davidson 1972). In a new effort to increase population, 50-acre lots were surveyed on either side of the roads, to be made available to settlers of lesser means. The owners of 50-acre lots were entitled to purchase the corresponding lot across the road at a later date should their means improve. In practice, few of these corresponding lots were cleared for agriculture, owing to limited productivity of the small acreages. As a result, many of these early roads are still lined with cedar forest, making present-day driving in Grey-Bruce extremely scenic. In 1856 the village of Sydemham was incorporated as the Town of Owen Sound (Davidson 1972). The town was (and remains) the largest settlement in Grey-Bruce.[1] The deep-water sound or port permitted dockage for large freighters traveling on the Great Lakes and marine traffic necessitated the construction of the Owen Sound General and Marine Hospital in 1892 (Davidson 1972).

According to historians, the late 1800s was the high point of economic development in Grey-Bruce (Davidson 1972; McLeod 1969). Pioneers benefited from inexpensive land, lucrative timber revenue, and burgeoning markets for farm produce in the south. There was off-farm employment available in forestry, fishing, and infrastructure development funded by the newly created province and municipalities. Rail lines were laid between lake ports in the north and west and the growing southern cities of Toronto, Hamilton, Kitchener and London.

There was a small boom in manufacturing, with the construction of industries serving both local and distant markets. Owen Sound, in Grey County, was the location of Harrison's flour mill in 1857, Harrison's sawmill in 1863, Keenan Brothers sawmill in 1894, Chatwin and Commedy cabinet factory in 1862, Quinn's tannery in 1857, McQuay's tannery in 1887, Corbet machine shop (later Corbet Foundry) in 1852, and most significantly the Canadian Pacific Railway (CPR)

[1] Interestingly, Owen Sound was the northern terminus of the Underground Railroad. So many former slaves traveled overland by this route that by the late 1800s a substantial proportion of Owen Sound's population (some sources say one-third) was black (Laidlaw 2008). Historians observe that "a century before Toronto began to think of itself as a multicultural centre, small towns like Owen Sound, Dresden and Chatham were already dealing with issues of race and ethnic tension" (Laidlaw 2008:1).

grain elevators in the 1890s. Hanover, a small town in Bruce County, became home to Knechtel Furniture Factory (later Sklar Pepplar Furniture) in 1873, Hanover Woollen Mills in 1870, and Britannia Metal Works in 1871. Manufacturing brought new residents to these towns, necessitating construction and service industries as well as civic infrastructure such as town halls, schools, libraries and newspapers (Davidson 1972).

But the boom times in Grey-Bruce were short-lived. By 1900, vigorous migration and land settlement policy by the Canadian government was attracting many Grey-Bruce residents westward (McLeod 1969). Prairie farms were allocated in 160-acre lots and in most cases no fees were required. Many Grey-Bruce homesteaders sold their land and moved westward. In 1901 the population of Grey County was 59,020; by 1911 it had dropped to 50,000 and by 1921 it had fallen again to 44,000. While the government broadened its immigration policy in the west to encourage immigrants from Northern European countries, in the east the old rules prevailed. Turn-of-the-century census records show the majority of new immigrants to Grey and Bruce Counties were from England, Northern Ireland, Scotland and Wales (McLeod 1969). The lack of ethnic diversity in the immigrant population may have contributed to the decline of the agricultural sector, as new farmers persisted in mixed-method farming, attempting to sustain diverse operations on small unsuitable acreages.

The decline of the early 1900s in Grey-Bruce was not limited to the agricultural sector. Prior to 1914, forestry was the dominant industry in the region, fuelled by the felling of trees for agricultural land clearing and by vigorous government initiatives in rail line and road building. Wiarton, a community on the south shore of Georgian Bay, had eight busy sawmills shipping 25 carloads of cedar railway ties and posts a day to busy southern markets (McLeod 1969). After 1914, dwindling supplies of timber forced the closure of all eight mills. The fishery also experienced severe decline in the early 1900s. Over-fishing resulted in dwindling catches of several lake species. Stocks of lake trout and yellow pickerel declined precipitously after the accidental introduction of sea lamprey species in the 1920s (McLeod 1969).[2]

McLeod (1969) studied the impact of economic decline in the 20th century. By the 1970s, the majority of sustainable farming operations were specialized single-species farms of 200 or more acres. Beef, dairy and hog farms prevailed; excepting the area around Hanover, where Horizon Poultry began operation in 1969, chicken farms all but disappeared, attracted south as local processers closed their doors. With a few significant exceptions, many manufacturers shut down during the Great Depression (McLeod 1969).

The decline in agriculture and manufacturing and the advent of automobile travel and improved roads led to significant reductions in both the rail and shipping industries. Passenger and freight service declined markedly during the 20th century. Until the 1960s, roads from the south were not considered navigable year-round due to heavy winter snowfalls. However the development of powerful modern snow plowing equipment made automobile travel possible during all but severe winter weather.[3] Rural mail delivery was no longer accomplished by rail but by automobile service, which provided delivery to rural lots rather than a central village post office. With the

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[2] Access to the Lake Huron and Georgian Bay fisheries is currently contested by the Saugeen First Nation, which has issued licences to non-Native commercial fishers since the 1830s (Saugeen First Nation 2000). Under provincial legislation, the commercial fishery is illegal. The matter remains before the courts.

[3] During the 6-month period of data collection for the present study, I was delayed or detained by road closures in Grey-Bruce on 14 occasions. On four occasions I arrived at study schools to find that school bus service had been cancelled.

automobile also came the centralization of other rural services, such as schools, churches, grist mills and mercantile services, and the decline of small towns and villages (McLeod 1969).

The effect of the foregoing processes (rural economic decline and centralization owing to the advent of the automobile) on the social structure of Grey-Bruce cannot be underestimated. The closure of rural schools, churches and post offices reduced the sense of community in small localized places. A lack of community identity inevitably led to fewer local gatherings, associations and societies. Churches, clubs, sports leagues and choirs struggled to compete with larger centres for membership, eventually leading to the demise of many local organizations. After 1950, the number of fall agricultural fairs declined precipitously (McLeod 1969).

The process of rural socioeconomic decline in Grey-Bruce is typical of many rural Canadian communities. As a result of declines in agricultural commodity prices, farms have been consolidated and, to a large extent, industrialized. The majority of rural families live in small residential communities or in rental accommodation on increasingly large farms, where smaller homesteads are now subsumed by commercial operations with absentee landlords and migrant labour (Paquette and Domon 2003; Quandt *et al.* 2002).

Non-farm industries in rural communities are largely based on resource extraction, with seasonal workforces and little benefit to communities beyond employment. The centralization of education and health care services has had a deleterious effect on quality of life in small, rural communities, to the extent that the challenge of recruiting professionals, particularly in the health services, to live and work in small towns and villages in based on the lack of these services (Greenhalgh 2005; Reilly *et al.* 2005).

Low household income, high adult unemployment, and low parental educational attainment, are widespread phenomena. Rural out-migration draws young adults in their income-earning years away from rural communities, leaving the burden of municipal taxes on the remaining residents, many of whom are seniors on fixed incomes (Dupuy *et al.* 2000). As a result of this cyclical process, rural communities increasingly lack the infrastructure and services to support young families and teens (James 1999).

One significant exception to decline in Grey-Bruce has been tourism. The very factors that have constrained agricultural and economic development (poor, rocky soils and long, cold winters) have in some measure contributed to the growth of tourism in Grey-Bruce. The 1987 establishment of Bruce Peninsula and Fathom Five National Parks on the northern tip of Bruce County have brought visitors wishing to explore the rugged Niagara Escarpment and the coastal waters of Georgian Bay (McNamee 1994). Sailing, boating and sport fishing have long been popular with both tourists and locals. Scenic trails and heavy snowfall make for excellent snowmobiling and cross-country skiing. Downhill ski areas in Grey County attract many outdoor enthusiasts. In fact, tourism has been a significant part of the region's economy since 1900. Following the turn of the century, resort communities sprung up along the Lake Huron shoreline to serve visitors touring the Great Lakes by passenger ship.[4] Flourishing towns such as Kincardine, Port Elgin, Southampton and Sauble Beach provided hotel and cottage

[4] My own grandparents toured Manitoulin Island and Killarney Park, in north-eastern Georgian Bay, by passenger ferry during their honeymoon in 1929.

accommodation for visitors. This industry has struggled recently, however, with declining demand and competition from areas more accessible by car from metropolitan Toronto, such as Haliburton and the Muskokas. However there are large cottage developments underway along the Lake Huron and Georgian Bay shores. Many cottages occupy land by the Saugeen First Nation, which has only recently begun asserting its jurisdiction over these lands and is now charging cottagers rent (Saugeen First Nation 2000). There is a large casino and gaming complex in Hanover, and another planned for north Grey.

Another significant economic opportunity has been the development of alternative energy projects in Grey-Bruce. Between 1970 and 1987, the Bruce Nuclear Generating Station was constructed at Inverhuron.[5] It is the second-largest nuclear generating station in the world and employs 3000 people (Bruce Power 2007). Two wind farms, one located along the Lake Huron shore and the other along the escarpment in Grey County, are the first commercial wind farms in Canada (Huron Wind 2002).

3.3 Defining "Rural" Communities

In an attempt to parse the many and conflicting definitions of rural, a number of authors have explored traditional and alternative definitions of rural. As Racher *et al.* (2004:3) observe, "definitions of 'rural' are constructed for particular purposes." For example, the most widely available demographic and socioeconomic data on Canadians comes from the census. The data set is updated every five years and is accessible through a variety of media (Statistics Canada 2001). However for researchers exploring issues of rural health, some challenges arise from the

[5] My father was employed for a season as a tour guide during the construction of the Bruce Nuclear Generating Station in 1965.

fact that census definitions of rural tend to obscure much of the geographical, social, psychological, and historical variability in non-metropolitan Canadian communities.

Geographic definitions of rural tend to emphasize low population density vis à vis cities. The 2001 Census of Canada categorizes a region as rural if its population density is lower than 400 persons per square kilometer (Statistics Canada 2001). The Organization for Economic Co-operation and Development (OECD) defines rural communities as those with fewer than 150 persons per square kilometer (Canadian Rural Information Service 2000). By either definition, Bruce and Grey Counties are classified as rural, with population densities of 15.4 and 19.8 persons per square kilometer respectively.

For the purposes of labour market comparisons, the Census of Canada divides census subdivisions into Census Metropolitan Areas (CMAs), which have minimum urban core populations of 100,000 persons, and Census Agglomerations (CAs), which have minimum urban core populations of 10,000 persons (Statistics Canada 2001). CMAs and CAs include all neighbouring municipalities where fifty percent or more of the workforce commutes to the urban core for employment. While the small Grey County city of Owen Sound has a population of 21,430, it is categorized as a City, rather than a CA, as it lacks a minimum core population of 10,000. The populations of Bruce and Grey Counties fall entirely under the Canadian Census category of "Rural and Small Town" (RST) (Statistics Canada 2001). This category refers to the non-CMA/CA population, and consists of all populations residing outside the main commuting zones of larger urban centres.

The U.S. Bureau of the Census adopted the CMA/CA classification for its 2000 census. In addition, the U.S. Office of Management and Budget expanded the 2000 definition of CMA to include commuter thresholds as low as 25 percent. The net effect of this change was to decrease the non-metropolitan population of the U.S. by 8.9% (Racher *et al.* 2004).

This exclusionary definition of rural is negatively constructed and is built on assumptions about the shared experiences of urban, suburban, and commuting populations, rather than by any consideration of the shared or diverse experiences of rural populations. Rurality is defined by travel for employment. While this definition is useful for some research purposes, its overall effect is to underestimate Canada's rural population (Racher *et al.* 2004).

For example, in the 2001 Census of Canada, about 6 million persons fell under the RST classification. However only 4 million of these fell into a third classification, "Census Rural", which includes only those individuals living in census subdivisions of 1000 persons or less (du Plessis *et al.* 2001). In some cases, fewer than half of the RST population lives in census rural areas, making it difficult to select a category of analysis that reflects the particular characteristics of a population or group.

Depending on the definition, Canada's rural population ranges between 22 percent and 38 percent, with variation in provincial rates of rural population from 15 percent in Ontario to 100 percent in Yukon, the Northwest Territories and Nunavut (du Plessis *et al.* 2001). But while the socioeconomic characteristics of individuals are different depending on the definition of rural, there is a pattern of lower employment rates and lower incomes in rural areas compared with the Canadian average.

Beyond this general pattern lies a diversity of geographical, social, psychological, and historical experience that belies simple comparisons amongst rural and between rural and urban communities. Understanding this diversity is integral to generating knowledge about the health of individuals living in these communities. The following is a brief sketch of some of the historic, geographic and socioeconomic factors influencing the population from which this study's sample is drawn.

3.4 Socioeconomic Profiles of School Communities

The primary community partner in the research is the Bluewater District School Board. In 1998, due to declining rural enrollment and pressure from provincial government, the Bruce County Board of Education and the Grey County Board of Education amalgamated to form the new Bluewater Board. The Board currently oversees educational programs in 48 elementary and 11 secondary schools in the two counties (Figure 3.3).

In the autumn of 2003, six schools were selected to take part in research on children's growth and nutrition. The schools were selected to represent a range of community sizes and socioeconomic indicators from census. Prior to the start of the research, one school principal declined participation and an alternate school (school 5) was selected with a similar geographic and socioeconomic profile.

The six school communities exhibit variability in terms of socioeconomic indicators known to influence child nutrition such as household income, parental employment status, and parental educational attainment. The following is a brief summary of the location and selected socioeconomic indicators for the six school communities (Figures 3.4-3.7).

School community 1 is located on the Bruce Peninsula. The school catchment is roughly the municipality of Northern Bruce Peninsula, Bruce County, excluding the town of Tobermory at the peninsula's northernmost tip. The school itself is located roughly at the midpoint of the peninsula in the village of Lion's Head, population 150. The school catchment incorporates coastal and wooded areas used mainly for cottages and open grassland suitable for beef cattle production. The majority of employment in school community 1 is in forestry, agriculture, or services such as construction, education and tourism. Average household income of $47,320 falls well below the Ontario average of $66,836 (Statistics Canada, 2001). Due to the seasonal nature of its industry, the population receives 19.8% of its income in the form of government transfer payments such as employment insurance and guaranteed income supplements. The unemployment rate is 4.8% which appears low due to the fact that many seasonal and agricultural workers are independently employed. Educational attainment rates are comparable with Ontario figures, although a greater proportion of adult residents have a level of schooling below grade 9 (10.88% for community 1 c.f. 8.7 % for Ontario) and fewer adults (53.2%) receive post-secondary education[6].

[6] Educational attainment is categorized by highest level of schooling according to the 2001 Census of Canada (Statistics Canada 2001). Secondary school includes a highest level of schooling from grades 9-13, as adults educated in Ontario would have had the opportunity to attend grade 13. Grade 13 was eliminated in Ontario in 2003. Post-secondary education includes time spent completing an apprenticeship or trades certificate, or attendance at a community college, diploma-granting institution, or university.

Figure 3.3: Bluewater District School Board service area

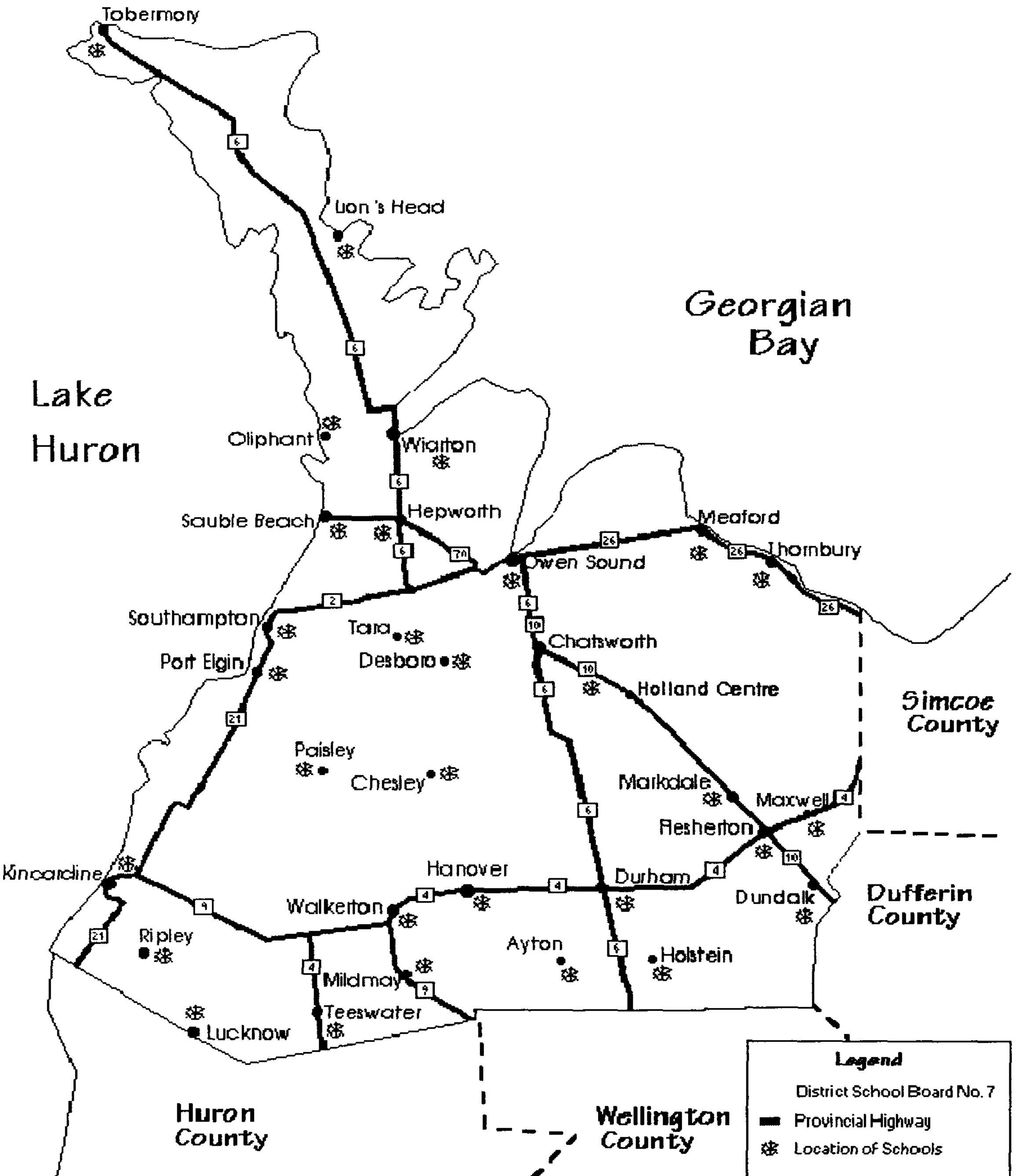


Figure 3.4: Average household income by school community compared with the Province of Ontario (Statistics Canada 2001)

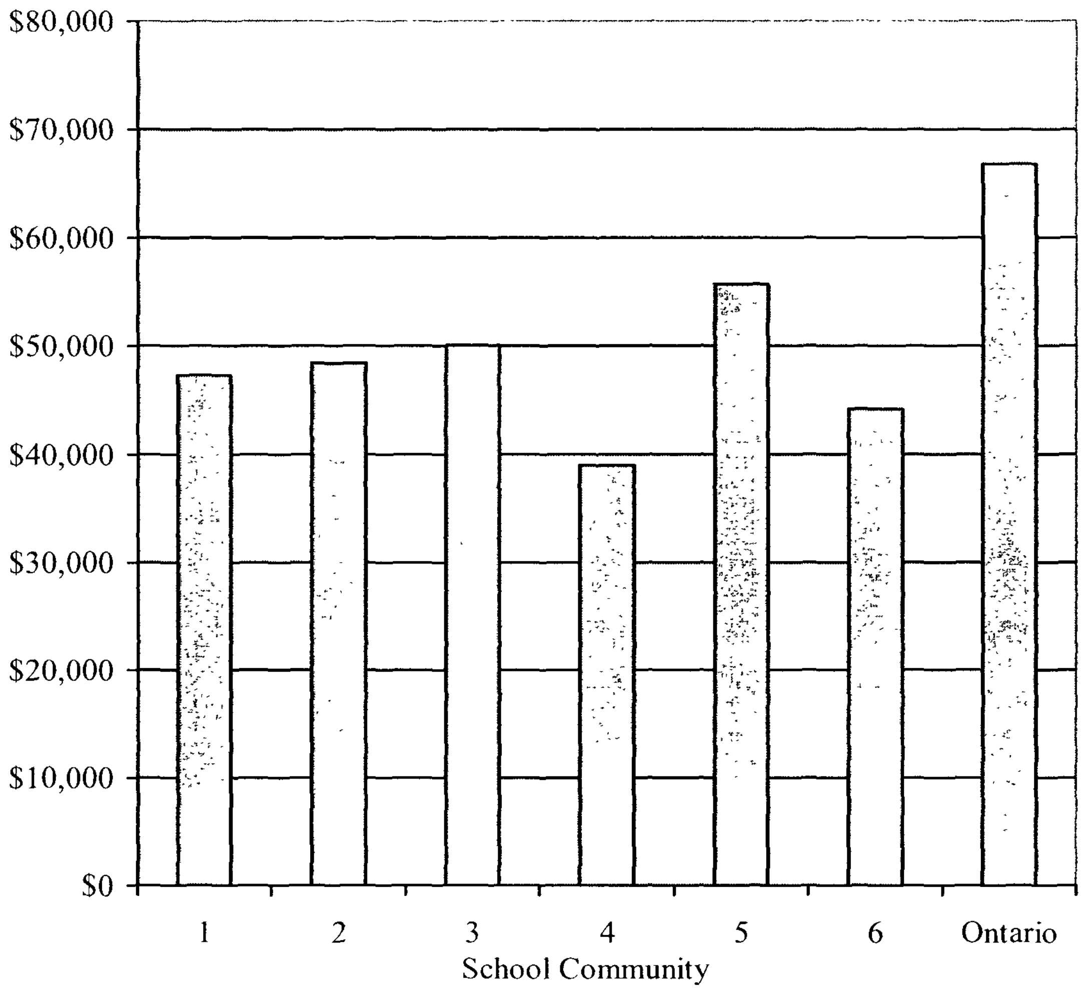


Figure 3.5: Percent of total income from government transfer payments by school community compared with the Province of Ontario (Statistics Canada 2001)

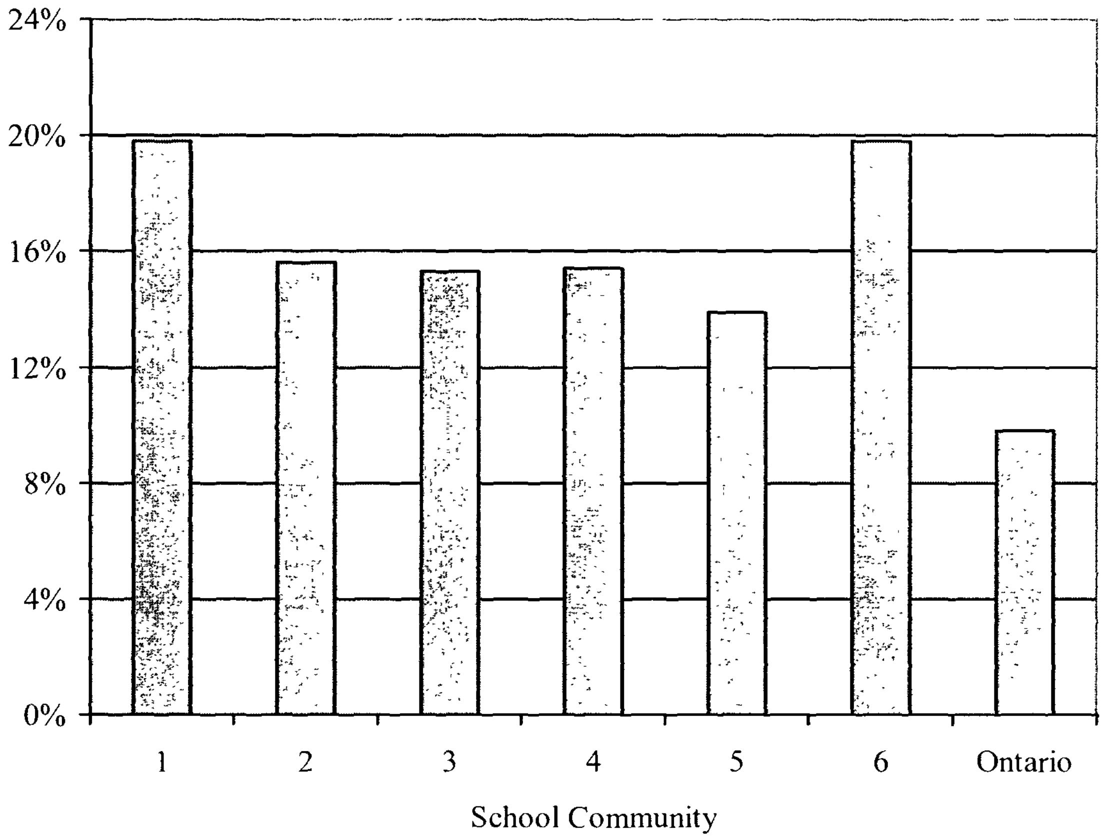


Figure 3.6: Percent of unemployed individuals ages 15 years and over by school community compared with the Province of Ontario (Statistics Canada 2001)

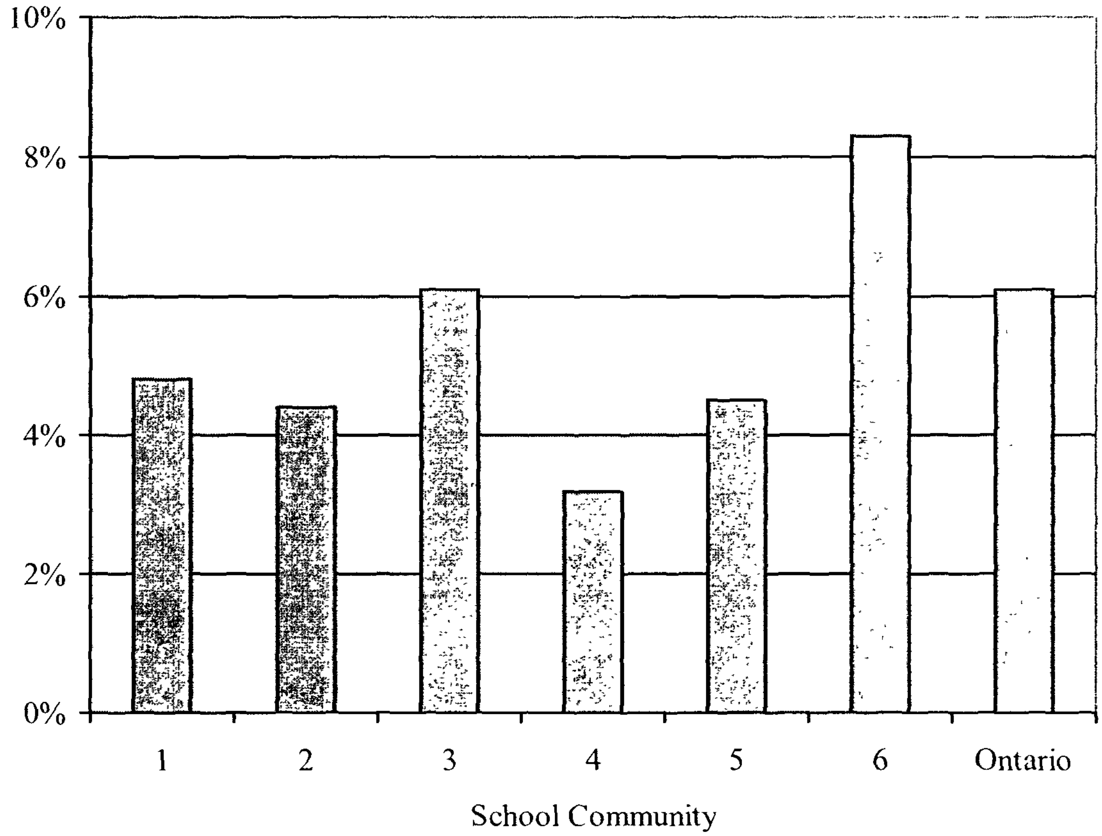
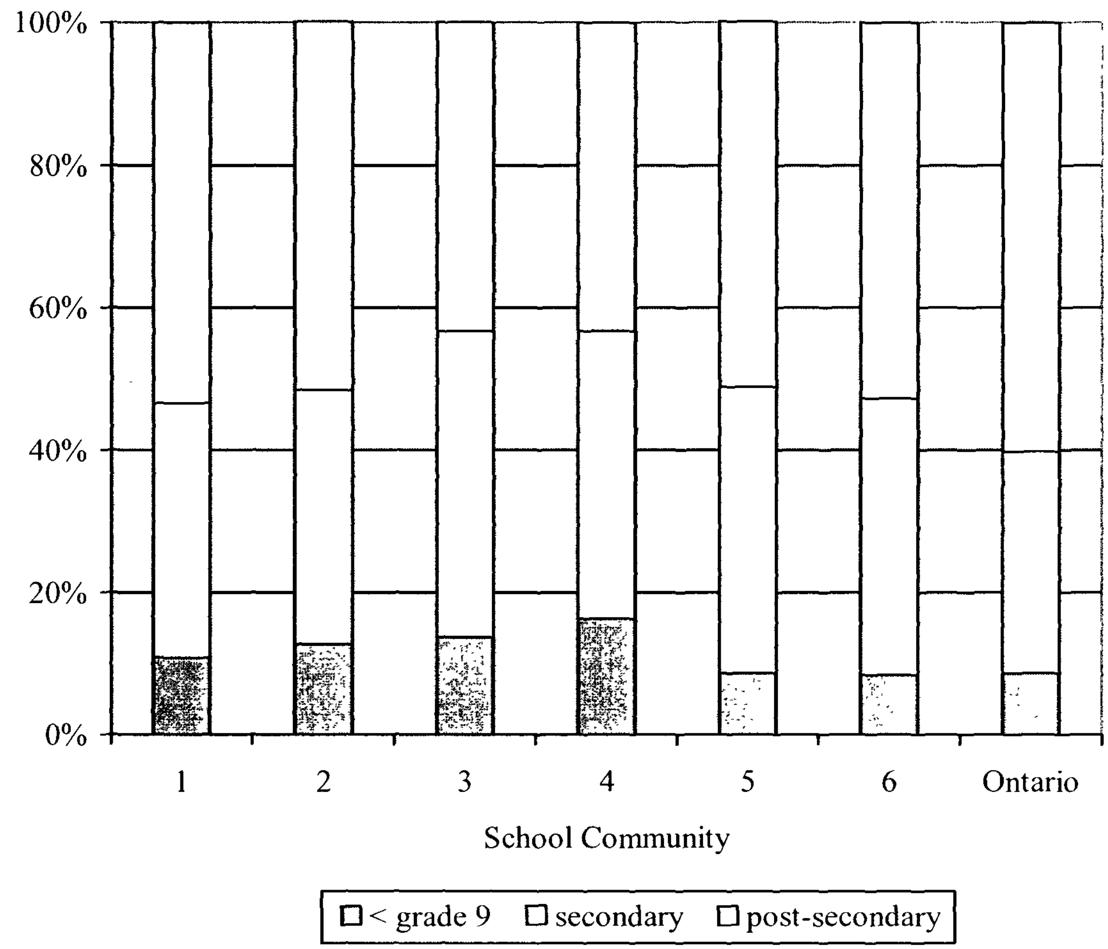


Figure 3.7: Highest level of schooling for individuals ages 20 years and over by school community compared with the Province of Ontario (Statistics Canada 2001)



School community 2 is located in Chatsworth Township in west Grey County. The school itself is located on a paved county road approximately1 km from the Hamlet of Desboro. The catchment area is a combination of dairy and beef farms and forested land. Average household income is $48,455, with an unemployment rate of 4.4%. Sixteen percent of income is received in the form of government transfers. Educational attainment rates are below the Ontario average, with 12.7% of adults at a level of schooling below grade 9 and 51.7% of adults receiving some form of post-secondary education.

School community 3 is located in Southgate Township in east Grey County. The school is located on the outskirts of the town of Dundalk, population 1972. The catchment is the Dundalk Highlands, an area of very marginal farmland, cedar forest, and swamp. However, proximity to the Honda production facility at Alliston, and reasonable commute times to Guelph and Brampton (approximately 1 hour) offer Southgate residents a number of employment options unavailable in school communities 1 and 2. Average household income is $50,110, the highest of the study school communities, though still well below the Ontario average of $66,836. Fifteen percent of income is in the form of government transfer payments. Unemployment stands at 6.1%, equivalent to the provincial average. Educational attainment rates are substantially lower than Ontario levels, with 13.7% of adults at a level of schooling below grade 9 and only 43.2% of adults receiving post-secondary instruction.

School community 4 surrounds the town of Hanover, located at the boundary between Grey and Bruce counties. The school itself is located in the centre of Hanover and about half of students are "walkers" who live in town. The other half are bused from the catchment located north, south, and east of the town. The town offers employment in a number of service industries such as restaurants, retail, education and health care. However the economy of the surrounding area is agriculturally based, with little or no industry. Average household income is the lowest in the study, at $38,965, though 15.4% of income comes in the form of government transfers. The unemployment rate is a mere 3.2%. Educational attainment rates are the lowest of the six study communities, with 16.3% of adults achieving a level of schooling below grade 9, and only 43.1% of adults receiving post-secondary instruction.

School community 5 spans the municipality of Meaford, from the Georgian Bay shore south through the scenic Beaver Valley. The school itself is located in the town of Meaford, population 4,524. The catchment includes the Georgian Bay shore east and west of the town, populated seasonally by cottagers; the Meaford Tank Range west of the town, sparsely occupied by Department of National Defense staff and their families; and a large area to the south characterized by small mixed farms, fruit growers, and ski resorts. The diversity of employment contributes to higher average household income ($55,755) and low unemployment (4.5%) in this community. However much of the work is seasonal, resulting in a level of government transfers (13.9%) higher than the Ontario average. Educational attainment rates are comparable with Ontario's, though fewer (51.2%) individuals receive post-secondary education.

School community 6 includes the small city of Owen Sound, population 21,430, and an additional catchment west of the city in the Georgian Bluffs area of Grey County. The city itself offers employment in service industries such as retail, restaurants, education (Georgian Community College is located here), and health care, including an emphasis on retirement and senior's services. There is a grain terminal and shipping access on a seasonal basis. The Georgian Bluffs catchment consists largely of marginal mixed farming and cedar bush. There is little year-round industry in the area. As a consequence, average household income is $44,173, with 19.8% of income earned in the form of government transfer payments. The unemployment rate is 8.3%, the highest of the study school communities and substantially higher than the provincial average of 6.1%. Educational attainment rates are relatively consistent with Ontario levels, with 8.4% of adults receiving less than grade 9 instruction. Again, fewer adults (52.6%) receive post-secondary education.

In summary, the school communities are roughly characteristic of the range of demographic and socioeconomic characteristics common to rural North America. The people in these villages and towns earn modest livings in agriculture, service, and resource-based sectors of the economy. Due to the seasonal nature of these sectors, the population is heavily reliant on government transfers to support income during lean months. However unemployment rates are low, suggesting that the majority of residents are employed as independent or seasonal workers for the majority of the year. Educational attainment rates are lower than Ontario levels. In some communities, one in six adults has attained a highest level of schooling below the grade 9 level. According to existing literature, these factors combine to place children living in the school communities at an elevated level of risk for poor nutrition and growth.

3.5 Profiles of Schools

The participating schools vary in their size and services. This section provides the reader with brief sketches of each school, with particular reference to nutrition-related practices and services at the schools (Table 3.1).

Table 3.1 Comparison of participating schools

School	2003-2004 Enrollment	Grade Range	Location	Nutrition-related programs and services
1	403	JK-12	Lion's Head ON	• Milk program • Full-service cafeteria
2	281	JK-6	Hanover ON	• Milk program • Breakfast for learning • Weekly hot lunch
3*	561	JK-8	Dundalk ON	• Milk program • Snack bar • Weekly hot lunch
4	416	JK-8	Meaford ON	• Milk program • Full-service cafeteria
5	222	JK-8	Desboro ON	• Milk program • Breakfast for Learning • Balanced Day
6	318	JK-6	Owen Sound ON	• Milk program • Balanced Day

* School 3 is actually two facilities located in the same community: a JK-3 school with enrollment of 214 and a larger grade 4-8 school with enrollment of 347.

School 1 is perhaps the most unique in terms of its location and enrollment. The facility itself consists of a series of additions to a historic one-room brick schoolhouse. Located in Lion's Head (population 150) it provides JK-12 services for 403 children from the surrounding area. Elementary-age children have daily access to the school's full-service cafeteria, which is staffed by one paid employee and several dedicated volunteers. This cafeteria offers a wide range of healthy meal and snack items, including homemade soups, stews, muffins, chili and vegetarian lasagna. Fresh raw vegetables are included with every entrée and beverage choices include only milk, water and 100% fruit juice. The school has won recognition from the Bluewater District School Board for its innovative approach to school foodservice. In addition, the school offers daily milk sales. While the school is located only two blocks from convenience and grocery stores, school policy prohibits elementary-age children from visiting the stores during school hours.

School 2 is located in Hanover, Ontario, where it serves 281 JK-6 children from the town and JK-3 children from both the town and a large rural catchment. The school participates in Breakfast for Learning, a daily school breakfast program funded by the Canadian Living Foundation (2005) and staffed by local volunteers. All children are offered toast (white or brown) and 100% fruit juice on arrival at school. The school also offers daily milk sales.

The school provides weekly hot lunch sales consisting of hot dogs (made on-site) or local fast food options such as pizza. Although located in town, the distance to convenience and fast food outlets is too great for students to walk during their lunch hour. However, during data collection, I observed that the local McDonalds outlet sponsored the school's Fire Safety Awareness Week, during which participating children were provided with a free children's meal.

School 3 consists of two separate facilities located in the small town of Dundalk, Ontario. The first is a primary school serving 214 children in grades JK-3. The only foodservice at this facility is a daily milk program. Children are not permitted to leave the school grounds for lunch unless accompanied by an adult. The second facility, located on the outskirts of town, serves 347 children in grades 4-8. Despite the long walk to the town centre, many of these children purchase lunch and snack items at downtown shops. While there are no fast food outlets, there is a family-owned pizza and submarine shop that is frequented by schoolchildren.

The school itself offers daily milk sales through its snack bar, staffed by parent volunteers, which also sells chips, licorice, and a variety of sweetened beverages and soft drinks. Weekly hot lunch items include chicken burgers and chicken fingers (prepared on-site) and pizza, which is purchased from a franchise in a neighbouring town.

School 4 serves 416 children in grades JK-8 from in and around the town of Meaford, Ontario. This school offers a full-service cafeteria staffed by one employee. Although food sales include less healthy options such as hamburgers, chicken burgers, and nacho chips with cheese, efforts are underway to improve the range of healthy options available. Salads and soups are on offer as were large fruit and vegetable trays for very reasonable prices. The school also provides daily milk sales. In addition, the presence of a fully-stocked kitchen permits some flexibility in foodservice. I observed numerous instances of staff using the kitchen in order to provide meals for special needs students who were hungry during the day.

The school is located at a convenient distance to a number of stores and fast food outlets, resulting in frequent trips by students to purchase meal and snack items. School policy requires a letter from parents providing permission for these excursions during lunch and recess.

School 5 is located in a rural setting, with its entire enrollment of 222 students bused from outlying areas. Students in grades JK-8 are offered toast (white or brown), cheese, and 100% fruit juice on arrival at school through the Breakfast for Learning program. Interestingly, school 5's Breakfast for Learning is offered in a central location through which all students must pass on their way to classrooms. Volunteers suggest this improves participation and lessens social stigma for children who arrive at school hungry after long bus rides. At the other two schools that participate in breakfast for learning, the service is provided in the gymnasium. School 5 also provides daily milk sales. In addition, this school was one of the first in the province to shift to the Balanced Day, a school board initiative which realigned the school schedule to provide two 20-minute "nutrition breaks", rather than the traditional lunch hour. Both morning and afternoon, children break for 20 minutes of nutrition followed by 20 minutes of outdoor physical activity. In addition, children in grades 6-8 take their nutrition breaks on trestle tables set up in the cafeteria, rather than in their classrooms at their desks.

School 6 is unique in the study in that it is a 90-year-old Victorian building located in the small city of Owen Sound. Its 318 students in grades JK-6 are a combination of rural and urban residents receiving English and French-immersion instruction. This school is also organized around the Balanced Day, although the altered schedule was more recently applied here, and students are experiencing some difficulty with the transition. "Walkers" complain that the 40-minute break afford too little time to travel to and from home for lunch. Beyond milk sales, there is no organized foodservice at the school.

3.6 In the Field: the Experience of Working in the Study Schools

As a researcher, the experience of working in the study schools gave me small interesting albeit limited, insight into the experiences of children attending them. Elementary schools are little islands unto themselves, quite separate during the school day from the communities in which children live. The school day is passed largely indoors, with limited travel between instructional rooms. The day is segmented into timed intervals denoted by loud bells or buzzers. Within a few days I found myself highly attuned to the schedule at each school, anticipating the buzzer and bracing for its impact and the resulting bustle of transition. I also became highly attuned to the length of the school day, anticipating the breaks that came with recess, lunch time and dismissal.

At school the authority of teachers and administrative staff is absolute; children are frequently disciplined for minor breaches of protocol and etiquette, some of which seem antiquated ("no hats on in the halls"). I myself deferred to this authority unconsciously on numerous occasions.

Despite the pervasiveness of authority and discipline, the atmosphere at school is relatively pleasant. The large numbers of students mean that all activities have a social component. Children interact in verbal and non-verbal ways throughout the day, exchanging news and chatter at every opportunity. While silence is the norm during class time, there is ample opportunity for verbal interchange during recess periods. Out of doors, there is no need for silence, which is only enforced in line-ups after the bell.

Physically, schools remain the bland, institutional buildings I recall from my childhood. The study schools were all brick or cinder-block buildings with few soft surfaces (carpets, curtains) to absorb sound or light. Classrooms were brightly lit with a combination of natural and overhead fluorescent lighting. In contrast, service rooms such as washrooms, staff rooms and kitchens were located along interior walls and therefore had few windows and only fluorescent lighting. The combination of institutional design and cinder-block materials made for drab days indoors, despite the efforts of many teachers to decorate their classrooms with brightly-coloured posters and displays. I must say I found the experience of spending time in schools physically and mentally dispiriting.

In terms of nutrition, I found great discrepancies between the mealtimes of staff and students. As an adult, I was invited to join the staff for meals in the staff room. While students generally eat at their desks in their classrooms, during a 10-minute interval in which silence is the norm, teachers eat in the relatively social atmosphere of the staff room. Tables and chairs are provided for staff, as well as facilities for microwaving food and washing dishes (these facilities are rarely available for students). Except for those whose duties included supervising children on the playground, staff members have 30-60 minutes in which to eat lunch, and no restrictions on their physical movement or the volume of their conversation. That said, it appears many staff members elect to return to their classrooms early to catch up on work.

Where schools offered food services, both staff and students availed themselves of the opportunity to purchase food and beverages. I sampled the menus of all schools with foodservice. At school 1, I was able to purchase the highly nutritious hot entrees available to students (eg. vegetarian lasagna). At school 4, the cafeteria boasted soups, sandwiches, and delicious fruit and vegetable trays. In contrast, at schools 2 and 3, only non-nutritious fried foods were on offer (hot dogs, chicken nuggets), along with a selection of potato chips and candy. Like students and staff, I brought my own lunch to schools 5 and 6, where no foodservice was available.

In all, the experience of conducting research in schools reawakened in me the sense, developed throughout my own pre-university education in small rural schools, of isolation from the surrounding community. Within the school bounds is a physical and cultural space distinctly separate in many ways from the outside world. I saw few visual connections to that outer world (one exception was brand advertising on the beverage machine) during my time in schools, a fact that increased the sense of separation. While that separation in many ways facilitates a space of learning for children, it also affords the opportunity for a culture of "separateness" to develop at school, one in which the actions of adults and children can develop patterns that are unlike those of the larger society.

For example, despite the presence of many small children, some of them as young as three years of age, there is little behaviour on the part of adults that could be described as nurturing. Young children are well cared for in the sense that their shelter, food and safety needs are met, but they function quite independently compared to young children outside of school: they put on their own coats, hats, mittens and boots independently, or else play without these protections outdoors; they access packed lunches but choose and eat items independently, often rejecting or discarding many items; they toilet themselves and are responsible for handwashing and self-care. Even young children with physical and mental disabilities are held to a high degree of independent function while in school. And teachers exercise group discipline on children, often holding all class members accountable for the actions of a few. This type of discipline or "singling out", I would suggest, is frowned upon in public settings.

The foregoing is an attempt to illustrate my profound sense of the separation that exists between school as a locality and the broader context of society. While school is undoubtedly a place where societal views are institutionalized and transferred to succeeding generations of children through their interactions with adult teachers, I wish to emphasize that there is a particularity to school as a scene of social action. This was my sense throughout the research and it has undoubtedly permeated both my experience of collecting anthropometric data and my interpretations of the data collected in focus group discussions with children.

3.7 Conclusion

The present study is set in the rural Ontario counties of Grey and Bruce. Owing to its unique geology, the region was sparsely, and usually seasonally, populated by Aboriginal communities until relatively recent times. European immigration resulted in a brief economic boom in the late 19th century, followed by a period of significant economic decline in the 1900s, reflecting the general trend in many rural Canadian areas.

All of the school communities which make up the study population can be defined as rural under Statistics Canada guidelines. While they vary extensively by population size and socioeconomic factors such as income, unemployment rate and educational attainment, they are analyzed in the aggregate in the present study. Within-group comparisons (rural and small-town or village) would result in small age- and sex-groupings and dilute much of the significance of the data. In its present form, the aggregate data provides a basis for comparison with other rural and non-rural North American studies of child growth and nutrition.

There is also a degree of heterogeneity in the schools themselves. It is important to observe that scheduling, foodservice and classroom practices vary between, and even within schools. School and classroom "culture" has an effect not only on nutrition practices but on the research process itself. This heterogeneity contributes to the richness of the data, while at the same time necessitating a cautious approach to interpretation.

Chapter 4 Methods

4.1 Introduction

In a 2004 volume of the *Canadian Journal of Public Health*, Mark Tremblay called for greater investment in direct measures of the Health of Canadians[1]. Tremblay was concerned that increasing policy discussion around childhood and adult obesity prevalence was founded on reported, rather than measured, data. At the time of Tremblay's call, the 1981 Canada Fitness Survey was the most recent large-scale survey available, with measured heights and weights of 4176 children and youth (Canada Fitness Survey 1983). The 1988 Campbell's Survey on the Well-Being of Canadians provided measures of height and weight for 481 children and youth (Stephens and Craig 1990). However the more recent and larger 1996 National Longitudinal Surveys of Children and Youth (NLSCY), with its nationally representative sample of 7847 children aged 7-13 years, provided height and weight measures that were based on parental report (Tremblay and Willms 2000). While many parents undoubtedly performed height and weight measures of their children directly, the lack of standardized protocol and equipment clearly limited interpretation of the NLSCY data. As well, parent reports of children's height and weight have been found to be of varying accuracy (Banach *et al.* 2007).

Studies of children's dietary intake also tend to rely on parent- or child-report using food frequency questionnaires (Lamb *et al.* 2007; O'Loughlin *et al.* 2000; Veugelers *et al.* 2005),

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[1] This call has since been answered by the annual release of data from the Canadian Community Health Survey (CCHS) (Health Canada 2007). Begun in September of 2000, the CCHS includes health indicators such as height and weight. Cycle 1.1 includes data on the height and weight of Canadians aged 12 years and older. Cycle 2.2, begun in 2004, expands the age range to 1-year and older and includes data on adults' and children's nutrient intake.

which are intended to provide information on overall diet quality, rather than quantitative data on food or nutrient intake (Gibson 1990). Studies have questioned the accuracy of parent-assisted dietary recalls and demonstrated that children themselves are reliable 24-hour recall respondents (Eck *et al.* 1989; Sobo and Rock 2001; Sobo *et al.* 2000). Another form of dietary intake data available in Canada is the Family Food Expenditure (FOODEX) survey, a component of the Canadian Labour Force survey in which dietary intake is extrapolated from household food purchases. However useful on a macro scale, these data obscure both the portion of food consumption attributable to children and the role of children as arbiters of food selection and consumption.

My decision to collect data directly from children was in part a reaction to existing parent-centred research on child growth and nutrition. The decision to locate the research in schools was an attempt to access children in a location where they congregate in order to pursue research that was, to some degree, child-centred. This follows wider trends in anthropology to make research more child-centred (Corsaro 1997; Christensen and James 2001a; Mayall 2000). The following chapter describes the methodological and ethical challenges I faced in carrying out this school-based, directly-measured study of child nutrition and growth. The school context of the research influenced my sampling strategy and had a large effect on participation rates in each stage of the data collection: anthropometry, dietary recall and focus groups. The application and limitations of data collection are discussed below, as well as issues that arose during fieldwork and dissemination of the research findings. Finally, I devote several pages to an exploration of some of the ethical issues associated with the study of child growth and nutrition, notably participation, consent, assent, privacy, hunger, self-esteem and sociability in children.

4.2 Sampling and Participation

In September, October and November 2003, I attended staff meetings, parent council meetings, and "meet the teacher" nights at all seven study schools. Using a table-top display, I provided a brief overview of the research questions, methodology and plans for dissemination. I responded to teachers' and parents' questions, which were mainly centred around the data collection protocol.

In December I visited participating classrooms and provided a brief 5-minute oral presentation wherein I introduced myself to students and briefly described the purpose and methods of the research and the role of students in data collection and dissemination. Following the presentation, letters of information (Appendix 1) were distributed to 1042 students in grades 2-8 in participating schools. Letters were left with teachers to be distributed to children at the end of the day, following classroom protocol.

Typically, children receive information ("handouts") on school and classroom activities at the end of the day in preparation for departure. If all goes well, the majority of handouts are placed by children in their backpacks or book-bags and taken home, rather than left in desks or shelves within the classroom. However this system is far from foolproof.

In the coming weeks, teachers collected consent forms which were returned to classrooms by children. I then returned to classrooms to collect the completed consent forms from teachers. The delay between distribution and collection of consent forms was approximately 5 weeks; at the principals' request, forms were distributed in early December and collected from classrooms in mid-January. The timing was planned to ensure children and parents had several weeks to consider participation and contact me with any questions. I received telephone calls from two parents with questions about the data collection procedure; I responded to these by providing additional information.

In all, 1042 consent forms were distributed to children; 637 (61%) were returned to me by teachers. Of the consent forms returned to me by teachers, 535 (84%) contained written consent for children's participation in the study. The high number of positive consents returned to me indicates that there was bias operating on return rates favouring positive consents. Despite the presence of a negative option on the consent form (Appendix 1), parents or children may not have felt it was necessary or acceptable to return forms in which consent was declined. It may have been useful to include a statement on the form requesting it be returned in either case. As I neglected to provide instructions to the contrary, it is also possible that teachers sorted the returned consents, providing me with only those in favour of children's participation.

The overall participation rate of 51% is comparable to that of other recent school studies in Canada (Moffat *et al.,* 2005; Veugelers *et al.,* 2005). However participation rates varied between schools and classrooms (Table 4.1). Among the six schools, the participation rate varied between 42% and 70%. Schools 1 and 4 had the lowest participation rates in the study at 42% and 43% respectively. Conversely, schools 2 and 5 had extremely high participation rates at 70% and 68% respectively. I observed a strong commitment to the research on the part of principals and teachers at schools 2 and 5.

Table 4.1 Participation rate by school

School	Consents Out	Consents In	Yes	No	Participation
1	168	80	72	8	42.9 %
2	145	123	101	22	69.7 %
3	172	115	89	26	51.7 %
4	335	153	141	12	42.1 %
5	78	65	53	12	67.9 %
6	144	99	79	20	54.9 %
Total	1042	635	535	100	51.3 %

The participation rate in schools was directly related to the rate of consent form return. In some classrooms at schools 1 and 4, as few as 20% of consent forms were returned. At school 2, the lowest rate of classroom return was 64%; the highest was 96%. Obviously, some classes were more effective at distributing and collecting consent forms. I observed that in classrooms with high rates of consent form return, teachers were highly engaged with the research. Many used the study as an opportunity to further curriculum goals by relating the research process to concepts in mathematics, social studies, science and nutrition. Conversely, in classrooms with low rates of consent form return, teachers were less engaged with the research. Teachers' participation in the study was nominally voluntary, although they were strongly encouraged to participate by both the Superintendent and Principal. Teachers were instructed to distribute information packages and collect consent forms to students during class time. This format undoubtedly added to teachers` workload and although the extra work may have been minimal, teachers may have perceived the imposition as disrespectful and my appearances in class as interruptions. These perceptions were undoubtedly communicated to students and may have affected their engagement with the study.

Interestingly, the participation rate was also related to the proportion of forms where parents had declined to give consent. In schools with lower participation rates, roughly 10% of children returned forms that indicated that parents declined consent. In all other schools, approximately 20% of children returned forms that indicated that parents declined consent. The lower rate of return of declined consent forms in low-participation schools may simply reflect the lower overall return rate in these schools. It is possible that many of the unreturned forms would have indicated declined consent. The overall effect in terms of bias is likely minimal. There is probably no bias in terms of the types of students participating in the study, but rather variable participation rates among classrooms that was mediated by varying degrees of teacher enthusiasm.

Variability in consent return and participation rate reflects underlying methodological and ethical issues in recruitment and sampling. Many of these are discussed in the *Ethics* section below. Others require additional attention to the way information is distributed and collected in schools. For instance, children and parents may be more likely to return consent forms if incentive is provided to them. Teachers may encourage high rates of return if their time and energies are respected in the form of incentive or reward. I believe that, in future, increased attention to these issues could result in more effective sampling.

4.3 Anthropometry Protocol

Between January and March, 2004, children with parental consent participated in anthropometric measures of height and weight. Children were measured by the researcher in a private room located on school premises. A research assistant was present to record data. Verbal assent was obtained from children prior to measurement. Twenty-nine children were absent from school or involved in school activities that prevented their participation. Two children declined to be measured and were excluded from the sample. Measurements were completed for 504 children (253 boys and 251 girls).

Measurement procedures were consistent with standardized anthropometric procedures (Gibson 1990; Lohman *et al.* 1988). Children were asked to remove their shoes. Height was measured with a portable stadiometer (Perspective Enterprises PE-AIM-101). Participants were asked to remove any hair ornaments that interfered with the function of the stadiometer.[2] Children were positioned standing straight with their feet flat on the floor and their heels, buttocks and shoulder blades touching the vertical surface of the stadiometer. A research assistant performed the mandibular thrust maneuver placing the Frankfurt plane in a horizontal position. Children were asked to take a deep breath; height was measured at maximum inspiration. The researcher made all measurements at eye level. Weight was measured with a portable digital scale (Tanita TBF-551) placed on a hard, level flooring surface. The scale was calibrated with fixed portable weights each time it was moved to a new location. The scale was zeroed prior to each measure.

[2] The removal of hair ornaments prior to stadiometry is described briefly by Gallo *et al.* (2005). In my experience, relatively few children, all of them girls, wear hair ornaments that require removal prior to measurement. However the removal of items such as barrettes and elastics can cause some discomfort for children, and the replacement of these items to the children's satisfaction is not always possible, given the tools (hairbrushes, combs etc.) and skill of the researcher. An unusual circumstance arose in one school where anthropometric measurement occurred on the same day as "Crazy Hair Day". These spirit days are not infrequent in schools and interfere considerably with measurement of height. If possible, this circumstance should be anticipated with the scheduling of measurement on alternative days.

4.4 Limitations of Anthropometry

Measurement of height and weight are relatively simple and can be performed after minimal instruction of personnel (Gibson 1990). The necessary equipment, in this case portable stadiometer and scale, is relatively inexpensive and can be set up and taken down easily in multiple locations. When standardized techniques are used, anthropometric methods produce accurate and consistent results that provide reliable data on long-term nutritional status and growth (Gibson 1990; Lohman *et al.* 1988).

However as a tool for measuring growth, height and weight measurements have several important limitations. First, they are relatively insensitive, meaning that many children with growth problems elude identification by these measures alone. Cross-sectional measures of height and weight often fail to capture recent disturbances in nutrition affecting growth, especially in children (Gibson 1990). These measures are also relatively blunt, as they are unable to identify specific nutrient deficiencies or distinguish between a variety of nutritional processes. Anthropometry can only identify sustained or historic changes in diet. Recent or periodic insufficiencies of nutrients cannot be measured. While anthropometric measures will reveal weight gain or excessive growth resulting from prolonged excessive energy or fat intake, periodic or recent changes in dietary energy may not be captured by anthropometry alone.

In addition many disease states complicate anthropometric assessment as biological systems compete for available energy and nutrients. Genetic factors complicate anthropometric status; for example regulation of basal metabolic rate is controlled to a significant degree by genetic factors (Dahlman *et al.* 2005; Fernández *et al.* 2003). Nutritional anthropometry is therefore best used to generate information on long-term nutritional history, to screen populations for long-term nutritional patterns, to screen populations at high risk for severe or long-term malnutrition, or to evaluate changes in nutritional status over time (Gibson 1990). In combination with other biological data, such as measures of nutrient intake or immune function, data generated from nutritional anthropometry can be extremely useful to human biologists.

(i) Body Mass Index in Children: Issues and Limitations

Body mass index (BMI) is calculated using the equation:

$$\text{BMI} = \text{weight} / \text{height}^2$$

where weight is given in kg and height is given in metres. In children, BMI varies considerably with age, necessitating comparisons to a representative reference population.

The use of BMI as a measure of childhood adiposity has been challenged on a number of levels. While weight is a relatively straightforward measure, measures of height may be compromised by technical issues. In some children, large amounts of adipose tissue may make it difficult for children's heels, buttocks and shoulder blades to maintain contact with the vertical surface of the stadiometer (Gibson 1990).

Diurnal variation in height has been observed, with height measures decreasing slightly later in the day due to increasing spinal compression (Ulijaszek and Kerr 1999). In order to control for diurnal variation in height, some authors endeavor to measure children at approximately the same time of day. For example, in anthropometric measures of 271 youth, Gallo *et al.* 2005 made all measurements within a 3-hour window so that children's height was assessed at approximately the same time of day. In the present study, measures were taken within the 6-hour window afforded by the school day. The results therefore reflect some diurnal variability in height.

The existence of prior undernutrition can affect interpretation of BMI in children. In populations with a history of either episodic or sustained food shortage, growth recovery will favour non-linear over linear growth. Therefore children with low height will have increased weight-for-height and increased BMI despite having concurrent low peripheral skinfold thicknesses and little overall body fatness (Schroeder and Martorell 1999; Trowbridge *et al.* 1987).

Prevailing wisdom asserts that rapid fluctuations in linear growth complicate the interpretation of BMI in children (Horlick, 2001) and that the validity of BMI may be compromised in cross-population comparisons and by environmental circumstances such as prior under-nutrition (Dietz and Bellizi, 1999). Of particular concern is the moderate correlation between BMI and height in children (Freedman *et al.*, 2003) which could result in taller children being classified as obese. In a study of 1180 children, Freedman *et al.* (2004) measured height and adiposity in children using anthropometrics and dual x-ray absorptiometry[3] (DXA). The authors found a correlation between height and BMI (r~0.3) among children that was due not to the limitations of BMI but to the greater adiposity of taller children in the sample. Among 5-11-year-old children, height was strongly correlated with BMI, sum of skinfold thicknesses, and percentage body fat as measured

[3] Dual-energy X-ray absorptiometry is a radiographic technique whereby the radiographic density of various body compartments is measured. The subject is placed between the X-ray source and the absorptiometer. Different tissue types within the body absorb radiation at different rates, thus attenuating the radiation exiting the body. The absorptiometer quantifies this attenuation giving the experimenter the ability to measure the amount of bone, lean tissue and fat tissue within the subject's body. While the technology appears to be extremely useful in medical applications, some validation studies have illustrated variability in soft tissue readings in the same individual (Brownbill and Ilich 2005).

by DXA. There is concern that this correlation could complicate comparisons of obesity prevalence among groups of children of differing heights after controlling for age (Fung *et al*,. 1990). While Freedman *et al.*'s (2004) results confirm that the use of BMI produces high prevalence of obesity among taller pre-adolescent children, the authors suggest that this high prevalence is not a complicating factor as it reflects an empiric tendency toward greater adiposity in taller children.

The present study reflects a similar tendency toward preferential classification of tall children in obese category. Twenty-two percent of tall children (HAC>85th percentile of the 2000 CDC reference) were classified as obese, compared with only eight percent of children whose height fell below the 85th percentile of the reference. Without skinfold data, it is impossible to determine whether this difference in obesity prevalence arises from a confounding correlation between height and BMI or from greater adiposity in the tall children. However it is possible that, like Freedman *et al.* (2003; 2004), we are observing high BMI in a sub-sample of the population whose caloric intake exceeds that sufficient to achieve maximal linear growth.

(ii) Sensitivity and Specificity of BMI

Sensitivity and specificity are epidemiologic concepts that provide useful information about the validity of anthropometric methods. Like other anthropometric indicators, the sensitivity of BMI is relatively weak; this means that many individuals who are overweight or obese are not identified as such using BMI classifications. In comparisons of obesity classification using BMI and other forms of measurement, standard BMI cutoffs fail to identify all overweight or obese children. For example, in a comparison of BMI with densitometry[4] in 474 adolescents, only 72% of overweight boys and 22% of overweight girls were correctly classified by BMI (Neovius *et al.* 2004). In a comparison of BMI with DXA in 3334 adolescents, 52-74% of overweight boys and 42-66% of overweight girls were correctly identified by BMI; 24-43% of obese boys and 22-46% of obese girls were correctly identified by BMI (Neovius and Rasmussen 2007). The variability in sensitivity between boys and girls appears to be the result of variability in percent body fat in both pre-pubertal and adolescent boys and girls (Taylor *et al.* 2002), a finding that confounds comparisons of BMI with other classification systems at any age. In terms of sensitivity, a cautious interpretation of the literature indicates that the use of BMI may result in the misclassification of many obese children and adolescents as non-obese. It follows that obesity prevalence based on BMI can be considered a conservative estimate of true obesity in a population.

In contrast BMI is regarded as a highly specific indicator of obesity in children. Specificity is the ability of an indicator to avoid incorrectly identifying disease in individuals who are not diseased. Researchers report that BMI produces specificities of greater than 90% for both overweight and obesity in children (Field *et al.* 2003; Neovius *et al.* 2004; Neovius and Rasmussen 2007) with specificities greatest at the highest percentile cutoffs. For example, Field *et al.* (2003) calculated BMI in 596 children ages 5-18 years. Compared with body fat percentages from DXA, the authors found that BMI was 99% specific at the 95th centile cutoff of

[4] Densitometry is the calculation of body volume using displacement of water. Traditionally, in a procedure known as hydrostatic underwater weighing, subjects are submerged in water and the volume of water displaced is measured. Using the subject's known body mass, the experimenter can determine total body volume. During underwater weighing, the subject is attached to a breathing apparatus so that water is not displaced by the subject's exhalations (Claros *et al.* 2005). More recently, new techniques for densitometry involve the use of air-displacement systems which are much less stressful for subjects (Fields *et al.* 2002).

a reference population and 96% specific at the 85th centile cutoff (96%) (Field *et al.* 2003). The lower the percentile cutoff used, the greater the number of false-positives (non-overweight children misclassified as overweight) which were generated using BMI.

As a result, BMI is a highly specific but relatively non-sensitive indicator of obesity in children. This makes BMI an appropriate screening tool for population-based studies of obesity risk and prevalence but a less effective tool for identifying obesity in individual children (Power *et al.* 1997). The potential misidentification of overweight children as non-overweight carries implications for program development and health policy. It is important to ensure that analyses of anthropometric indices such as BMI are presented as population-level statistics rather than diagnostic screening tools.

Despite its limitations, BMI is regularly used as an indicator of obesity prevalence in populations as it correlates well (i.e. shares high specificity) with other measures of body fatness such as water and air and densitometry, dual-energy X-ray absorptiometry (DXA), and four compartment modelling[5] (Dietz and Bellizi 1999; Field *et al.* 2003; Marshall *et al.* 1991; Mei *et al.* 2002; Pietrobelli *et al.* 1998; Sampei *et al.* 2001; Zimmerman *et al.* 2004). Many of these technical methods are expensive, time-consuming, and extremely invasive, often involving radiation exposure (Poskitt 1995). In addition these methods require the removal of some or all of children's clothing. While relatively less invasive, skinfold thickness measurement also

[5] Four compartment modeling is the current "gold standard" for body composition assessment. There are a number of four-compartment models currently in use. All divide total body weight into aqueous, protein, mineral and fat portions, and use various technologies to determine the aqueous, protein and mineral portions, then subtract these from total body weight to determine the fat portion (Gately *et al.* 2003; Heymsfield *et al.* 1990; Sopher 2004).

requires the removal of long-sleeved clothing. In contrast, BMI requires only measures of children's height and weight, which can be accomplished with little distress to the child.

4.5 Assessment of Measurement Error

A random sub-sample of children were randomly selected to be measured a second time in order to test for intra-observer error (i.e. variability in a single measurer, as in this study all measurements were made by the researcher). These children were informed of their selection for re-measure during their initial measurement, and were provided with both a brief explanation of the need for re-measure and a letter of information for their parents (Appendix 2).

The literature on anthropometric error provides varying guidelines on the size of sample required. Ulijaszek and Kerr (1999) recommend that duplicate measures be carried out on "at least 10 subjects" in order to test intra-observer error, while Lohman *et al.* (1988) recommend that measurement error calculations be performed on a repeat measure sample of 50 individuals. In practice, numerous authors perform repeat measures of height and weight on 10% of individuals in their sample (Garlie 2000; Moffat *et al.* 2005). Often, measurement error calculations are not reported (Veugelers and Fitzgerald 2005, for example).

In the present study, following the guidelines provided by Lohman *et al.* (1988), fifty-seven children (11.3%) were measured by the researcher at a minimum one hour interval from the previous measure (Appendix 2). The results of the two measurements were compared in order to ascertain the reliability and validity of the measurement technique. Technical error of measurement (TEM) was used to assess the presence of measurement error in a single measurer using the equation:

$$\text{TEM} = \sqrt{(\Sigma D^2)/2N}$$

where D is the difference between first and second measures and N is the total number of individuals measured (Ulijaszek and Kerr 1999). TEM is expressed using the unit of measurement, and is therefore only comparable with studies using the identical form of measurement. In Table 4.2 the results of the present study are compared with the maximum acceptable values for TEM proposed by Ulijaszek and Kerr (1999).

Table 4.2: Results (reference values) of intra-observer error calculations

Measurement	TEM (Reference)	CV (Reference)	R
Height	0.26 cm (1.2 cm*)	0.18 % (1 %*)	0.99 (>0.95**)
Weight	0.12 kg (0.32 kg*)	0.30 % (1 %*)	0.99 (>0.95**)

* Ulijaszek and Kerr 1999
** Ulijaszek and Lourie 1994

A number of authors caution that TEM is age-dependent (Lourie and Ulijaszek 1992; Ulijaszek and Kerr 1999). The age-dependence of TEM arises from the positive association between TEM and mean value of measurement: the larger the mean measure, the larger the TEM. This correlation between TEM and mean has been observed in a large-scale study of anthropometric measurement error conducted by Ross *et al.* (1994). The authors recommend the calculation of relative rather than absolute TEM values in order to assess measurement precision across the entire sample.

One relative measure of TEM is the coefficient of variation (CV) which is calculated using the equation:

$$CV = TEM/mean \times 100$$

where mean is the mean measurement value for the total sample. CV is expressed as a percentage, permitting comparisons both within and among samples and between various forms of measurement (Ulijaszek and Kerr 1999). Table 4.2 presents CV for height and weight in the present study, accompanied by reference values for CV. In the present study the TEM for height (0.263 cm) and weight (0.116 kg) can be compared using CV, yielding the observation that there was greater intra-observer error in weight (0.3%) than in height (0.183%) measures. Part of the variability in weight measures in individual children (intra-observer error) may arise from diurnal variation in fluid balance.

A second method of assessing relative TEM is the calculation of the coefficient of reliability (R) for height and then weight using the equation:

$$R = 1 - ((\text{total TEM})^2/SD^2)$$

where SD is the total standard deviation for the study sample. The calculation of R yields a measure of measurement precision across the entire sample. The R value of 0.99 for the sample indicates that 99% of the observed variation in height and weight is due to factors other than measurement error (Ulijaszek and Kerr 1999).

4.6 Anthropometry Reference Standards

In the present study, children's height, weight and BMI were compared with reference values from the 2000 Childhood Growth Charts published by the US Centers for Disease Control and

Prevention (Kuczmarski *et al.* 2002). The 2000 CDC Growth Charts are a revised version of the 1977 National Center for Health Statistics (NCHS) growth charts that were adopted in 1978 by the World Health Organization (WHO) as its international growth reference (Dibley *et al.* 1987). The use of the WHO growth reference during the 1980s and 1990s led to consistent and vocal criticism of its applicability to international populations on a number of bases, among them the fact that high weights at the upper end of the distribution skew the curves dramatically, a phenomenon blamed on the "unconstrained growth of the US sample population" (de Onis and Habicht 1996).

Widespread acknowledgement of the limitations of the 1977 NCHS growth reference led to efforts to minimize similar problems during the construction of the 2000 CDC growth charts. In particular, efforts have been made to address the impact on the growth reference of soaring North American obesity rates. The new 2000 CDC growth charts were first published in May 2000 (National Center for Health Statistics 2002a). Whereas the old reference spanned the 5th to 95th percentiles of growth, the new reference was expanded to cover the 3rd to 97th percentiles. The broadening of the data range was intended to reduce the number of children whose growth measures lay beyond the upper and lower limits of the reference. The upper age limit of the charts was increased from 18 to 20 years for the express purpose of monitoring "the rising prevalence of adolescent obesity" (Roberts and Dallal 2001:32).

The most significant alteration in the growth reference in relation to obesity research is the inclusion of BMI charts for children ages 2-20 years. Despite recommendations by the International Obesity Task Force (IOTF) that BMI cutoffs for children follow a graded system, the 2000 CDC charts use the 85th and 95th percentiles as the cutoffs for "at risk for overweight" and "overweight" respectively (National Centers for Health Statistics 2002a). A comparison of the CDC 85th and 95th percentiles with the IOTF cutoffs reveals that the CDC cutoffs are consistently lower than those recommended by the IOTF. The differences in the cutoffs are most significant between the ages of 3 and 7 years, when the IOTF values are approximately 0.5 BMI units greater. This observation is important in light of the emphasis in the research literature on early diagnosis of BMI (see Auer *et al.* 2001; Lau 1999, for examples). It would appear that the CDC has deliberately selected the lower cutoffs for its BMI curves with the purpose of identifying larger numbers of children at risk for obesity.

Another significant aspect of the 2000 CDC reference is the variability in the data sets which make up the reference population. In 1977, the growth charts for height-for-age, weight-for-age, and weight-for-height were all constructed from the same data set. At the time, that included results from the National Health Examination Surveys (NHES) II and III, the National Health and Nutrition Examination Survey (NHANES) I, and a Fels Research Institute study of infant growth from 1929-1975 (National Center for Health Statistics 1977).

The 2000 CDC height-for-age, weight-for-age and weight-for-height charts were constructed using data from the NHES II and III and the NHANES I, II and III (National Center for Health Statistics 2002a). However the 2000 CDC BMI charts exclude data from the NHANES III for children ages 6 years and over. The selection of 1988 is arbitrary and based on concern regarding rising obesity rates in US children which were clearly observed in the NHANES III: "(there was) a marked increase in weight of children 6 years and older in NHANES III compared with previous surveys" (Roberts and Dallal 2001:33).

The 2000 CDC growth reference is expressly intended to define child overweight relative to US population surveys conducted prior to the NHANES III (begun in 1988). The data have been selectively manipulated to construct BMI curves that recommend rather than describe healthy growth (Roberts and Dallal 2001). This fact underscores the need to interpret data on obesity prevalence with the full knowledge that reference values have been designed to heighten awareness of childhood obesity. As an anthropometric index, BMI is a useful tool for identifying groups at risk. It is not intended as a diagnostic criterion.

4.7 Dietary Recall Protocol

Between March and May, 2003, children with parental consent participated in dietary recalls. The number of participants was limited by school activities and the length of time required for each dietary recall interview (15-20 minutes). Because 24-hour recalls have been validated for children 8 years and older (Lytle *et al.* 1993), efforts were concentrated on children in grades 4-8 (aged 8-13 years). All recalls were done with children rather than parents. In a study of parent-reported dietary intake data, parents scored relatively poorly in their estimates of children's intakes. Although parents tend to add to the breadth of dietary data collected by identifying foods that children forget (Sobo and Rock 2001), children in general prove to be reliable 24-hour recall respondents (Baranowski *et al.* 1986; Domel 1997; Domel-Baxter *et al.* 2000). In addition, children's recalls may be less affected than those of adults by biases toward reporting of food perceived to be healthy or nutritious (Eck *et al.* 1989; Sobo *et al.* 2000)

Dietary recalls were conducted interview-style in a private room on school premises. All recalls were administered by the investigator with a research assistant present to record responses. Verbal assent was elicited prior to each interview. The duration of each interview ranged from 15-30 minutes, depending on the child's ease of recall. Through a series of open-ended questions and neutral prompts (Domel *et al.* 1994; Domel 1997; Domel Baxter *et al.* 2000), the investigator asked the child to trace the events and activities of the previous day, from the time the child awoke until the time the child went to sleep. All reported foods and drinks were recorded, along with, where possible, detailed descriptions of ingredients, preparation, portions served, and portions consumed. Because of the large number of school lunches consumed, particular emphasis was placed on shared, traded, or discarded foods. Children were assisted in their recall by the presence of calibrated food models and a range of grocery items. Accurate portion size estimation was facilitated by sample cups, dishware, and graduated measuring containers. At the end of the interview children's reported intake was summarized for their verification. In addition, children were asked about inadvertent omissions (foods not reported) or intrusions (foods reported but not actually consumed) (Domel 1997; Domel Baxter *et al.* 2000; Domel Baxter *et al.* 2002).

Recalls were conducted on a total of 364 children. The recall records of eight children were excluded from the data set because: (1) the children reported feeling ill during the previous 24 hours; or (2) they were uncertain about their ability to recall the previous day's dietary intake. Because most of the children were over age 9 in grade 4, the records of four 8-year olds were removed to facilitate comparison with Dietary Reference Intakes (Institute of Medicine 2002), which are provided for children in age groupings above and below 9 years. The recall records of the remaining children constitute the primary nutrient data set (n=352; 170 boys and 182 girls). This data set is used in analyses of nutrient intake by age and sex groupings.

A secondary nutrient data set (n=328; 159 boys and 169 girls) was constructed of recalls from children who participated in both dietary recall and anthropometry. This involved the removal of recall records for 24 children who had not participated in anthropometry. This data set is used in analyses of nutrient intake by anthropometric indices.

4.8 Limitations of Dietary Recall

Twenty-four hour dietary recall is an accepted method of assessing both the quantity and quality of nutrition in samples of children (Gibson 1990). There is general agreement in the literature that alternative methods, such as food records and food frequency questionnaires, yield less reliable measures of food consumption and nutrient intake[6] (Dwyer and Coleman 1997; Humphrey *et al.* 2000; Lytle *et al.* 1993; McPherson *et al.* 2000). Other alternative methods include observation, weighed food records, dietary history and doubly-labeled water[7], though these can be extremely time consuming for the researcher and somewhat invasive for the respondent.

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[6] In contrast, there are studies that assert that 3- and 7-day food records provide fewer errors and food reporting while yielding greater amounts of data on children's food consumption patterns (Crawford *et al.* 1994; Frank 1991b).

[7] Doubly labeled water is a technique in which the subject ingests isotopically-labeled water containing isotopes of hydrogen (deuterium) and oxygen (oxygen-18). The concentration of the hydrogen and oxygen isotopes in the body decreases as a result of dilution of body water by new, unlabelled water (consumed as food and drink and produced during oxidation of foodstuffs), coupled with the simultaneous loss of labeled water via urinary excretion and via evaporation from lungs and skin. The test requires a minimum of two post-dose samples of body fluid, over a time period of several days to several weeks, depending on the subject's age and rate of water consumption. These samples are analyzed by mass spectrometry and compared in order to determine the water consumption rate of the individual. This rate is said to yield an accurate measurement of energy expenditure in humans (Cole *et al.* 1990).

Gibson (1990:37-9) describes the process of dietary recall as follows:

> Subjects are asked...to recall the exact food intake during the previous 24-hour period or the preceding day. Detailed descriptions of all foods and beverages consumed...are recorded by the interviewer...Food models of various types can be used as memory aids...The respondent burden is small for a 24-hour recall, so that compliance is generally high. The method is quick, relatively inexpensive, and can be used with illiterate individuals.

In my opinion, this description does not adequately capture the experience of a researcher conducting 24-hour dietary recalls with children.

The school context of the present study presented challenges for the use of the dietary recall method. Privacy requirements and the large volume of materials (calibrated food models, grocery items, graduated measuring containers) necessitated a constant search for appropriate locations for dietary recall interviews. The length of interview for each child (15-20 minutes) spanned recess and lunchtime breaks, often necessitating the interruption, delay or repetition of recall interviews with children. These breaks also affected children's concentration, often leading to repeat interviews at a later time.

While food models, grocery items and measuring containers proved extremely useful in assisting children's recall, these items were somewhat distracting, especially to young children, who were curious about the latex food models. Children often requested that I provide them with snacks from among the grocery items. The open-ended interviewing strategy recommended in the literature (Gibson 1990) often led to incidents where children had accidentally recalled the wrong day's meals. These errors were identified by prompts from the researcher, requiring the child to start over again. This not uncommon process presented very little discomfiture to the child but lengthened the dietary recall process considerably.

In all, the dietary recall interviews consumed the bulk of my time and resources in the field. Where I performed between 26 and 55 anthropometric measures per day, the greatest number of dietary recalls I performed in one day in the field was 11; I averaged 7 recalls per day. The literature on dietary recall, while extremely helpful in regard to protocol and limitations, is currently lacking in descriptive detail on the enormous undertaking, especially with children, inherent in this methodology.

There is evidence that children's dietary intake varies substantially by meal, day and season (Cullen *et al.* 2002; Gagne *et al.* 2004; Roth *et al.* 2005). While Gibson (1990) asserts that single 24-hour recalls are adequate for population-level assessments of child nutrition, multiple dietary recalls are becoming standard practice in large-scale studies of dietary intake. For example, in an effort to remove the effect of day-to-day in nutrient intake, since 2003 the US National Health and Nutrition Examination Survey (NHANES) has included two 24-hour recalls on each individual in the sample (Carriquiry 2003). This practice is also prevalent in epidemiologic studies of environmental exposure to contaminants (Chan *et al.* 1995; Kim *et al.* 1998; Kuhnlein *et al.* 1995). As childhood obesity can be understood in terms of environmental exposure to energy-dense foods, and keeping in mind the variability of children's diets, it may be useful to collect repeat 24-hour recall data on children for population-level comparisons.

While time- and resource-intensive, repeat 24-hour recalls would improve the quality of data on children's dietary consumption patterns. However, the ability of the researcher to conduct multiple dietary recalls depends on a number of factors, among them respondent burden (Dodd *et al.* 2006). In the school setting, each dietary recall represents a lengthy disruption in both the child's and his or her classmates' education. I elected in this case to limit recalls to one per child. While the large number of recalls (n=352) in the data set supports the validity of mean intakes calculated for this sample (Murphy *et al.* 2006 propose a minimum group size of 100), I have no way of estimating whether the sample is representative of the population as a whole. There may have been selection bias in the total sample of positive consents returned. In addition it is likely that there was a participation bias operating in favor of children whose school performance would not suffer from their absence from class to participate in lengthy dietary recalls. That said, I observed a tendency in teachers to encourage the participation of children who they deemed "at risk" of poor nutrition. It is difficult to predict the effect of these combined biases on the sample's representativeness.

Due to the school context of this study, I opted to conduct all of the recalls on Tuesday through Friday. This practice is not uncommon in school-based studies of children's nutrition (Frank 1991b). As a result, the dietary recall data reflects weekday eating patterns only, and may not be representative of daily variability in children's overall intake. Haines *et al.* (2003) report that on weekends children consume significantly more energy from fat and carbohydrate and less energy from protein. The use of weekday data in the present study limits comparisons of the results to other studies of children's dietary intake.

There is evidence that children's accuracy of recall varies between meals. For example Domel-Baxter *et al.* (2007) report that during 24-hour dietary recall children are less accurate in recalling foods consumed at breakfast than lunch despite the fact that fewer foods were consumed at breakfast. The authors suggest that length of time between the meal and its report is negatively associated with children's reporting accuracy, a claim which is borne out by studies of accuracy in 24-hour vs. previous day recalls. Children's recall accuracy is significantly improved through the use of the prior 24-hours, rather than the previous day (Domel-Baxter *et al.* 2004). Accuracy can be further improved through the use of single meal recalls (Domel-Baxter 2002) or by limiting the time interval between the meal and reporting (Domel-Baxter 1997), though in order to gather data on overall food consumption patterns, these techniques necessitate numerous repeat interviews with children at differing times of day. This was not possible in the present study given time constraints imposed by the school schedule.

The results of the present study do not include the impact on children's diet from oral vitamins and supplements. Twenty-nine percent of children reported consuming some form of dietary supplement. However the type of supplement varied widely between children, from brand name children's multi-vitamins to herbal and mineral blends. In addition, many children reported consuming "a vitamin" but were unable to describe the brand or formulation. Authors of numerous studies of children's diet do not comment on the portion of intake from dietary supplements (Champagne *et al.* 2004; Rocandio *et al.* 2001; Veugelers *et al.* 2005, for examples). Others report minimal numbers of children whose diets are influenced by vitamin or mineral supplements (Bowering and Clancy 1986; Looker *et al.* 1987; Salamoun *et al.* 2005).

This variability in reporting may be due in part to inconsistencies in formulation, labeling, and regulation of dietary supplements in Canada and the US. In addition, estimates of dietary intake from supplements are hampered by a lack of available databases and by controversy over the bioavailability of nutrients from various non-food sources (Dwyer *et al.* 2003; Murphy *et al.* 2007; Yates 2001). While it appears that the proportion of children reporting supplement use in this sample is higher than previously reported, the effect of supplement use on children's nutrient intake is an issue for future analysis.

4.9 Dietary and Nutrient Analysis and the Use of Dietary Reference Standards

An issue of concern to nutrition researchers is the limited number of existing publications which employ the new dietary reference intakes (DRIs) as reference standards. While DRIs represent a harmonization of Canadian and US approaches to dietary evaluation that is extremely valuable to researchers, their use presents a number of challenges to the interpretation of dietary recall results. For group intake analysis, the new guidelines recommend comparisons to the estimated average requirement (EAR), which represents the "average daily nutrient intake level estimated to meet the requirement of half the healthy individuals in a particular life stage and gender group (Murphy *et al.* 2002). The EAR value is calculated as the median of a normal distribution of nutrient requirements. The recommended daily allowance (RDA), which was the old unit of comparison, now represents "the average daily nutrient intake level sufficient to meet the nutrient requirement of nearly all (97%) healthy individuals in a particular life stage and gender group" (Murphy *et al.* 2002: 267). The RDA can be calculated as the EAR plus two standard deviations of nutrient requirement. In theory, the use of EAR represents a more nuanced approach to determining dietary adequacy, as the distribution of intake values below the RDA includes some values near the RDA that are probably adequate to individual needs. Authors caution that the EAR should never be used as a definitive cutpoint for evaluation of intake, as individuals with intake above the EAR have probabilities of inadequacy as high as 50% (Murphy *et al.* 2002). In addition, where requirement distributions cannot be described, reference values are given as adequate intakes (AIs). Like RDAs, AIs describe target intakes for individuals and cannot be used as cutoffs for determining prevalence of inadequacy[8].

These recommendations present a number of obstacles to group intake analysis: the lack of EARs for many nutrients; the significant gap between the EAR and the RDA; and the large probability of nutrient insufficiency above the EAR cutpoint. These obstacles have been addressed in the present study by: the use of EARs wherever possible; by calculating the prevalence of inadequate intake below the EAR; by avoiding calculation of prevalence of inadequacy based on AI; and by the use of caution in determining the significance of mean intake below the EAR. These methods are consistent with other early publications using the new system of DRIs (Champagne *et al.* 2004; Moffat and Galloway *in press* ; Veugelers *et al.* 2005) as well as more recent publications which offer recommendations for the use of DRIs to assess intakes of groups (Dodd *et al.* 2006; Murphy *et al.* 2006). That said, the use of EAR cutoffs for determining adequate intake and prevalence of inadequacy ensures that estimates of mean intake and inadequacy are conservative in the extreme. The present study represents a cautious approach to determining dietary quality based on the newest reference information available.

[8] Studies that report mean nutrient levels in group samples often cite the AI for reference purposes (see Champagne *et al.* 2002, for example), acknowledging the limitations of this practice. I do this in Chapter 6 (Figure 6.5 on p. 372). However, despite clear guidelines to the contrary (Murphy *et al.* 2002), some authors calculate the prevalence of nutrient deficiency by comparing mean values to the AI (Champagne *et al.* 2002:204-5). Following the recommendations of Murphy *et al.* (2002), I do not do this (Table 6.5 on p. 372). However I must acknowledge that I too assume low calcium intake in children based on comparison of mean value with the AI (p. 174). The lack of an EAR for several nutrients limits the options available for researchers reporting dietary intake in population groups.

On the topic of nutrient analysis, I believe comment is warranted on the software currently available to nutrition researchers. As far as I am aware, there is currently no software available that calculates servings from either Canada's Food Guide to Healthy Eating (1997) or the US Food Pyramid (United States Department of Agriculture 2007). Researchers simply formulate their own calculations using software packages such as Microsoft Excel or SPSS. This practice is cumbersome, lacks standardization, and leads to irregularities in reporting, the most alarming of which is the tendency in recent literature to report servings of foods which are not categorized, such as added sugar and "discretionary fat" (Champagne *et al.* 2004). Because of widespread public and professional knowledge of food group/pyramid categories, data reported in this form is both accessible and appealing to health planners and service providers. The development of software designed for this purpose would enable researchers to analyze and communicate food group data much more effectively than is presently accomplished through various techniques.

In studies of population nutrition, the majority of nutrient analysis is done using software that calculates macro- and micronutrient intake from established values of nutrient content in foods. In the present study, I used Nutribase 5 Clinical Nutrition software (CyberSoft Inc.) which has both US and Canadian nutrient content values (in the present study I used the Canadian values in nutrient analysis).[9] While the manufacturer claims the software is designed for both clinical and research applications, in my experience this product and others like it lack the flexibility necessary for use in research. Data on food and beverage intake is converted into energy and nutrient measures which are retrievable by meal or by day for individuals or groups.

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[9] Nutrient content varies in manufactured foods between Canadian and US markets as manufacturers must meet the regulatory standards of differing jurisdictions.

Comparisons of meal, day, individual or group values are not possible. Nutrient values must be exported to other more powerful statistical software in order to perform these analyses. Locating research-quality nutrition software remains a challenge for investigators.

4.10 Focus Group Protocol

From each classroom's pool of study participants with parental consent, four children were randomly selected to participate in the focus group discussions. A total of 144 children (72 boys and 72 girls) took part in 37 focus groups (Appendix 3). The majority of focus groups in this study were comprised of four participants. There were five groups with only three participants and one group of five. Verbal assent was elicited from children prior to each focus group.

Focus groups were led by the investigator and conducted in private on school premises during school hours. Each discussion took approximately 20 minutes. A research assistant made digital audio recordings of the discussions and took notes. Open-ended questions were designed to elicit information about the physical and social environments children experience during snack and lunch times at the schools, for example: How do you know when it's time for snack? Describe the place where you eat your snack; what is it like? Are there any rules about snack time? The questions were used as prompts with extra verbal explanation provided by the investigator to stimulate discussion where necessary.

4.11 Limitations of Focus Group Data

(i) Content

It had originally been my intent during focus groups to discuss the issue of body image as it relates to food and nutrition programs in schools. During the ethics review process, members of the McMaster Research Ethics Board (MREB) expressed concern that focus group discussions involving body image might prove injurious to children's self-esteem. The MREB requested the removal of this topic from the focus group protocol and I complied. Interestingly, in 2007, Haines *et al.* published findings from a series of focus groups with elementary school-age children. Both boys and girls described weight-related issues that arise at school, such as poor body image and teasing. Children suggested that they would benefit from programming aimed at improving body image, for example "using famous role models who are different shapes and sizes to help bolster how students feel about themselves" (Haines *et al.* 2007). Body image is an issue of great significance for children, one which is not likely to diminish in significance with the rise in childhood obesity prevalence.

Beyond the content of the focus group discussions, there are a number of challenges to the internal validity of qualitative data generated from focus groups, such as selection bias and experimenter bias.

(ii) Selection Bias: Small group sizes give each participant more time to talk and free the facilitator from the greater degree of control and discipline required by larger groups (Morgan 1997). In children this lesser degree of control and discipline is especially advantageous, as it distances the facilitator from the structural constraints which characterize adult-child

relationships at school. In addition to the desirability of small group sizes, spatial constraints necessitated small groups; we were often gathered in a small ante-room, such as the health room, which was not designed for comfortable discussion amongst group members.

Despite the random selection of students from each classroom, the small number of participants in each focus group may have been limiting to the range of student opinion as well as the gender composition within the groups. The random selection of four participants from among students with parental consent in each class generated a list of focus group participants biased in favour of males. However in a number of cases teachers denied boys permission to leave the classroom, necessitating the selection of alternate participants. Through this process, teachers unwittingly corrected the gender imbalance in the focus group sample but may have significantly altered the results. The nutrition-related experiences of the boys denied participation may have been significantly different from those of boys who participated in the focus group discussions.

(iii) Observer Effect: The historical and structural relationships between the researcher and participants, and amongst the participants themselves, are likely to influence the responses children give during focus groups. In the case of the present research my status as an adult female may have been advantageous. The majority of teachers at the study schools were female and thus my presence fit into children's existing framework of relationships while permitting a novel opportunity for self-expression: "having an adult who listens to them and who is, to some degree, at their mercy, fits into preadolescents' needs for social control" (Fine and Sandstrom 1988:58). In addition, children benefit from consistency of contact with a single researcher. This is true of preadolescent children, as they have reached the developmental stage where they have

a rudimentary right of privacy, meaning they can control the way in which they relate to the researcher by concealing information (Fine and Sandstrom 1988:50). It is even more crucial to establishing relationships of trust between the researcher and adolescents, whose personal sense of privacy and autonomy are highly developed (Fine and Sandstrom 1988:60-1).

In terms of interpersonal conflict, it can be difficult to control for tension between individuals within a focus group (Morgan 1997). I attempted to control for interpersonal conflict by establishing a contract of trust amongst the researcher and all participants: we agreed to share equally in the discussion and listen respectfully to each other's contributions. This respect was demonstrated consistently by my verbal and non-verbal behaviour . In addition, my research assistant and I committed to protect the confidentiality of all statements made by students during the focus group. It was this commitment, especially, that distanced us as researchers from the authoritative structures students associate with school, and placed us in a relationship characterized by an egalitarian, rather than an authoritarian, exchange of ideas.

The focus groups were transcribed by the research assistant and then encoded and analyzed in their entirety by myself. It has been suggested that encoding by a second blinded researcher improves intra-observer reliability (Krueger 2000) though this practice is rarely recorded in reports of qualitative research (see Hart *et al.* 2002, for example). While blinded coding may control for deficits of memory and misinterpretations by the observer, there is also value in having the original researcher encode the data. First-hand knowledge of the interaction, as well as recollections from the researcher`s field notes, can enrich the focus group data set by giving additional context about the mood, tone, and flow of conversation.

In the present study, the researcher facilitated all 37 focus groups, in an effort to: (1) provide consistency in the order and content of the discussions; and (2) limit the number of researchers coming into contact with the children over the course of the study (both the researcher and the research assistant were present for all aspects of the data collection, and the researcher herself conducted dissemination activities within each classroom). The discussions were recorded using both digital audio software and simultaneous note-taking by the research assistant. In addition, the research assistant recorded information about the non-verbal cues exchanged during the discussion. Taken together, the various notes and transcripts provide a detailed record of what transpired during the focus groups.

4.12 Teacher Interviews

Initially, I had planned to conduct adult face-to-face interviews with teachers on the subject of the school nutrition environment. I planned to carry out these interviews over the duration of my time spent in schools. In hindsight, I recognize that this plan was highly optimistic and based on a limited understanding of teachers` daily schedules.

Due to limited success in teacher recruitment, only four interviews were conducted with teachers. The teachers represented only two of the six study schools, and were unwilling to be interviewed after school hours. The limitations imposed on teachers within the framework of their employment were a significant obstacle to both child and teacher recruitment. By engaging the Superintendent of Elementary Education as a partner in the research, I undoubtedly and inadvertently introduced a political element to the process of recruitment. At the suggestion of the Superintendant, who provided the necessary resources, the project was introduced to school principals at a board-wide luncheon, with attending principals' wages and travel costs supported. No such introduction was given to teachers, whose participation was entirely voluntary and unsupported. Accordingly, teachers distributed information packages and collected consent forms to students during class time. Although I offered to conduct interviews with teachers in the evenings or by telephone, all declined in favour of brief face-to-face interviews at school. In future, I believe both teacher and student recruitment would be enhanced by the expenditure of resources on teachers, rather than just school principals. In addition, teacher recruitment would be improved by a more formalized approach to soliciting their input.

4.13 Ethics

Part of the impetus for this research was the call by Tremblay (2004) for directly measured data on the growth of Canadian children. However the collection of body size measures, indeed of all data, from children poses significant ethical and methodological challenges, not the least of which is the maintenance of privacy and self-esteem. This section represents an analysis of some of the wider issues regarding children's participation in research that arise from the tension between the researcher's responsibility to protect vulnerable research subjects and the need to respect children's authority and autonomy.

It is the responsibility of both the researcher and the research ethics board (REB) to ensure that the study protocol protects the rights of vulnerable research subjects such as children. In the Fall of 2003 the study protocol was reviewed by several REBs: McMaster University (MREB), the Grey Bruce Health Unit, and the Bluewater District School Board. As part of McMaster's annual education of new board members, the study protocol was randomly selected for review by the entire McMaster Research Ethics Board, rather than a selected committee. The university board review was nothing if not thoroughgoing, requiring my appearance before the full board on two occasions, the first to respond to questions and the second to demonstrate my responses as a researcher to scenarios involving children's and parents' questions regarding the research. In contrast, the health unit and school board reviews were relatively swift as they took place after the university review, in which the study protocol benefited from numerous suggestions and changes.

The following section addresses some of the ethical considerations that arose both during and after the ethics review. While the MREB took great pains to ensure that the protocol adhered to the Tri-Council Policy Statement on Ethical Conduct for Research Involving Humans (Canadian Institutes of Health Research *et al.* 1998), I felt that there were numerous occasions where intent to protect children's safety or to respect the autonomy and authority of child research participants were constrained by factors in the school environment that were difficult to control. I feel strongly that these issues deserve a more thoroughgoing discussion than is currently available in the literature. The following section is my contribution to that literature.

(i) Recruitment and Participation

By selecting the school as research setting, the researcher immediately lends authority to the structures governing access to children in school: the school board, administration (principals, vice-principals) and staff (teachers, educational assistants). The individuals in these roles become the primary gatekeepers, guarding access to children through their control and authority over children's schedules and physical locations. While the intent of ethical guidelines for consent is to place gatekeeping authority in the hands of parents and guardians, I would suggest that parents' authority is influenced by prior relationships between parents and the authoritative structures within schools.

I will use several examples from the present study to illustrate this point: My research protocol, approved by both the MREB and the Bluewater District School Board, required that I introduce myself to students in classrooms on the day I handed out information letters and consent forms to students. I was granted this access to classrooms by the school board and individual school principals and teachers, without the foreknowledge of parents and guardians. While I had also attended "meet-the-teacher" events held earlier in the year, many parents and children were unable to attend those events. Therefore the first contact many parents had with me as researcher was through the letters of information brought home by their children, who had met me hours earlier.

A second example is, I believe, a larger and more ubiquitous illustration of the influence of schools' gatekeeping authority. While the overall study participation rate was 51.3%, it varied significantly between schools and between classrooms. Participation rate was directly related to the rate of consent form return by children. Examined by classroom, the rate of consent form return varied between 20% and 96%. Obviously, some classes were more effective at distributing and collecting consent forms. As noted above in section 4.2, I observed that consent rate form return depended on teacher engagement with the research. This perception was undoubtedly communicated to students and through them to their parents and guardians.

The third example illustrates teachers' influence on children's participation in the research. The overall study sample pool consisted of 535 children whose parents and guardians had provided written consent for their participation. As stated above in Section 4.11, in a number of cases teachers denied boys permission to leave the classroom due to behavioural and work-related issues, necessitating the selection of alternate participants. Thus some participants were denied the opportunity to participate, regardless of the fact that they had the written consent of their parents and, according to the Tri-Council policy Statement principal of inclusion (Canadian Institutes of Health Research *et al.* 1998:5.9) had the right to participate in the research.

(ii) Consent

I sought active parental consent in the form of a written document from the parents or guardians of schoolchildren (Appendix 1). The Tri-Council Policy Statement on Ethical Conduct for Research Involving Humans states that informed consent for children's participation in research seeks to protect the interests and dignity of those who are deemed "incompetent" to provide consent on their own behalf (Canadian Institutes of Health Research *et al.* 1998). In the Tri-Council Policy Statement, the definition of competence contains two concepts: one is the ability to "appreciate the potential consequences of a decision" (1998:2.10); the other is "vulnerability" to harm.

There is a large body of literature focusing on children's capacity to participate in decisions about their participation in research (Beardsmore and Westaway 2007; Halila and Lőtjőnen 2003; Hultqvist and Dahlberg 2001; Miller *et al.* 2004; Qvortrup 1990; Wendler 2006; Wendler and Shah 2003; Woodhead and Faulkner 2000). Among researchers, there is recognition that children's decision-making ability regarding research participation is highly variable and dependent on numerous factors, among them age, developmental stage, cognitive status and prior experience. Baylis *et al.* (1999:7) assert that "respectful involvement in decision-making about research participation requires, at the very least, an assessment of (1) what the child knows; (2) what the child can understand; (3) what the child's decision-making capacity is; and (4) what the child needs to know in order to exercise her decision-making capacity." Maguire (2004) contends that the incorporation of this type of process requires a fundamental re-thinking of the epistemology of childhood and children, one that is certainly underway in the literature (Hoyles 1989; James and Prout 1990; Jenks 1996, 2001; Mayall 1994, 2001; Oldman 1994; Woodhead 1990) but whose effects have not yet trickled down to the organizations who regulate child-centered research.

Numerous agencies have published statements respecting the rights of children to self-determination. The United Nations (UN) Convention on the Rights of the Child[10] states that signatories shall guarantee "to the child who is capable of forming his or her own views the right to express those views freely in all matters affecting the child, the views of the child being given due weight in accordance with the age and maturity of the child" (1989:Article 12). The Tri-Council Policy Statement itself recognizes that the ability to provide free and informed consent to participate in research "may vary according to the choice being made, the circumstances

[10] The UN Convention on the Rights of the Child has been ratified by 193 countries. To date, the only UN member states that have not yet ratified the convention are the US and Somalia. US opposition is based on conservative and pro-family groups' interpretations of the document that fear it will undermine parental rights. President George W. Bush stated in 2001: "The Convention on the Rights of the Child may be a positive tool for promoting child welfare for those countries that have adopted it. But we believe the text goes too far when it asserts entitlements based on economic, social and cultural rights. ... The human rights-based approach ... poses significant problems as used in this text" (Anderson 2001). This argument has been echoed in the United Kingdom, where it is felt by many that the promotion of children's rights "obstructs parental rights and family life" (Lansdown 1994).

surrounding the decision, or the time in question...competence is neither a global condition nor a static one; it may be temporary or permanent" (Canadian Institutes of Health Research *et al.* 1998:2.9)[11]. However Maguire (2004) observes that in practice the overwhelming majority of research ethics boards interpret these principles conservatively, resulting in sweeping constraints on children's participation in the process of consent. The institutionalization of these constraints is evident in the language of ethical guidelines (the term "incompetence" is used in both national (Canadian Institutes of Health Research *et al.* 1998) and in international (World Medical Association 1964) ethical policy statements, and in justifications advanced by ethical bodies for continued exclusion of children from the process of consent. For example, according to the National Council of Bioethics in Human Research (1997:17) "the large majority of children lack the ability to understand and therefore make a rational decision about whether to consent to therapy or to participate in research."

In fact, legal interpretations of competence have not upheld children's statutory right to be involved in decisions regarding their consent. In a 1985 case in the United Kingdom involving an adolescent's right to make decisions on her own behalf, the judge ruled that the right to consent does not include the right to refuse consent, "irrespective of the competence of the young person in question" (Lansdown 1994:38). The exclusion of children from decisions on participation is in contrast to other socio-legal contexts, such as family and divorce court, where children's input is often actively sought (Smith *et al.* 2003a). The conservatism persistent in research ethics may

[11] While the literature lacks a standard definition of competence (Stanley *et al.* 1987), competence has been recognized as a multi-dimensional trait, consisting of several different domains, among them comprehension of information, understanding of risks and benefits, reasoning ability, and decision-making ability (Beauchamp and Childress 1994, Weithorn and Campbell 1982). However competence is rarely operationalized as a multi-faceted variable. Miller *et al.* (2004) reviewed ten studies of children's competence to provide consent for research. In all but one, competence was defined by a single dimension.

stem from the entrenchment of ideas regarding children's ability to interpret information regarding their participation in research. However this conservatism is also closely linked to societal notions of children's vulnerability to harm.

Canada's Tri-Council Policy Statement stipulates that "the notion of harm applied to children should be understood differently from harm in adults" (Article 2.5:2.11). This special definition of harm in children is the ideological descendent of several sources: the 1924 Geneva Declaration of the Rights of the Child, the 1959 UN Declaration of the Rights of the Child, and the 1989 UN Convention on the Rights of the Child. Durkheim (1992:147) observes that childhood is vulnerability personified:

> What is a child from the physical point of view? He is the puniest of beings, a small body that the merest blow can break, that the slightest illness imperils, a collection of muscles, nerves and organs which are, so to speak, made of milk and which only form, develop and increase in strength by their being placed in a wonderful environment of careful attention, of consideration, of favorable circumstances and protective influences.

This modern definition of children's incompetence extends into the cognitive realm. Foucault (1992:170) equates insanity with the mental state of childhood, in which children are incapable of regulating their physical power through cognitive means: "(they) have an overabundance of strength and make dangerous use of it." Interestingly, this definition of vulnerability rests on competing conceptualizations of the physical competence of children: according to one they are physically weak, while according to the other they are too physically strong.

The notion of children as vulnerable to harm is a relatively new one historically. Ariés (1992) traces the development of an ideology of childhood through literature and iconography, observing that there are very few representations of children in medieval art and literature. Until roughly the 18th century, the lack of linguistic or artistic reference to children denotes a virtual absence of the concept of childhood as we now understand it: "as soon as a child could live without the constant solicitude of its mother, his nanny or his cradle-rocker, he belonged to adult society" (Aries 1992:36). A quote from Molière's *Le Malada Imaginaire* demonstrates the invisibility of childhood in seventeenth-century Europe: "How is it, Brother, that rich as you are and having only one daughter, for I don't count the little one, you can talk of putting her in a convent?" (in Ariés 1992:36).

Coveney (1992) contends that the modern concept of childhood arose from a confluence of discourses regarding the state of society during the industrial revolution. Rousseau challenged the long-held Christian tradition of original sin with the notion of the noble savage and children as *tabula rasa*, a notion perpetuated by Victorian authors such as Blake, Wordsworth and Dickens. In contrast, the writings of Cesare Lombroso perpetuated deep-seated myths about "the character and existence of a criminal class" (Platt 1992:152). Herbert Spencer's social Darwinism, built on a flawed interpretation of Charles Darwin's theory of biological inheritance, resonated in a Victorian Christian society replete with class strife: "a large proportion of the unfortunate children that go to make up the great army of criminals are not born right" (in Platt 1992:153). Out of this mêlée, argues Coveney (1992), was borne the intriguing twin conceptions of children as "innocent" and "dangerous", conceptions which inform present-day notions of children's vulnerability.

The Tri-Council Policy Statement defines harm as "pain, anxiety or injury" (Canadian Institutes of Health Research *et al.* 1998:2.9) and rests its claims to special protection for children on the potential long-term developmental effects of research participation on children. Research on parental consent for children's participation in research has demonstrated that both parents and researchers rate disclosure of risk of harm as the single most important element of the consent procedure (Tait *et al.* 2002), above voluntariness, possible benefits, and the ability to withdraw from the research. The adults involved in obtaining consent base their decision-making about children's participation largely on the possible risk of damage to children's physical and emotional well-being. However, there is some evidence that concern over risk is greater among researchers than it is among parents. Tait *et al.* (2002, 2004) observe that parents are extremely altruistic when it comes to children's participation in research. In a study of parents of children undergoing a variety of surgical procedures, approached on the day of their child's surgery to consent to their children's participation in a variety of research studies, parents based their decisions on knowledge of both the risks to their child and the possible benefits to society. Parents rated potential benefits to society higher than did the researchers, whose concerns were focused largely on risk of harm to children. It is possible that parents' knowledge of their children gave them a greater sense of their children's strength and resiliency. It is equally conceivable that researchers' concept of the vulnerability of children is embedded in their authoritative structural position vis-à-vis both parents and children.

Lansdown (1994) categorizes children's vulnerabilities as inherent and structural: inherent vulnerabilities, such as physical size, weakness, immaturity and lack of knowledge, diminish rapidly as children grow and develop the capacity to exercise responsibility for themselves; structural vulnerability derives from children's lack of political, economic and civil rights in society. Using Lansdown's categories, it can be argued that ethical guidelines such as the Tri-Council Policy Statement prioritize the protection of children's inherent vulnerabilities while perpetuating institutionalized constraints on their structural vulnerabilities. As Oldman (1994:43) observes, "there is a hegemony of *perspectives* on childhood" in which it is in the interests of adults to perpetuate a concept of childhood that includes the notion of children's vulnerability.

Whatever its provenance and implications, the current system purports to "protect (children's) dignity through the free and informed consent of authorized representatives" (Canadian Institutes of Health Research *et al.* 1998 Article 2.5). However, in practice, there is enormous variability in reports of the methods by which the consent of these authorized representatives is obtained for children's participation in research. In a review of 25 studies with children, Franck *et al.* (2006) report that the quality of parental consent process is generally poor, with large gaps in parents' knowledge about the procedures involved in the study. Mathews *et al.* (2005) report that written parental consent is consistently required by the United States Department of Health and Human Services. However US federal regulations governing research with children permit the waiver of the requirement for written parental consent "provided an appropriate mechanism for protecting the children who will participate as subjects in the research is substituted, and provided further that the waiver is not inconsistent with federal, state, or local law" (US Department of Health and Human Services 2004 Subpart D). In practice, a form of negative option consent is used, in which "parents are sent information and their permission is assumed if they do not reply otherwise" (Esbensen *et al.* 1996; O'Donnell *et al.* 1997:376). This practice, often termed "passive consent", is common in both the US (see Centers for Disease Control and Prevention 2002; Sargent and Dalton 2001; Lustbader *et al.* 1998, for examples) and Canada (see Barrette *et al.* 2006; Leatherdale and Manske 2005; Leatherdale *et al.* 2005, for examples). In a recent example from the UK, the researchers studying childhood obesity provided teachers with a lesson plan for measuring schoolchildren's height and weight, and then distributed letters to parents explaining that they could withdraw their child from the lesson by completing and returning a tear-off slip (Routh *et al.* 2006). The effect of opt-out consent on participation was significant: Routh *et al.* (2006) had a participation rate of 98.8% (compared to mine, which was 51%). I argue that opt-out or passive consent is neither as informed nor as free as active parental consent, due to limitations on the distribution of information and peer pressures on children in a school setting.

Arguments in favour of passive consent cite the over-representation of wealthy, non-minority, well-educated, employed and non-smoking parents among respondents who provide active written consent for their children's participation in research (Dent *et al.* 1993). Passive consent is seen as a means of broadening recruitment in studies designed to benefit children of lower socioeconomic status. The use of passive rather than active written consent in school-based studies, however, raises important ethical concerns over the authority of the school in mediating the process of consent. Numerous authors have documented the influence of authoritative structures on children at school (Christensen and James 2001b; Mayall 1994). School is recognized as an institution with enormous influence over the temporal, spatial, cognitive and emotional lives of children (Bird 1994; Ennew 1994; Kovařík 1994; Mayall 1994; Näsman 1994; Oldman 1994; Warde 2001). This influence undoubtedly extends to the process of consent for children's participation in research. The Tri-Council Policy Statement stipulates that free and informed consent must be voluntarily given, without manipulation, undue influence or coercion (Canadian Institutes of Health Research *et al.* 1998 Article 2.2:2.4). Further, the statement recommends that research ethics boards pay "particular attention to the elements of trust and dependency…because these can constitute undue influence" (Article 2.2:2.4). How can this ideal be achieved within the authoritarian structural framework of school? Children and parents are socialized to a high degree of compliance with school norms and routines (Mayall 1994; Warde 2001). Within this structured environment, it is likely that both children and parents exhibit varying degrees of autonomy and control over their decision-making. It is highly conceivable that the institutional authority of school dominates both children's and parents' decisions regarding participation in research.

(iii) Assent and Dissent

There is disagreement in the literature on the age or developmental stage at which children can comprehend the implications of their participation in research. Some researchers contend that children less than 10 years of age cannot appreciate the risks and benefits of research participation (Ondrusek *et al.* 1998; Tait *et al.* 2003; Wendler and Shah 2003). Others have documented that children as young as seven can understand some elements of informed consent, such as voluntariness and the ability to withdraw. This disjuncture between researchers is likely due to variability in the rate of cognitive development among children.

However there is agreement among researchers and ethics boards that children of all ages are capable of expressing their dissatisfaction, discomfort or objections to various aspects of the research (Wendler and Shah 2003). Assent, or "positive agreement" (Wendler 2005) and dissent, or disagreement, can be used to recognize the autonomy of rights of children to disengage from situations or experiences which are unpleasant to them. The use of assent and dissent procedures during research represents an attempt to formally recognize the voluntariness of children's participation in research.

The Tri-Council Policy Statement recommends the use of both assent and dissent to permit individuals who are not legally competent "to express their wishes in a meaningful way" (Canadian Institutes of Health Research *et al.* 1998 Article 2.7:2.10). However Ungar (2006) observes that guidelines for assent have been incorporated into ethical guidelines in a much less rigorous way than have guidelines for informed consent. Under US ethical guidelines, responsibility for the processes of obtaining and recording assent rests with the institutional ethics board (IRB): "when the IRB determines that assent is required, it shall also determine whether and how assent must be documented" (US Department of Health and Humans Services 2004). The Canadian Tri-Council Policy Statement contains no guidelines for recording assent or dissent.

In practice, ethics boards have modeled the procedure for obtaining and documenting assent on the procedure for obtaining written consent in adults (Ungar 2006). It is useful to consider the reasons for obtaining a written signature from child participants. If the signature indicates the child's autonomous authorization to participate in an aspect of data collection, then the signature is a useful, and ethically important, part of the research protocol. "If, on the other hand, the purpose of obtaining the child's signature is merely to provide the investigator with a defense against the charge that she or he failed to obtain the child's assent, then the requirement for signature risks becoming superfluous or even a distraction from the important goal of engaging the child in discussions about research in a cognitively and psychologically appropriate way" (Ungar 2006: S32). The current flexibility regarding assent in ethical guidelines permits a wide range of interpretations about the manner of seeking and documenting children's assent.

Dissent is an equally, if not more, challenging concept to operationalize. While young children may be aware of their right to freely choose to participate in research, it may be more difficult to convince them of their right *not to participate* in research. Guidelines for obtaining and documenting dissent are almost non-existent. The few recommendations for dissent that exist are subjective and extremely vague. Wendler and Shah (2003) report that "in most cases, verbal or behavioral objections will reflect distress. However, this is not always the case. For instance, an infant might cry in the absence of distressing stimuli" (2003:4). In light of the variability among children's responses, the authors recommend that dissent be registered if the child expresses the wish to discontinue participation "verbally or though bodily movements" (Wendler 2005:231) or if "the child is experiencing more than minimal distress" (Wendler and Shah 2003:4-5).

The likelihood of the child exercising his or her right to dissent or withdraw from research is undoubtedly influenced by the structural relationships between the child, the researcher, and the parent or guardian who provides written consent for the child's participation. At home, children are assumed to be under the control of their parents. At school that control is assumed by adult teachers. Schoolchildren are immersed in a culture where their autonomy rights are subsumed by the authority of surrounding adults (Bird 1994; Ennew 1994; Kovařík 1994; Mayall 1994;

Näsman 1994; Oldman 1994; Warde 2001). It is extremely difficult for an adult researcher to separate herself from the authoritarian structures surrounding schoolchildren.

In the case of my own research, I had incorporated a procedure for obtaining children's assent prior to each part of the data collection. Prior to individual measurements of children's weight and height, I obtained the verbal assent of each child in privacy, with only myself and a research assistant present to record the assent. However, prior to focus group discussions, children were brought as a group from their classroom to the interview room. It was felt by myself and the research ethics board that the process of separating the children to obtain their verbal assent in privacy would cause undue stress during what was understood to be a group interview. Assent was therefore elicited in the focus group setting, where an element of peer pressure could conceivably have influenced children's decisions whether or not to participate in the discussion.

A second example from my own research highlights the influence of the physical environment on assent and dissent. Due to space constraints at one school, I was provided with meeting space in the office of the vice-principal, who was absent for the day. It is possible that the research participants had prior experience of that physical location, often associated with remedial discipline, and that may have influenced their anxiety level during the process of obtaining assent.

In the present study, I modeled my assent protocol on that for consent, in that I provided children with a description of the data collection procedure. However, I kept the description brief and omitted explanation of the overall goals of the research or specific risks and benefits to the child.

My primary goal in obtaining assent was to ensure that children had the opportunity to refuse to participate should they feel at all uncomfortable. My research assistant and I tried very hard to reduce the structural differences between adult researchers and schoolchildren by using our first names, going slowly, conversing at eye-level, and by giving children adequate time to take in the strange people and instruments in the room. In all, we had only two refusals. The low number of refusals may indicate that, despite our efforts, children did not feel able to refuse to participate.

Miller and Nelson (2006:S28) have observed that "very few studies have documented the extent to which children are susceptible to undue influence in the research setting." If research ethics boards are to safeguard the interests of child research participants, it is essential that assent and dissent be defined, exercised and documented with regard to the particular research context of each study. Researchers working with schoolchildren face a particularly difficult challenge in ensuring that children's assent is freely given and that children have the freedom to exercise their right to withdraw from research participation.

(iv) Body Measurement and Children's Privacy Rights at School

Children's privacy rights have often been overlooked since we view them as non-adult and thus not subject to the same rights and considerations. Alderson (1994) observes that the abrogation of children's privacy rights arises from a Western conceptualization that views the child as "incomplete". For example, both Piaget and Freud described childhood *processually*, invoking the notion that children are developing traits of cognition, personality and identity (Sugarman 1987). This incomplete or non-adult conceptualization of childhood implies that children have a limited sense of their own identities and justifies actions that would violate adult boundaries of self.

Further, there is tension between the privacy and protection rights of children, which results in limited privacy, especially for young children. The notion of children's vulnerability is deeply embedded in Western society. Adults may violate children's privacy if the act of doing so is deemed in any way protective. This is especially the case in schools, where parental protection rights are assumed by principals and teachers (Bird 1994). For example, I observed one occasion where a teacher held up a child's lunch contents to the class as an example of poor nutritional choices. It was an appalling invasion of the child's right to privacy, especially in light of the fact that the child *may not have had any control* over the contents of the lunch. While we have come a long way from the institutional practices and harsh remedial discipline of the 1940s and 50s, children continue to be subjected to assessment, evaluation, verbal correction and disciplinary measures in the public setting of the classroom. Much harm is still done to children in schools "for their own good".

I feel it is critical that we as researchers take steps to ensure that our research does not violate children's privacy. And I feel it should be stated that *it is extremely easy* to violate children's privacy in the school setting. The authority of the adult researcher, especially the adult female researcher, in the school setting is immediately recognized and rarely questioned by both children and parents. In the interests of achieving a large sample size, it is tempting for researchers to proceed quickly with the processes of explanation, assent and measurement, giving children little or no opportunity to register their dissent. The physical spaces available for research use are rarely conducive to visual and auditory privacy. For example, at one school I conducted measures of height and weight behind a library partition, a location which necessitated the communication of measurements between researcher and recorder in writing, rather than out loud. The location was far from ideal and may have prevented children from registering their dissent verbally, as there were other children within hearing distance.

The measurement of height requires particular care, as the stadiometry requires that the child's head be placed in the Frankfort plane through the use of the mandibular thrust (Lohman *et al.* 1988). This hands-on maneuver is performed by the researcher and can be extremely discomfiting to the child unless time is taken to explain the technique and its significance prior to measurement. During my own research, the research assistant performed the mandibular thrust maneuver while I observed the height measurement. In the course of the research, the children had not met the research assistant prior to height measures. Several minutes' time, as well as patient and comprehensive explanation, were required in order for participants to develop rapport with the research assistant, in order for them to feel comfortable enough to permit her to place her hands on their heads. It was also necessary to stop the procedure occasionally and verify that children were comfortable continuing. Prompts such as "Are you OK?" and "Would you like us to stop?" were helpful in ascertaining whether or not children wished to register their dissent.

The measurement of children's weight has other significant implications for children's privacy and self-esteem. Both children and parents cannot fail to be aware of social discourse on body size. The mainstream North American media certainly favours thinness over fatness (Neumark-Sztainer 1999). In the US, Health care providers' concerns over rising childhood obesity rates, such as the US Surgeon General's 'Call to Action to Prevent and Decrease Overweight and Obesity" (US Department of Health and Human Services 2001), have prompted initiatives targeting childhood obesity. The response in Canada has been similar, with organizations such as the Heart and Stroke Foundation of Canada (2006) calling for increased governmental support for BMI screening programs.

In 2003, the Arkansas state legislature passed a law requiring schools to monitor students' weights and heights and send home periodic "BMI report cards" to parents (Ikeda *et al.* 2006). The BC Medical Association (Legislative Assembly of BC Select Standing Committee on Health 2006) has recently proposed the creation of a child health registry which would track children's height, weight and waist-to-hip ratio between kindergarten and grade 12.

As a researcher, I have grave concerns with the location of obesity screening programs in schools, where the lack of regard for children's privacy and autonomy rights is so deeply institutionalized. My own experience suggests that the consent for such screening would likely be affected by the complex relationship between children, parents, and those in authoritative roles at schools. Numerous researchers have described the harmful effects of ill-advised screening programs on children's self-esteem and body image (Budd and Volpe 2006; Haines *et al.* 2007; Ikeda *et al.* 2006; Neumark-Sztainer 1999). Should governments proceed with school-based obesity screening, I recommend the measurement protocol include measures to safeguard the privacy and autonomy rights of children.

(v) Self-Esteem

The Tri-Council Statement requires that we minimize the risk of harm to children It asserts that the notion of harm in children should be understood differently than from harm in adults, as harm may have longer-term consequences to children's growth and development (Canadian Institutes of Health Research *et al.* 1998).

Of primary concern in anthropometric research with children is the prevention of psychological harm associated with bodily measurement or size. During review of the research protocols, the MREB took great care to ensure that I was equipped to deal with issues of gender, body image, and self esteem that might arise during anthropometry. For example, I was called to appear before the board to respond to mock scenarios of children's reactions to anthropometric measurement.

My research assistant and I went to great efforts to provide privacy and reassurance to children during anthropometry. We responded to children's questions about body size by emphasizing the variability in growth rates between children and the differing growth trajectories of boys and girls. We took care that all of our statements about children's bodies reflected positive approaches to child growth, health and physical activity. In addition, we provided information to children and families about additional information and resources available in their communities.

Overall, it is unquestionably the responsibility of the researcher to protect children's self-esteem and dignity during research. This responsibility is especially tested in studies like mine that incorporate data on children's growth and body size. I believe this responsibility is not adequately addressed in the methodological literature and the result is insensitivity to issues of self-esteem in research practice. For example, a recent university newsletter describing a study of obesity and diabetes prevention in children featured an image of a pig riding a bicycle (Huynh 2007). The use of such an image raises concerns over the author's sensitivity in dealing with body image issues during the research.

However there are broader self-esteem issues in children that impact any school-based study. I would like to highlight one that has arisen in the course of my experience: the identification of the sex of children. On the consent form, I asked parents to provide the child's name, grade and date of birth. In retrospect, I should have asked parents to provide the sex of the child. The majority of elementary-school-age children have not yet undergone the secondary sex differentiation that occurs during adolescence. Consequently, it was occasionally difficult to ascertain the sex of the child. Names were of little assistance. In the case of my study, children's growth and dietary intake measures must be compared with sex-specific reference values. Therefore, it was occasionally necessary to obtain this information confidentially, from a third party such as the school principal. In no case would I ask this information of a child, as the implication, that sex was not observable, could be extremely injurious to the child's self-esteem. However I was uncomfortable with the need to obtain this information from a third party. I recommend the collection of this information from parents during the consent process.

(vi) Representation

The ethical issues that arise during dissemination are largely concerned with representation. In order to avoid interpretations arising from the use of visual images of children, I elected not to photograph children in schools. Instead, where possible, I included quotes from conversations with children, so that their voices and opinions are represented.

I have encountered challenges of representation which arise from the terminology used to describe the research findings. For example the latest Centers for Disease Control guidelines recommend the use of the terms "at risk for overweight" and "overweight" to describe categories that are labeled "overweight" and "obese" in the general literature (Kuczmarski *et al.* 2000). Due to the medicalization of obesity, the conflation of childhood and adult measures of BMI, and widespread media attention to this issue, I am extremely cautious about the language I use in both academic and public presentations.

The rural context of the present study means that there are relatively small numbers of child participants from each of the study schools. In public and media presentations I am extremely cautious in the use of graphs and charts to ensure that outliers are not visible in the data as individual children could be identified. The data are always presented in age- and sex-groupings, rather than by individual school. In addition, the applied nature of the research means that the local health unit and school board are interested in the issue of obesity risk. I endeavor to present findings in language that avoids risk or blaming and emphasizes trends in relation to provincial and national findings.

It is clear from the forgoing examples that ethical guidelines governing research participation are by no means comprehensive with respect to their application in school settings. It is the responsibility of researchers and REBs to interpret the possible and probable implications of consent procedures within the context of the school community, to recognize the profound influence of the authoritarian structures on the processes of consent and participation, and to provide strategies to ameliorate the impact of the school environment, and the people in it, on children who participate in school-based research. The challenge of meeting these responsibilities while acknowledging the autonomy and authority of children requires new tools and procedures.

4.14 Conclusion

By combining the methodologies of anthropometry, dietary recall and focus groups, the present study affords broad scope for understanding child growth and nutrition in a rural population. I feel that as a researcher this breadth has also afforded me perspective into various branches of scientific knowledge. In order to create a safe research space for three differing methodologies, I have frequently been forced to step back from my role as investigator to take on a new role as facilitator in a mixed-methods project. This role has allowed me to appreciate the competing and often conflicting forces governing the production of scientific knowledge.

For instance, my choice of school as a study venue, a choice made fairly rapidly in light of a lengthy history of school-based anthropology and the constraints imposed on sample size by the rural context of the study, was fraught with challenges that affected every stage of the research, from design to dissemination. My use of relatively simple, tried and true methods such as anthropometry and 24-hour dietary recall was complicated by factors such as space and time constraints within schools as well as interpersonal issues between teachers and students and parents. These matters deserve attention in the literature to ensure that researchers develop and share new and creative approaches to study that engage communities and build children's capacity and self-esteem.

Finally, I feel it is essential that the research community undertake a reconsideration of the procedures used to provide ethical approval for research with children. There is a wide degree of variability in methodological and ethical approaches to research with children, for example, the use of passive versus active parental consent. Current practices do not reflect either the spirit or the letter of ethical guidelines. Research conducted in school settings is particularly likely to contravene the intent of ethical guidelines due to the confluence of factors which constrain children's agency. The authority of teachers, principals, and researchers is inherent not only in their adulthood but in their structural role as the arbiters of children's autonomy and authority. Matějček (1985, in Kovařík 1994) estimates that approximately 25% of children suffer chronic stress with regard to school performance and achievement. It is likely that in the context of the school environment various aspects of the research process are both helped and hindered by the authoritative structures located there. The choice of school as a research setting is one that carries with it major implications for the research. It is not neutral ground.

Chapter 5 Obesity Rates Among Rural Ontario Schoolchildren

Manuscript prepared for the *Canadian Journal of Public Health*

Submitted 25 July 2005

Accepted 05 January 2005

Citation: Galloway T. 2006. Obesity rates among rural Ontario schoolchildren. *Can J Public Health* 97(5):353-6.

5.1 Preface

This paper was prepared immediately upon completion of the anthropometry data analysis. It was agreed upon by the community organizations working in partnership with the project, the Board of Education and the regional Public Health Unit, that timely dissemination of the results was critical to the formation of new policy and programs supporting children's nutrition.

The Health Unit was working with national-level data on adult obesity and local-level data on cardiovascular disease risk (see chapter 1) that indicated that rural Ontario residents were at significant risk of obesity-related morbidity. The support of Health Unit staff for the present study was founded on the belief that health unit goals in the area of obesity prevention would be augmented by local-level data on the prevalence of childhood obesity in the region.

The *Canadian Journal of Public Health* was selected as the vehicle most appropriate for achieving the goal of early dissemination. Its broad readership (including Public Health workers, employees of the regional health authority, hospital and general practice physicians, nurses, and child care workers) would circulate the data widely to health planners and practitioners. And its brevity (2000 word count restriction) would permit rapid preparation and early release of the anthropometry data.

During manuscript preparation and revisions, both the school board and health unit moved ahead with changes to school nutrition policy during the 2005-6 school year. The publication of the data in September 2006 served as an affirmation of early program initiatives and an impetus to accelerate the pace of reforms to nutrition and physical activity policy in schools.

5.2 Abstract

Background: The majority of existing studies of obesity risk among Canadian children come from urban populations. The purpose of this study is to assess the prevalence of obesity in a sample of rural Ontario children.

Methods: Measures of height and weight were obtained for 504 children attending seven public elementary schools in Grey and Bruce Counties, a predominantly rural area of Southern Ontario. Body mass index (BMI, or weight/height^2) scores were calculated and compared with reference data from the Centers for Disease Control (Kuczmarski *et al.* 2002).

Results: Rates of overweight and obesity were high in this sample, with 17.7% of children classified as overweight and 10.9% classified as obese. There was a significantly high prevalence of overweight for both boys (17.8%) and girls (17.5%) (Chi-square=75.70, p<.001). However there was a significant gender difference in obesity prevalence: 15.0% of boys were obese, compared with 6.8% of girls (Mann-Whitney U=29133.0, p,>05).

Conclusion: Findings indicate that among rural children, particularly boys, risk of overweight and obesity are at least as high as in their urban Canadian counterparts. There appear to be fewer girls than boys at the extreme high end of the distribution of BMI, which may indicate differences in the growth environment of rural boys and girls.

5.3 Introduction

The attention of North American public health researchers is increasingly focused on the prevalence of obesity and its comorbidities, such as type 2 diabetes and cardiovascular disease (Birmingham *et al.* 1999; Fontaine *et al.* 2003; Peeters *et al.* 2003). Canadian data on obesity prevalence reflects the larger North American trend toward high rates of adult obesity and a rapidly increasing population of overweight children.

It is to be expected that across such a large nation, Canadian communities will exhibit a diverse range of obesity prevalence, mitigated by various local forces. Researchers have documented negative associations between childhood obesity, and numerous socioeconomic factors, among them income, parental employment status, and parental educational attainment (Alaimo *et al.* 2001; Crooks 1999a; Evers and Hooper 1995; Haas *et al.* 2003; Johnson-Down *et al.* 1997; Moffat *et al.* 2005; O'Loughlin *et al.* 2000; Sherry *et al.* 1992). In addition, there is an emerging body of research describing neighbourhood-level effects of place on obesity risk (Moffat *et al.* 2005; Diez-Roux 2001; Timperio *et al.* 2005).

In an analysis of Canadian childhood obesity rates by both geographic and socioeconomic variables, Willms *et al.* (2003) demonstrate that geography (in this case province of residence) has a significant association with obesity prevalence that is both *greater than* and *separate from* the effect of socioeconomic variables such as family income or parental educational attainment. It would appear, then, that area-level factors may play a significant role in the development of childhood obesity. This relationship between neighborhood and child growth and nutrition has been explored in urban Canadian communities (Moffat *et al.* 2005; O'Loughlin *et al.* 2000).

While Canadian researchers stress the need for directly measured data at the national and local level (MacLellan *et al.* 2004; Tremblay 2004), few studies (Crooks 1999a, for example) target rural communities specifically. The purpose of this study is to assess the growth and nutrition of children living in a geographically rural area of Canada. This paper reports findings from the anthropometry portion of data collection.

5.4 Methods

The Bluewater Nutrition Project is a study of children's growth and nutrition in rural Ontario, Canada. Between January and June 2004, anthropometry, 24-hour dietary recalls, and focus groups were conducted with children. The sample was constructed from the populations of seven elementary schools in the Bluewater District School Board, located in the Georgian Bay region of Southern Ontario. The schools serve a diverse range of community sizes: the smallest school communities are entirely rural, with all children bused from surrounding townships; the largest school is located in a small city, population 21,000. All school communities fall under the Statistics Canada definition of "rural non-metropolitan" (DuPlessis and Clemenson 2001; Statistics Canada 2003).

Ethics approval for this study was obtained from the McMaster Research Ethics Board, McMaster University, as well as from the Bluewater District School Board and the Grey Bruce Health Unit. Letters of information were distributed to 1042 students in grades 2-8; the guardians of 535 children returned written consent for children's participation in the study (51.3% participation rate). Verbal assent was elicited from children at the time of measurement. Two children declined to be measured and were excluded from the sample. In addition, a number of children were absent from school on the day of measurement. Anthropometric measures were conducted on a total of 504 children (253 boys and 251 girls) ages 7-14 years.

All measurements were performed by the author in private rooms on school premises, with a research assistant present to record data. Children were asked to remove their shoes. Height was measured with a portable stadiometer (Perspective Enterprises PE-AIM-101). Weight was measured with a portable digital scale (Tanita TBF-551). Measurement techniques were consistent with Lohman *et al.*'s (1988) standardized procedures for anthropometric measures.

In order to test for intra-observer error, 57 of the 504 children were randomly selected and measured a second time. Technical error of measurement (TEM) and coefficient of variation (CV) were within acceptable limits for both height (TEM=0.263; CV=0.183) (Ulijaszek and Lourie 1994) and weight (TEM=0.116; CV=0.300) (Bouchard 1985). Coefficient of reliability (R) for both variables was 0.999.

Anthropometric measures were converted to Z-scores and percentiles using Epiinfo Version 3.3, and analyzed using SPSS Version 12.0 software. Students T-tests were conducted on mean Z scores to permit comparison with the 2000 CDC reference (Kuczmarski *et al.* 2002). BMI centiles (BMIC) were categorized as overweight (BMIC $\geq$85 and <95) or obese (BMIC $\geq$95) and compared with the 2000 CDC reference standard using the cutoffs (Frisancho 1990; Roberts and Dallal 2001) and terminology consistent with North American usage (Moffat *et al.* 2005; Plotnikoff *et al.* 2004). Chi-square tests were performed to determine whether prevalence deviated significantly from that of the reference population. Non-parametric statistics were used to compare BMIZ and prevalence by age and gender. Significance was observed at the level of $p \leq 05$.

5.5 Results

In the overall sample, the mean BMIZ was significantly higher than that of the reference sample ($t=11.171$, $p<.001$). BMIZ scores are presented in Table 5.1. Boys' mean BMIZ score (0.539) exceeded girls' mean BMIZ (0.392), but the difference was not statistically significant. There were no significant differences in BMIZ scores across age and gender groupings.

Table 5.1 Mean BMIZ scores

	Boys			Girls		
Age (years)	n	Mean BMIZ	St. Dev.	n	Mean BMIZ	St. Dev.
7	26	0.86	0.89	15	0.49	0.52
8	40	0.62	0.98	29	0.3	0.96
9	29	0.53	1.05	51	0.59	0.85
10	68	0.71	0.93	53	0.36	0.88
11	56	0.42	0.98	53	0.25	0.98
12	23	0.31	1.09	29	0.31	0.73
Total	242	0.54	1.00	245	0.39	0.86

Prevalence of overweight (17.7%) and obesity (10.9%) in the total sample significantly exceeded the 2000 CDC reference values of 10% and 5% respectively (Chi-square=75.70, $p<.001$). Comparing age and gender categories (Table 5.2), boys' rates of obesity were significantly higher than girls' for both the 7- and 10-year age categories ($p<.05$ and $p<.05$ respectively). Overall rates of obesity were significantly higher for boys (15.0%) than girls (6.8%) (Mann-Whitney U=29133.0, $p<.05$).

Table 5.2 Prevalence (%) of overweight (BMIC ≥85and<95) and obesity (BMIC ≥95)

	Boys				Girls			
	BMIC ≥85and<95		BMIC ≥95		BMIC ≥85and<95		BMIC ≥95	
Age (years)	n	%	n	%	n	%	n	%
7	5	19.2	6	23.1*	3	20.0	0	0.0*
8	7	17.5	5	12.5	2	6.9	4	13.8
9	5	17.2	4	13.8	14	27.5	4	7.8
10	16	23.5	14	20.6†	9	17.0	3	5.7†
11	11	19.6	5	8.9	10	18.9	4	7.5
12	0	0.0	4	17.4	4	13.8	1	3.4
Total	45	17.8	38	15.0‡	44	17.5	17	6.8‡

* Mann-Whitney U=150.0, p=.047
† Mann-Whitney U=1533.0, p=.020
‡ Mann-Whitney U=29133.0, p=.003

5.6 Discussion

In total, 32.8% of boys and 24.3% of girls in this sample had BMI values above the 85th centile of the 2000 CDC reference sample. These findings compare with those of the National Longitudinal Surveys of Children and Youth (NLSCY), in which 28.8% of boys and 23.6% of girls have BMI above the 85th centile (though this comparison is hindered by a difference in reference population: the authors use the 1981 Canada Fitness Survey) (Tremblay and Willms 2000). Combined rates of overweight and obesity for some cohorts in the present study exceed any yet reported for Canadian children. For example 44.1% of 10-year-old boys in the sample are overweight or obese.

The gender difference in obesity rates in the present study also supports Tremblay and Willms' (2000) finding of a decreased rate of obesity for preadolescent girls between 1988 and 1996. The use of parent-reported data led the authors to speculate that cultural bias may have led to underreporting of girls' body mass in the 1996 NLSCY (Tremblay and Willms 2000). The present study, using measured data, finds the obesity rate (6.8%) among girls to be significantly lower than that of boys (15.0%), and nearer the expected 5% of the reference population. Plotnikoff *et al.* (2004) document self-reported obesity rates of 9.3% in boys and 4.8% in girls in a sample of rural Alberta high school students. In the same study, urban boys and girls report obesity rates of 8.3% and 2.3% respectively. While it is difficult to rule out reporting bias in self-reported survey studies, the directly measured data in the present study support a growing body of evidence that girls may be at slightly lower risk of obesity than boys. It also underscores the need for measured data to monitor obesity risk in Canadians of all ages (Tremblay 2004).

The literature on adult obesity prevalence also reports a gender difference, but in the opposite direction. According to MacLellan *et al.* (2004), 29% of PEI women are obese, compared with 20% of men. Similarly, Liebman *et al.* (2003) find that 30% of rural US women under 50 are obese, compared with 25% of men. The gender difference in the present study indicates that this rural North American population may exhibit a pattern of childhood obesity that runs counter to that observed in adults.

Where patterns of obesity risk appear to converge is in an increased risk for rural residents. The US literature reports that 70% of rural men and 59% of rural women are overweight, compared with 63% of men and 55% of women in the general US population (Liebman *et al.* 2003). Plotnikoff *et al.* (2004) report that rural Albertan teen boys are at higher risk of overweight (17.6%) than their urban counterparts (12.4%). Similarly, rural teen girls are significantly more likely to be obese (4.8%) than urban teen girls (2.3%) (Plotnikoff *et al.* 2004). In children, Willms *et al.* (2003) report a west-to-east gradient in obesity prevalence, which may be partly attributable to the higher proportion of rural residents in the Atlantic provinces.

However not all findings are consistent with an increased risk for rural residents. Ge and Bushey (2004) report rates of overweight (14.5% of boys and 16.9% of girls) and obesity (11.8% of boys and 8.8% of girls) in a study of grade one schoolchildren in Simcoe County, Ontario. These rates are slightly lower than those of the present study. While Simcoe County is non-metropolitan and largely rural, the study design excludes schools with fewer than 80 grade one students, a criterion that would effectively eliminate all seven schools in the present study. Logistic factors such as time, funding, driving distance and weather make it difficult to conduct research in rural communities. It is likely that the design of much research, even that labeled 'rural', constrains investigators' ability to measure health outcomes across a diverse spectrum of Canadian communities.

In the present study, the low participation rate reflects difficulties with sampling a school population. Parental consent was obtained through letters of information and consent forms sent home with children. Only 61% of consent forms were returned: of those returned, 84% provided consent. Forms were circulated in December, in order to avoid the concentration of school-related forms sent to parents during other months. The overall participation rate of 51% is comparable to other recent school studies (Moffat *et al.* 2005; Veugelers *et al.* 2005).

Overweight and obesity prevalence in the present study is comparable with studies of urban Canadian children, most of whom live in high-poverty inner city neighborhoods in Montreal (Johnson-Down *et al.* 1997) and Hamilton (Moffat *et al.* 2005). This suggests that the rural environment may contain elements of nutritional risk to children that are similar to the risks experienced by children living in high-poverty urban communities, such as low household income. Data from the 2001 Census of Canada (Statistics Canada 2003) confirm that rural poverty rates are higher than the Ontario average. For example, the average household income in Grey County is $52,988, well below the Ontario average of $66,836. On average, Ontario residents receive 9.8% of their income in the form of government transfer payments, such as employment insurance and income supplement. Grey County residents' corresponding percentage is 14.5%. It is probable that some of the causes of elevated obesity risk are shared between both urban and rural low income communities.

However neither of the urban studies cited report significant gender differences in obesity prevalence, a fact which raises questions about the particular influence of the rural nutrition environment on childhood obesity. The results of the present study most closely mirror those of Crooks' (1999a) investigation into child growth and nutritional status in a high-poverty rural community in Appalachian Kentucky. Crooks (1999a) reports high rates of overweight in both boys (21.4%) and girls (15.2%), with rates of obesity of 21.4% in boys and 8.7% in girls. Girls were significantly less likely to be obese and more likely to have low height-for-age. Crooks (1999a) suggests that while there is little evidence for differential feeding practices in the US, the gender differences may be partially attributable to cultural assumptions about differing energy requirements for boys and girls. It is possible that Canadian families are subject to similar cultural assumptions about boys' and girls' energy intake and expenditure. Ethnographic data on children's nutrition environment may reveal factors underlying observed gender and rural-urban differences in childhood obesity prevalence. Future analysis of focus group data from the present study may be useful in this regard.

While rural girls may be at lower risk of obesity than rural boys, they are equally at risk of being overweight, with its concomitant health risks. Although rural and urban Canadian children may share significant risk of obesity and overweight, the factors contributing to that risk may differ according to place. While urban studies of health and place have identified risk factors such as a lack of safe play space (Timperio *et al.* 2005) and the concentration of fast food restaurants (Cummins and MacIntyre 2005) in core areas, little work has been done to identify the factors contributing to rural children's obesity risk. Rural locations may place children at nutritional risk due to issues around transportation, including limited access to affordable, nutritious food. Transportation issues may also affect children's levels of physical activity: many rural children spend hours commuting to and from school by bus, and families without cars have limited access to safe, low-cost options for physical activity. In addition, many rural communities lack the infrastructure to support opportunities for organized physical activities, such as soccer and swimming.

5.7 Conclusion

In summary, the present study indicates that, like their urban counterparts, rural Ontario schoolchildren have elevated risk of overweight and obesity. In addition, there are more boys than girls at the high end of distribution of body mass index, indicating that rural Ontario boys suffer elevated risk of obesity, likely through a combination of dietary patterns, physical activity, and cultural factors yet to be explored.

Chapter 6 Gender Differences in Growth and Nutrition in a Sample of Rural Ontario Schoolchildren

Manuscript prepared for the *American Journal of Human Biology*

Submitted 11 August 2006

Accepted 16 December 2006

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Citation: Galloway T. 2007. Gender differences in growth and nutrition in a sample of rural Canadian schoolchildren. *Am J Hum Biol* 19(6):774-788.

6.1 Preface

While the early release of the anthropometry data was a shared priority of the research partners, it was always my intention to examine the data on child growth in greater detail and in combination with the data from dietary recall. The following paper was intended as a comprehensive analysis of the growth and nutrition data. It was also intended to examine the limitations of the present study, including sampling and use of a single weekday dietary recall. The study's significant contribution to the literature on child growth is the observation of gendered patterns of obesity prevalence and nutrient intake in rural elementary schoolchildren. The paper also makes a significant contribution to nutritional research in the form of a critical analysis of the use of the new dietary reference intakes as reference standards for nutritional intake in populations.

The paper is followed by two afterword sections. The first discusses whether the findings of gender differences in growth and nutrition in this population represent a local biology of child growth that is unique to the rural cultural and socioeconomic context of Grey and Bruce Counties, Ontario. The second afterword examines the application of findings from the growth and nutrition portion of the present study. A series of newsletters, presentations and workshops provided opportunities to disseminate results to the Grey Bruce Health Unit, the Bluewater District School board, and to staff, children and parents at participating schools. Together these form a large part of the applied portion of the present research.

6.2 Abstract

This paper reports findings of a cross-sectional study of the growth and nutrition of children living in rural Ontario, Canada. The objectives of the research were threefold: (1) to obtain data on obesity prevalence and nutrient intake in a sample of rural Canadian schoolchildren; and (2) to compare findings with rural and national-level data on obesity prevalence and nutrient intake; and (3) to provide data to school board and public health agencies planning and implementing nutrition policy and programs to this population. Measures of height and weight were obtained for 504 children ages 7-13 years. Height for age and body mass index scores were calculated and compared with 2000 data from the Centers for Disease Control (Kuczmarski *et al.* 2002). Weekday 24-hour dietary recall was conducted on a subsample of 352 children and the results compared with Canada's Food Guide (Health Canada 1997) and dietary reference data from the US Institute of Medicine (2000). Prevalence of overweight and obesity were high in this sample, with 17.7% of children classified as overweight and 10.9% of children classified as obese. Fifteen percent of boys were classified as obese, compared to 6.8% of girls. Boys consumed significantly more servings from the grain and meat food groups than girls. While mean daily intake of fibre and micronutrients was significantly low for both boys and girls, there were significant gender differences in nutrient intake, with boys consuming greater energy, protein, carbohydrate, calcium, iron, phosphorus, and sodium than girls. A number of limitations are discussed, in particular issues arising from the use of Dietary Reference Intakes.

6.3 Introduction

Child growth has long been a focus of anthropological research because of its sensitivity to environmental conditions. In the North American setting, this research is increasingly centered on the prevalence of childhood obesity. There are excellent national-level data from both the US and Canada which document the increase in childhood obesity prevalence from 1981 to the present (Baskin *et al.* 2005; Dehghan *et al.* 2005; Flegal and Troiano 2000; Hedley *et al.* 2004; Katzmarzyk *et al.* 1999; Shields 2005; Tremblay and Willms 2000). There is also national-level literature which demonstrates heightened obesity risk for North Americans experiencing socioeconomic deprivation (Alaimo *et al.* 2001; Gordon-Larsen *et al.* 2003; Phipps *et al.* 2006; Willms *et al.* 2003). However researchers stress the need for directly-measured data at both the national and local levels in order to develop understandings of the global and proximate causes of obesity in the environment (MacLellan *et al.* 2004; Tremblay 2004).

Local-level data on childhood obesity is emerging, much of it in population groups whose socioeconomic indicators, such as income, employment, and education, place them at disproportionately high risk of poor health outcomes. Children living in low-income inner city neighborhoods, new immigrant communities, and Aboriginal reserve communities experience obesity prevalence that exceeds that of the general North American population (Evers and Hooper 1995; Gallo *et al.* 2005; Hanley *et al.* 2000; Johnson-Down *et al.* 1997; Lacar *et al.* 2000; Moffat *et al.* 2005; Sherry *et al.* 1992; Young *et al.* 2000).

Among these low socioeconomic status communities, rural areas are the focus of few studies of childhood obesity, perhaps due to the logistical challenges of conducting research in non-metropolitan areas (Galloway 2006). However there is a growing literature documenting obesity prevalence in rural Canadian and US children. Willms *et al.* (2003) report a west-to-east gradient in childhood obesity prevalence that may be attributable to the higher proportion of rural residents in Atlantic Canada. In a study of Canadian teens attending high schools in Alberta and Ontario, Plotnikoff *et al.* (2004) found that rural boys and girls had significantly higher prevalence of overweight (18% and 5% respectively) than urban boys and girls (12% and 2% respectively). Childhood obesity rates among rural Appalachian (Crooks 1999a; Demerath *et al.* 2003), Southern US (Davis *et al.* 2005), Mexican American (Lacar *et al.* 2000), and native North American (Gallo *et al.* 2005; Hanley *et al.* 2000; Young *et al.* 2000) populations are among the highest in North America, and point to a shared obesogenic environment that poses significant health risks to rural children and teens.

While there are few studies of obesity in rural North American adults, they consistently report a significant gender difference in obesity prevalence. Women have higher obesity prevalence than men in both Canadian and US studies (Borders *et al.* 2006; Liebman *et al.* 2003; MacLellan *et al.* 2004; Self *et al.* 2005). This gender difference is less consistently observed in studies of rural children. While some authors report gender differences in rural children`s obesity prevalence (Crooks 1999a) others do not (Demerath *et al.* 2003; Davis *et al.* 2005), indicating that gender-related differences in obesity risk may result from factors unique to the communities under study.

The research reported here is a cross-sectional study of child growth and nutrition in a rural Canadian population, undertaken from January to June 2004. In 2003, I contacted the Bluewater

District School Board regarding a study of rural children's nutrition and growth. The topic married well with the Board's need for empirical data on local child nutrition in order to set new nutrition policy in its elementary schools. The collaboration proved timely, in that by 2004 Ontario school boards were required to respond to a number of provincial initiatives designed to promote healthy eating in schools (Ontario Ministry of Education and Training 2004a, 2004b, 2004c; Ontario Society of Nutrition Professionals in Public Health School Nutrition Workgroup 2004). The resulting study was designed with the goal of evaluating child growth and nutrition at the local level while producing a data set large enough for statistical comparisons with a compatible reference sample. The objectives of the research were threefold: (1) to obtain data on growth and nutrition in a sample of rural Canadian schoolchildren; and (2) to compare findings with rural and national-level data on obesity prevalence and nutrient intake; and (3) to provide data to school board and public health agencies planning and implementing nutrition policy and programs to this population. The data collection included anthropometry, dietary recall, observation of the school nutrition environment, interviews with parents and educators, and focus groups with children. Only the results of anthropometry and dietary recall are presented here.

6.4 Methods

(i) Population

The Bluewater Nutrition Project is a study of rural children's growth and nutrition. The research was conducted in Grey and Bruce Counties, Ontario (Figure 3.1). These counties lie east of Lake Huron are located approximately 150 kilometers northwest of Toronto, Canada. Socioeconomic descriptors of Grey and Bruce Counties paint a picture of a farming and resource-based seasonal economy, with lower income, greater reliance on government transfers, and lower postsecondary educational attainment than the provincial average (Statistics Canada 2001).

The study sample was drawn from the school populations of seven elementary schools located in Grey and Bruce Counties, Ontario. The participating schools were selected by the community partners in order to represent rural communities of varying size and socioeconomic status. The smallest two schools are entirely rural, with all students bused from large catchment areas in the surrounding townships. The three mid-size schools have catchment areas surrounding and including rural towns. The largest school is located in the small city of Owen Sound (population 30,000) and receives a portion of its students from a rural catchment to the west of the city.

Ethical approval for the study was obtained from the McMaster Research Ethics Board, McMaster University, as well as from two partner agencies: the local health unit, which provides public health and nutrition services to the schools, and the regional school board, which provides education services in Grey and Bruce Counties.

(ii) Sample

Letters of information were distributed to all 1042 students in grades 2-8 in participating schools. The guardians of 535 children returned written consent for their children's participation in the study. The overall participation rate of 51% is comparable to that of other recent school studies in Canada (Moffat *et al.* 2005; Veugelers *et al.* 2005).

(iii) Anthropometry Protocol

Between January and March, 2004, children with parental consent participated in anthropometric measures of height and weight. Children were measured by the researcher in a private room located on school premises. A research assistant was present to record data. Verbal assent was obtained from children prior to measurement. Twenty-nine children were absent from school or involved in school activities that prevented their participation. Two children declined to be measured and were excluded from the sample. Measurements were completed for 504 children (253 boys and 251 girls).

Children were asked to remove their shoes. Height was measured with a portable stadiometer (Perspective Enterprises PE-AIM-101). Weight was measured with a portable digital scale (Tanita TBF-551). Measurement procedures were consistent with standardized anthropometric procedures (Lohman *et al.* 1988).

A random sub-sample of children were randomly selected to be measured a second time in order to test for intra-observer error. Fifty-seven children were measured at a minimum one hour interval from their previous measure. Technical error of measurement (TEM) and coefficient of variation (CV) were within acceptable limits for both height (TEM=0.263; CV=0.183) (Ulijaszek and Lourie 1994) and weight (TEM=0.116; CV=0.300) (Bouchard 1985). Coefficient of reliability (R) for both variables was 0.999.

(iv) Dietary Recall Protocol

Between March and May, 2003, children with parental consent participated in dietary recalls. The number of participants was limited by school activities and the length of time required for each dietary recall interview (15-20 minutes). Because 24-hour recalls have been validated for children 8-9 years and older (Lytle *et al.* 1993; McPherson *et al.* 2000), efforts were concentrated on children in grades 4-8. This resulted in a dietary recall sample of 364 children.

Dietary recalls were conducted interview-style in a private room on school premises. All recalls were administered by the investigator with a research assistant present to record responses. Verbal assent was elicited prior to each interview.

The duration of each interview ranged from 15-20 minutes, depending on the child's ease of recall. Through a series of open-ended questions and neutral prompts (Domel *et al.* 1994; Domel 1997; Domel Baxter *et al.* 2000), the investigator asked the child to trace the events and activities of the previous day, from the time the child awoke until the time the child went to sleep. Recalls were conducted Tuesday through Friday, thus yielding data on weekday food consumption. All reported foods and drinks were recorded, along with, where possible, detailed descriptions of ingredients, preparation, portions served, and portions consumed. Because of the large number of school lunches consumed, particular emphasis was placed on shared, traded, or discarded foods. Children were assisted in their recall by the presence of calibrated food models and a range of grocery items. Accurate portion size estimation was facilitated by sample cups, dishware, and graduated measuring containers. At the end of the interview children's reported intake was summarized for their verification. In addition, children were asked about inadvertent omissions (foods not reported) or intrusions (foods reported but not actually consumed) (Domel 1997; Domel Baxter *et al.* 2000; Domel Baxter *et al.* 2002).

The recall records of eight children were excluded from the data set because: (1) the children reported feeling ill during the previous 24 hours; or (2) they were uncertain about their ability to recall the previous day's dietary intake. The records of four children aged 8 years were removed to facilitate comparison with Dietary Reference Intakes (Institute of Medicine 2000), which are provided for children in age groupings above and below 9 years. The recall records of the remaining children constitute the primary nutrient data set (n=352; 170 boys and 182 girls). This data set is used in analyses of nutrient intake by age and gender groupings.

A secondary nutrient data set (n=328; 159 boys and 169 girls) was constructed of recalls from children who participated in both dietary recall and anthropometry. This involved the removal of recall records for 24 children who had not participated in anthropometry. This data set is used in analyses of nutrient intake by anthropometric indices.

(v) Data Analysis

Anthopometric measures were converted to z-scores and percentiles using Epiinfo Version 3.3, and analyzed using SPSS Version 12.0 software. Student's t-tests were conducted on mean z scores to permit comparison with the 2000 CDC reference (Kuczmarski *et al.* 2002). Low height was defined as height for age centile (HAC) below the 15th percentile of the reference. BMI centiles were categorized as overweight (BMIC $\geq$85 and $<$ 95) or obese (BMIC $\geq$95). While there has been some discussion around the cutoffs developed by the International Obesity Task

Force (Cole *et al.* 2006; Zimmerman *et al.* 2004), I have elected to use the cutoffs (Frisancho 1990; Roberts and Dallal 2001) and terminology which are most consistent with North American usage to facilitate comparison with other North American studies (see Crooks 1999a; Moffat *et al.* 2005; Plotnikoff *et al.* 2004, for examples). One-way analysis of variance (ANOVA) was used to compare mean height for age z-score (HAZ) and body mass index for age z-score (BMIZ) by age. Pearson Chi square tests were used to compare frequencies of low height, overweight, and obesity with the 2000 CDC growth reference (Kuczmarski *et al.* 2002). Cross-tabulations were used to compare overweight and obesity prevalence by gender.

Using the primary nutrient data set (n=352), dietary recall data were categorized by food group and serving and compared with Canada's Food Guide to Healthy Eating (Health Canada 1997) to assess the mean number of daily servings and the proportion of children with inadequate intake in each of the four food groups. The guidelines consist of a recommended range of servings for each food group. The lowest value in the range was used as the minimum number of daily servings recommended.

Reported dietary intake for each child was entered into Nutribase 5 Clinical Nutrition software (CyberSoft Inc.) using Canadian Nutrient Files to calculate observed daily intake for a range of macro- and micronutrients. Intakes were then analyzed and compared using SPSS Version 12.0 software. Mean daily intakes of selected nutrients were calculated for the total sample and compared with Dietary Reference Intakes (DRIs)[1] (Institute of Medicine 2000) in order to

[1] The Institute of Medicine (2000) provides Estimated Average Requirements (EARs) for the purpose of assessing dietary intake in groups. The EAR represents an estimate of the average daily nutrient level required to meet the dietary needs of half the healthy individuals of a given age and gender. Adequate Intakes (AIs) and Acceptable

determine the prevalence of nutrient inadequacy[2]. In addition, mean daily intakes and prevalence of inadequacy were calculated for age and gender groupings within the sample.

One-way analysis of variance (ANOVA) was used to compare mean nutrient intake by age. Student's t-tests (two-tailed) were used to compare mean nutrient intake by gender. Cross tabulations were conducted to compare the prevalence of nutrient inadequacy by age and gender groupings. Using the secondary data set (n=328), which includes both anthropometric and nutrient data, linear regression was performed to examine the effects of age, gender, and dietary intake on various anthropometric indices.

6.5 Results

(i) Anthropometry

In the total anthropometry sample (n=504), the mean HAZ of 0.229 (sd=0.93) was significantly higher than that of the 2000 CDC growth reference (Kuczmarski *et al.* 2002) (t=5.51, p=.000), as were mean HAZ for both boys (t=4.22, df=252, p=.000) and girls (t=3.55, df=250, p=.000) (Table 6.1). One-way ANOVA yielded no significant relationship between HAZ and age. While there was no difference in HAZ by gender in the total sample, boys had significantly greater HAZ than girls in the 7-year age category (t=2.270, df=39, p=.029).

The prevalence of low height (HAC<15) was not significantly different than the expected 15%, except in the 10-year age group where the prevalence (4.96%) was significantly lower (Pearson

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Macronutrient Distribution Ranges (AMDRs) are provided for nutrients for which no EAR can be calculated. For an in-depth analysis of the use of DRIs, see Murphy *et al.* (2002).

[2] The exception to that rule is for iron; although iron has an EAR, its requirement distribution is not normally distributed and therefore prevalence of inadequacy was calculated from weighted probabilities based on published tables (Institute of Medicine 2000) following Murphy *et al.* (2002).

Chi square=11.94, df=1, p=.001) (Table 6.2). There was no significant difference in prevalence of low height by gender.

Table 6.1: Mean z scores [mean (SD)] for HA and BMI for total sample (N=504) by age and gender

Age	*n*	HAZ	BMIZ
Boys			
7	26	0.45 (0.79)†	0.86 (0.89)
8	40	0.44 (0.98)	0.62 (0.98)
9	29	0.17 (0.95)	0.53 (1.05)
10	68	0.32 (0.94)	0.71 (0.93)
11	56	0.20 (0.96)	0.42 (0.98)
12	23	-0.79 (0.88)	0.31 (1.09)
13	11	0.09 (0.92)	-0.67 (0.88)
Total	253	0.25 (0.94)*	0.54 (1.00)*
Girls			
7	15	-0.21 (1.05)†	0.49 (0.52)
8	29	0.15 (0.92)	0.30 (0.96)
9	51	0.39 (0.91)	0.59 (0.85)
10	53	0.37 (0.73)	0.36 (0.88)
11	53	0.14 (0.95)	0.25 (0.98)
12	29	0.12 (1.06)	0.31 (0.73)
13	21	0.13 (0.76)	0.52 (0.76)
Total	251	0.21 (0.92)*	0.39 (0.86)*

† Significantly different between boys and girls, p < .05

* Significantly different from 2000 CDC reference (Kuczmarski *et al.* 2002), p < .001

Table 6.2: Prevalence (%) of low height (HAC<15th percentile) relative to the 2000 CDC growth reference for total sample (N=504) by age and gender

Age	*n*	Prevalence of low height (%)
7	41	12.20
8	69	8.70
9	80	10.00
10	121	4.96*
11	109	8.26
12	52	17.31
13	32	15.63
Total	504	9.52
Total boys	253	8.30
Total girls	251	10.76

* Significantly lower than 2000 CDC reference (Kuczmarski *et al.* 2002), p < .05

The overall mean BMIZ of 0.47 (sd=0.94) was significantly greater than that of the reference population (t=11.17, p=.000), as were mean BMIZ for both boys (t=8.55, df=252, p=.000) and girls (t=7.23, df=250, p=.000) (Table 6.1). One-way ANOVA yielded no significant relationship between BMIZ and age. Boys' overall mean BMIZ was higher than girls, with a difference approaching statistical significance (t=1.768, df=502, p=.078).

In the overall sample, the prevalence of overweight (17.66%; Pearson Chi square=32.85, df=1, p=.000) and obesity (10.91%; Pearson Chi square=37.09, df=1, p=.000) were significantly greater than the expected frequencies of 10% and 5% respectively (Table 6.3). Overweight and obesity prevalence were greatest in the 7-10 year age categories, with the majority of those groups significantly exceeding expected frequencies.

Table 6.3: Proportion of children (%) in categories of overweight (BMIC $\geq 85^{th}$ and $<95^{th}$ percentiles) and obese (BMIC $\geq 95^{th}$ percentile) relative to the 2000 CDC growth reference for total sample (N=504) by age and gender

Age	*n*	Overweight (%)	Obese (%)	Total overweight (%)
7	41	19.51*	14.63*	34.14**
8	69	13.04	13.04*	26.08*
9	80	23.75**	10.00*	33.75**
10	121	20.66**	14.05**	34.71**
11	109	19.27*	8.27	27.54**
12	52	7.69	9.62	17.31
13	32	9.38	3.13	12.51
Total	504	17.66**	10.91**	28.57**
Total boys	253	17.79**	15.02**†	32.81**†
Total girls	251	17.53**	6.77†	24.30**†

† Significantly different between boys and girls, $p < .05$

* Significantly different from 2000 CDC reference (Kuczmarski *et al.* 2002), $p < .05$

** Significantly different from 2000 CDC reference (Kuczmarski *et al.* 2002), $p < .001$

The prevalence of overweight was significantly greater than expected for both boys (Pearson Chi square=17.04, df=1, p=.000) and girls (Pearson Chi square=15.81, df=1, p=.000), as was the prevalence of obesity for boys (Pearson Chi square=53.47, df=1, p=.000) (Table 6.3). While the prevalence of overweight was comparable for boys and girls (17.79% and 17.53% respectively), there was a significant difference in obesity prevalence between boys (15.02%) and girls (6.77%) (Pearson Chi square=8.81, df=1, p=.000).

(ii) Dietary Recall

The results of food group analysis for the total dietary recall sample (n=352) indicate that mean daily servings were below the recommended level for all four food groups: grain products, milk products[3], vegetables and fruit, and meat and alternatives. Proportions of children with inadequate servings were high. For example, 79.31% of 7-9 year old children failed to meet the minimum 2 daily servings of milk products.

One-way ANOVA yielded no association between age and mean daily servings for any of the food groups. There was a trend toward decreasing prevalence of inadequate milk product servings with age. However there were no other observed relationships between food group consumption and age.

The results of food group analysis by gender (Table 6.4) indicate that boys consumed significantly more servings of grain products (t=3.04, p=.003) and meat and alternatives (t=4.13,

[3] In Canada's Food Guide to Healthy Eating, recommended servings for milk products are provided for 4-9 and 10-16 year age categories (Health Canada 1997). It is recommended that children ages 4-9 years consume 2-3 servings of milk products per day. It is recommended that youth ages 10-16 years increase their consumption of milk products to 3-4 servings per day during this period of rapid linear growth.

p=.000) than girls. Compared to girls, boys' prevalence of inadequate intake was significantly lower for grain products (Pearson Chi square=9.189, p=.002) and meat and alternatives (Pearson Chi square=8.941, p=.003). Boys' overall prevalence of inadequate milk product consumption did not differ from girls'. However in the 7-9-year age category, where girls' prevalence of inadequate intake was 90.32%, boys' prevalence of inadequate milk intake was significantly lower at 65.22% (Pearson Chi square=5.130, p=.024).

Table 6.4: Mean daily servings [mean (sd)] and prevalence of inadequate daily intake (%) of food groups listed in Canada's Food Guide to Healthy Eating for children 9 years and over who participated in dietary recall (n=352) by gender

Food Group	Mean *n* of servings per day (sd)		Prevalence of inadequate daily intake (%)	
	Boys	Girls	Boys	Girls
grain products	5.21† (2.30)	4.47† (2.08)	42.60†	59.14†
milk products				
ages 7-9 y	2.26 (1.88)	1.72 (1.03)	65.22†	90.32†
ages 10-14 y	2.31 (1.52)	2.06 (1.58)	65.75	66.23
vegetables and fruit	4.31 (3.18)	4.83 (2.96)	61.54	53.23
meat and alternatives	1.83†† (1.03)	1.43†† (0.82)	46.75†	61.29†

† Significantly different between boys and girls, $p < .05$
†† Significantly different between boys and girls, $p < .001$

Nutrient intake analysis was performed on the primary dietary recall data set (n=352). As a percentage of daily caloric intake, mean protein, carbohydrate and fat consumption fell within acceptable ranges. Mean g/day fibre consumption was less than half the recommended level. Mean consumption of calcium, magnesium, phosphorus, potassium, zinc, and total folate were low, resulting in prevalence of inadequacy for these nutrients as high as 84.66% for magnesium and 97.16% for total folate. In contrast, mean sodium intake, at 3.41 g/day, exceeded the recommended Upper Limit (UL) of 2.2 g/day (Institute of Medicine 2000).

One-way ANOVA showed a significant increase in mean daily fibre (F=3.26, p=.000) and total folate (F=1.70, p=.018) consumption with age. There was no relationship between prevalence of inadequacy and age for any of the reported nutrients.

There were a number of significant differences in nutrient intake by gender (Table 6.5). Boys had significantly greater mean daily intake of energy (t=3.83, p=.000), protein (t=4.47, p=.000), carbohydrate (t=3.13, p=.002), fat (t=2.87, p=.004), calcium (t=2.39, p=.020), iron (t=2.25, p=.025), phosphorus (t=2.75, p=.006), and sodium (t=2.96, p=.003) than girls. Boys' mean daily intake of thiamine and riboflavin were greater than girls, at differences approaching significance (t=1.95, p=.05 and t=1.91, p=.06 respectively). Boys were significantly less likely to consume inadequate iron (Pearson Chi square=1806.81, df=1, p=.000) than girls. Boys had lower prevalence of inadequacy for g/day protein (Pearson Chi square=3.267, p=.071), percent carbohydrate (Pearson Chi square=2.709, p=0.100), and phosphorus (Pearson Chi square=3.60, p=.058) with differences approaching statistical significance.

Linear regression was performed on the secondary data set (n=328). There was a significant correlation between calcium intake and HAZ (F=2.641, p=.009) but the r value was low (.158) indicating that calcium intake accounts for little of the variability in height for age in this sample. Similarly, a weak correlation (r=.152) between % calories from protein and BMIZ (F=2.577, p=.010) accounted for little of the variability of BMIZ in this sample. In the overall regression model, only male gender was positively associated with BMIZ (r=.162, p=.005).

Table 6.5: Observed mean daily intake [mean (sd)] and prevalence of inadequate daily intake (%) of selected nutrients for children 9 years and over who participated in dietary recall (n=352) by gender

Nutrient	Mean (sd)				Prevalence of inadequate daily intake (%)	
	Boys		Girls		Boys	Girls
Energy[a] (kcal)	2350.32††	(927.58)	2017.83††	(690.06)	-	-
Protein (%)	12.79	(3.39)	12.19	(2.92)	18.93	25.27
Carbohydrate (%)	55.97	(8.81)	56.61	(7.44)	9.47	4.95
Fat (%)	31.24	(7.05)	31.20	(6.49)	17.16	14.84
Protein (g)	73.31††	(27.41)	61.48††	(22.14)	1.18	4.40
Carbohydrate (g)	335.64†	(177.20)	287.51†	(104.38)	0	0.55
Fat[a](g)	81.71†	(35.01)	71.78†	(29.85)	-	-
Fibre[a] (g)	13.86	(16.81)	12.74	(6.51)	-	-
Calcium[a] (mg)	980.27†	(535.90)	846.63†	(510.95)	-	-
Iron[b](mg)	12.51†	(6.66)	10.99†	(5.96)	9.71††	16.08††
Magnesium (mg)	141.54	(76.14)	126.41	(68.44)	82.84	86.26
Phosphorus (mg)	836.11†	(448.33)	712.07†	(398.18)	72.19	80.77
Potassium[a] (g)	1.83	(1.03)	1.66	(0.78)	-	-
Sodium[a] (g)	3.63†	(1.37)	3.21†	(1.27)	-	-
Zinc (mg)	5.29	(3.75)	4.79	(3.17)	79.29	81.87
Vitamin A RE (µg)	446.41	(416.61)	494.48	(662.05)	61.54	59.89
Thiamin (mg)	1.29	(0.76)	1.14	(0.69)	23.67	28.57
Riboflavin (mg)	1.43	(0.78)	1.28	(0.67)	23.67	23.08
Niacin (mg)	9.49	(5.08)	9.46	(5.19)	50.89	50.00
Vitamin B6 (mg)	0.79	(0.54)	0.74	(0.53)	59.76	63.19
Total Folate (µg)	65.37	(70.94)	55.90	(71.52)	96.45	97.80
Vitamin C (mg)	154.54	(362.83)	116.01	(86.58)	21.89	19.23

[a] Nutrients without prevalence data have no reference value for calculation of inadequacy.
[b] Prevalence data for iron calculated from weighted probabilities based on published data in Tables I-5 to I-6, Appendix I, Institute of Medicine (2000).
† Significantly different between boys and girls, $p < .05$
†† Significantly different between boys and girls, $p < .001$

6.6 Discussion

(i) Anthropometry

In the total sample (n=504), the combined prevalence of total overweight and obesity (24%) is lower than US figures from the National Health and Nutrition Examination Survey (NHANES), which reports combined prevalence of overweight and obesity of 35% in boys and 30% in girls aged 6-11 years (Hedley *et al.* 2004). However the results of the present study are comparable with existing Canadian data from the 1996 National Longitudinal Surveys of Children and Youth (NLSCY) in which 29% of boys and 24% of girls ages 7-13 years are either overweight or obese (Tremblay and Willms 2000). The more recent 2004 Canadian Community Health Survey (Shields 2005) finds overweight prevalence of 17.0% in boys and 18.8% in girls, compared to 17.8% and 17.5% respectively in the present sample.

The significantly high BMIZ, and the high overweight prevalence in boys and girls and obesity prevalence in boys in the present study, are consistent with studies which document increased childhood adiposity in economically disadvantaged neighborhoods. In comparative studies, Alaimo *et al.* (2001) document greater prevalence of obesity among white non-Hispanic boys and girls from low- and middle-income families versus those from families with high income; and Moffat *et al.* (2005) report higher mean BMIZ and combined prevalence of overweight and obesity in 6-10-year-old children living in high-poverty neighborhoods in Hamilton, Canada, compared with children living in an affluent neighborhood. Johnson-Down *et al.* (1997) report combined prevalence of overweight and obesity of 42% for boys and 37% for girls living in a low income inner city neighborhood in Montreal, Canada.

In the present study, the overall obesity prevalence of 11% is slightly lower than published US data, in which 16% of children are obese (Baskin *et al.* 2005; Hedley *et al.* 2004). This is likely due to the significantly lower obesity prevalence in girls (7%) in the present study. Both Canadian and US surveys report slightly lower prevalence of obesity in girls, though the differences are not statistically significant. The NLSCY reports obesity prevalence of 12% in girls, compared with 14% in boys (Tremblay and Willms 2000). Results from the 1999-2002 NHANES report obesity prevalence of 15% in girls, compared with 17% in boys (Baskin *et al.* 2005; Hedley *et al.* 2004). More localized studies in US and Canadian urban communities do not document a gender difference in obesity prevalence (Alaimo *et al.* 2001; Evers and Hooper 1995; Johnson-Down *et al.* 1997; Moffat *et al.* 2005).

However Crooks (1999a) documents significant gender differences in obesity prevalence among children living in a rural Appalachian community. Twenty-one percent of boys aged 7-11 years were obese, compared with only 9% of girls. The combined prevalence of overweight and obesity was 43% for boys, compared with 24% for girls.

The results of other rural studies of childhood obesity prevalence lend little support to the hypothesis of gendered growth outcomes in rural North American children. Demerath *et al.* (2003) found no significant gender difference in obesity prevalence among children living in rural West Virginia. Similarly, Davis *et al.* (2005) observed no gender differences in obesity and its metabolic correlates in a study of children living in rural Georgia.

The literature on adult rural populations does report a gender difference in obesity prevalence, but in the opposite direction. MacLellan *et al.* (2004) report obesity prevalence of 29% in women, compared with 20% in men living in Prince Edward Island, a largely rural province in Eastern Canada. Similarly, Liebman *et al.* (2003) report that 30% of rural US women under 50 are obese compared with 25% of rural US men. Borders *et al.* (2006) report higher obesity prevalence in low income females living in rural Texas than in their male counterparts.

(ii) Dietary Recall

The results of food group analysis in the present study describe a pattern of under-nutrition which is typical of North American studies. Fewer than half of children consume the recommended servings of grain products, vegetables and fruit, and meat and alternatives. An alarming four-fifths of 7-9-year-olds consume too few milk products, resulting in a mean calcium intake significantly below the recommended level. Low milk and calcium intakes have been reported in other North American populations: Veugelers *et al.* (2005) document low milk product consumption in 42% of 10-11-year-old children, and mean calcium intake 11% below recommended. Moffat and Galloway (unpublished data; *in press*) report that 68% of 8-10-year-old children consume too few servings of milk, resulting in mean calcium intake 20% below recommended levels. In a study of 10-16-year-old children, Salamoun *et al.* (2005) observe that 88% had calcium intake below the AI of 1300 mg/day. And Cavadini *et al.* (2000) report a steady decline in milk consumption for adolescent boys and girls between 1965 and 1996.

There is evidence that adequate milk consumption in childhood confers a number of health benefits throughout the lifespan, including lower risk of dental caries (Marshall *et al.* 2005; Petti *et al.* 1997), higher bone mineral density and lower risk of osteoporotic fracture (Kalkwarf *et al.* 2003). On its own, the low milk intake observed in the present study may have a significant negative impact on population health.

However, low milk intake is rarely an isolated phenomenon. In school-age children, it is commonly associated with high consumption of fruit juice and sugar-sweetened soft drinks. Harnack *et al.* (1999) report a consistent negative relationship between soft drink consumption and milk consumption. Among 6-12-year-olds, those who drank more than 9 oz of soft drinks per day were three times more likely to report inadequate milk consumption than those who did not consume soft drinks. At the US national level, Nielsen and Popkin (2004) report that as a proportion of daily caloric intake milk consumption declined by 4.9% among 2-18-year-olds between 1977 and 2001. During the same period, fruit juice consumption rose by 1.8% and soft drink consumption rose by 3.9%.

Much of the literature on milk consumption focuses on low intake in girls. In a study of adolescent girls' beverage intake, Bowman (2002) reports decreased milk and increased soft drink consumption with age. Girls' mean soft drink intake of 276 g/day at age 12 was much lower than the 423 g/day observed at age 19. In contrast, 78% of 12-year-old girls consumed milk daily, a proportion which fell to only 36% by age 19. In the present study, which examined the diets of 9-13-year-olds, the proportion of children with inadequate milk intake declined only slightly with age, while mean calcium intake rose slightly with age. However the high prevalence of inadequate intake of milk products in children, and particularly young girls, raises concern over the future osteologic and dental health of girls in this population. Future analysis of this data set will examine the volume and frequency of sweetened juice and soft drink intake and its relationship to milk consumption in this sample.

Mean fibre intakes in the present study were considerably lower than recommended, a finding that parallels a number of recent studies of child nutrition (Champagne *et al.* 2004; Moffat and Galloway *in press*; Veugelers *et al.* 2005). Though mean fibre intake increased significantly with age, levels remained about half the reference value. US Department of Agriculture survey data indicate that 55-90% of children consume too little fibre (Saldanha 1995). Kimm (1995) observes that an inverse relationship between fibre intake and obesity prevalence could be explained through a number of mechanisms: diets rich in fibre may be low in caloric density; high dietary fibre content may speed gastrointestinal transit, allowing less time for protein and carbohydrate absorption; and fibre may play a role in mediating insulin release in response to carbohydrate ingestion. Interventions aimed at increasing children's fibre intake may be effective in decreasing their risk of obesity.

In the present study, children's average meat consumption was consistently lower than the recommended 2 servings. Iron levels, supplied by meat, some vegetables, and fortified breads and cereals, were on average adequate. In contrast, the prevalence of inadequacy for magnesium, phosphorus, zinc, and total folate was extremely high. The prevalence of inadequacy for the B vitamins Thiamin, Riboflavin, Niacin, and B6 ranged from 23-61%. This pattern is consistent with low intake of fresh fruit and vegetables and fortified breads and cereals (Champagne *et al.* 2004), and is supported by food group data in which 57% of children consumed too few fruits and vegetables and 51% of children consumed inadequate servings of grain products. The pattern is also supported by the large proportion of children (60%) with inadequate Vitamin A consumption, despite mean intake above the reference value. Large standard deviations in Vitamin A intake suggest that consumption of this nutrient is highly variable among children in the sample, which is consistent with reference data on Vitamin A in children (Institute of Medicine 2000).

In the present study, overall mean energy intake was comparable with findings from other studies of child nutrition (Bell *et al.* 2005; Moffat and Galloway *in press*; Veugelers *et al.* 2005). The lack of physical activity data in this study precludes the calculation of average energy requirements for individual children and thus the assessment of the adequacy of energy intake in this sample.

Although there was a significant difference in energy intake between genders, this difference is difficult to interpret. Boys' mean daily energy intake (2350 kcal) was significantly higher than girls' (2018 kcal). While boys' greater energy intake would appear consistent with their higher BMIZ and prevalence of obesity in this sample, logistic regression reveals no relationship between energy intake and BMIZ. A lack of relationship between energy intake and body size in children has been observed elsewhere. In a study of overweight and non-overweight schoolchildren, both energy and carbohydrate intake were significantly lower in the overweight children than in the non-overweight children (Rocandio *et al.* 2001). Crooks (2000) observed no significant relationship between overweight status and food consumption.

Veugelers *et al.* (2005) report mean daily energy intakes of 2256 kcal for boys and 2077 kcal for girls, but do not comment on the significance of the difference. Other authors report no gender difference in children's mean daily energy intake (Champagne *et al.* 2004; Crooks 2000). The lack of gender comparisons in the literature likely reflects the challenge of collecting both diet and activity data in order to accurately estimate energy requirements. In addition, across all age ranges boys' energy requirements are slightly higher than girls, obscuring gender comparisons (Institute of Medicine 2000).

However the gender differences in the present sample are not confined to greater energy intake in boys. Boys have higher mean daily intakes of all nutrients excepting Vitamin A and carbohydrate as a proportion of dietary energy. Boys have significantly higher mean daily intakes of protein, carbohydrate, fat, calcium, iron, phosphorus, and sodium than girls. Boys have lower prevalence of inadequacy for the majority of nutrients excepting fat, riboflavin, niacin, Vitamins A and C, and carbohydrate as a proportion of dietary energy. Boys' prevalence of low iron intake is 10%, compared with the 16% of girls in the sample.

While linear regression produced only a weak association between gender and growth outcomes, it is difficult to ignore the gendered results of both anthropometric and nutrient analyses. It is clear that there is a pattern of dietary consumption in this sample that produces greater energy and micronutrient intake in boys. It is possible that this gendered pattern of intake supplies excess dietary energy to boys, placing them at greater risk of obesity. Girls' lower energy intake may protect them from extreme obesity, but like the boys in the sample they too suffer significant risk of being overweight. And the overall pattern of micronutrient deficiency could be costly to children's health and development, especially in girls.

Crooks (1999a, 2000) observed similar outcomes in rural Appalachian boys and girls. Differential feeding practices have been observed in cross-cultural settings (Ross 1987). A review of this literature reveals that almost all research on differential feeding centers around the distribution of nutritionally important protein resources. While few North American studies have looked for gendered patterns of child nutrition that derive from cultural beliefs, Crooks (1999a:139) suggests that rural children's dietary patterns may be influenced by a variety of cultural factors:

> Cultural assumptions about greater energy requirements for boys may come into play; boys may be more readily taken to the doctor when they are ill, reducing the intensity and/or duration of illness; or boys may be fed higher quality food than girls, all of which can produce differential outcomes in growth.

In a study of Mexican schoolchildren aged 6-12 years, Brewis (2003:457) describes a strong relationship between male gender and obesity that appears to be mediated through cultural values around the role of boys in middle-class families: "while Mexican parents treasure and desire both daughters and sons, there is a special primacy given to male children." It is conceivable that similar cultural processes are at work in the present study population, leading to increased risk of obesity in rural boys. Future directions for research will explore these cultural dimensions affecting children's growth and nutrition, which may have particular historical and social contexts in different rural communities.

(iii) Limitations

There are a number of methodological considerations that may hinder the applicability of the results of the present study. The low overall participation rate (51%) reflects difficulties with sampling a school population. On the advice of teachers, forms were circulated in December, in order to avoid the concentration of forms sent to parents during other months. Only 61% of consent forms were returned: of those returned, 84% provided consent. Variability in the proportion of forms returned by classroom (from 20% to 96%) reflects varying degrees of teacher involvement, and might have been improved by directly rewarding teachers for this task.

BMI has been cross validated in numerous studies (Field *et al.* 2003; Marshall *et al.* 1991; Mei *et al.* 2002; Pietrobelli *et al.* 1998; Zimmerman *et al.* 2004) and is currently the accepted screening tool for population-level studies of obesity prevalence (Power *et al.* 1997). However its use as a measure of childhood adiposity has been challenged on a number of levels. Prevailing wisdom asserts that rapid fluctuations in linear growth complicate the interpretation of BMI in children (Horlick 2001) and that the validity of BMI may be compromised in cross-population comparisons and by environmental circumstances such as prior under-nutrition (Dietz and Bellizi 1999). The cross-sectional design of the present study precludes consideration of longitudinal growth patterns in this population. Data on population origin were not collected in this or most other studies of childhood obesity, limiting cross-population comparisons. However the lack of low height for age in the present sample suggests that prior under-nutrition is not a complicating factor.

The accuracy of 24-hour recall with children has been validated using doubly-labeled water (Johnson *et al.* 1996; Fisher *et al.* 2000) and this method is used to assess both macro- and micronutrient intake in adults and children (Gibson 1990). As young as 8-9 years, children demonstrate reliability as self-reporters (Lytle *et al.* 1993; McPherson *et al.* 2000). However authors suggest the accuracy of children's self-reports can be improved by using the previous meal (Domel Baxter *et al.* 2002) or the previous 24 hours (Domel Baxter *et al.* 2004), rather than the previous day, as the time frame for recall. Use of previous day recall in the present study may have compromised accuracy to some degree.

The large number of recalls (n=352) in the present data set supports the validity of mean intakes calculated for this sample. While there is no way of estimating whether the sample is representative of the population as a whole, it is hoped that sources of selection bias are limited. For dietary recall in particular it is likely that there was participation bias operating in favor of children whose school performance would not suffer from their absence from class to participate in lengthy dietary recalls. That said, I observed a tendency in teachers to encourage the participation of children who they deemed "at risk" of poor nutrition.

In the school setting, each dietary recall represents a lengthy disruption in both the child's and his or her classmates' education. It was necessary in this case to limit recalls to one per child. While the literature supports the use of a single 24-hour dietary recall for estimating average group intake in a random sample of the population (McPherson *et al.* 2000), there is evidence that children's dietary intake varies substantially by meal, day and season (Cullen *et al.* 2002; Gagne *et al.* 2004; Roth *et al.* 2005). The use of a single recall in the present study may have obscured some of this variability in food consumption. For example, in the present study, recalls were completed between April and June of a single year. It is possible that this limited time frame may have obscured seasonal variability in diet, though there is evidence that seasonality of diet may be minimal in industrialized contexts (Ma *et al.* 2006).

Due to the school context of this study, and the applicability of the results to questions surrounding school food sales and fundraising, I opted to conduct all of the recalls on Tuesday through Friday. The data reflect weekday intake only, and do not reflect variations in food intake that may occur in weekend diet. While this practice is not uncommon in school-based studies of children's nutrition (Frank 1991b), the results of the present study may actually underestimate mean daily energy and fat intake, as numerous authors find fast food intake (O'Dwyer *et al.* 2005) and energy and fat consumption (Haines *et al.* 1992, 2003; Matheson *et al.* 2004) are greater in the weekend diets of both adults and children.

Of final concern is the limited number of existing publications which employ the new dietary reference intakes (DRIs) as reference standards. While DRIs represent a harmonization of Canadian and US approaches to dietary evaluation that is extremely valuable to researchers, their use presents a number of challenges to the interpretation of dietary recall results. For group intake analysis, the new guidelines recommend comparisons to the EAR, which represents the "average daily nutrient intake level estimated to meet the requirement of half the healthy individuals in a particular life stage and gender group" (Murphy *et al.* 2002: 268). The EAR value is calculated as the median of a normal distribution of nutrient requirements. The recommended daily allowance (RDA), which was the old unit of comparison, now represents "the average daily nutrient intake level sufficient to meet the nutrient requirement of nearly all (97%) healthy individuals in a particular life stage and gender group" (Murphy *et al.* 2002: 268). The RDA can be calculated as the EAR plus two standard deviations of nutrient requirement. In theory, the use of EAR represents a more nuanced approach to determining dietary adequacy, as the distribution of intake values below the RDA includes some values near the RDA that are probably adequate to individual needs. Authors caution that the EAR should never be used as a definitive cutpoint for evaluation of intake, as individuals with intake above the EAR have probabilities of inadequacy as high as 50% (Murphy *et al.* 2002). In addition, where requirement distributions cannot be described, reference values are given as adequate intakes (AIs). Like RDAs, AIs describe target intakes for individuals and are not recommended for group intake analysis.

These recommendations present a number of obstacles to group intake analysis: the lack of EARs for many nutrients; the significant gap between the EAR and the RDA; and the large probability of nutrient insufficiency above the EAR cutpoint. These obstacles have been addressed in the present study by: the use EARs wherever possible; by the use of AIs where no EAR is provided; by calculating the prevalence intake below the EAR; by avoiding calculation of prevalence of inadequacy based on AI; and by the use of caution in determining the significance of mean intake below the EAR. These methods are consistent with other early publications using the new system of DRIs (Champagne *et al.* 2004; Moffat and Galloway *in press*; Veugelers *et al.* 2005). That said, the use of EAR cutoffs for determining adequate intake and prevalence of inadequacy ensures that estimates of inadequacy are conservative in the extreme. The present study represents a cautious approach to determining dietary quality based on the newest reference information available.

6.7 Conclusion

The results of the present study describe high prevalence of overweight in both boys and girls. This finding is consistent with data on childhood obesity in other rural North American settings, where socioeconomic factors such as income, employment and education contribute to elevated obesity risk in both adults and children. In addition, children in this sample are generally consuming inadequate servings from the four food groups, resulting in widespread nutritional inadequacies. Interventions for this population of rural children need to target overall dietary inadequacies and replacing existing caloric intake with nutrient-rich foods from across all four food groups.

Analysis of anthropometry and dietary recall indicates that, compared with girls in this rural Ontario sample, boys have higher obesity prevalence and receive significantly greater levels of dietary energy and nutrients than girls. This finding is less common in the literature on child nutrition and may be evidence of gendered dietary patterns in this population that are significantly impacting children's growth. Whether the growth and nutrition outcomes observed in the present study are the result of local or larger-scale forces remains to be discovered. However, the fact that they are not universally observed, and run counter to the general pattern of obesity risk in rural North American adults, suggests that there are local values, attitudes, and practices that are influencing children's diet, growth, and likely physical activity in this population. These arise from the particular historical and social environments in which children live. Interventions directed at improving health outcomes in this population will require sensitivity to the factors influencing growth and nutrition differently in boys and girls. Future research will examine environments, attitudes, beliefs and practices in order to better understand the processes which engender rural children's growth and nutrition in this and other rural North American communities.

6.8 Afterword I: Issues Arising from Interpretation of Growth and Nutrition Data

(i) Introduction

The following section contains additional comments on issues raised by the above publication. I have taken the opportunity to discuss further the gender differences in diet and obesity observed in the present study. Space constraints limited discussion of this finding in the above paper. Here I examine the literature on gender differences in obesity and discuss possible cultural influences on rural children's diet and body size.

(ii) Gender Differences in Growth and Nutrition: A Local Rural Biology of Childhood?

The preceding papers present findings of gender differences in body size and nutrition in this population of rural children. While both boys and girls have high prevalence of overweight, boys have higher prevalence of obesity than girls. In addition, boys consume more servings of meat and grains, and greater energy, protein, carbohydrate, calcium, iron, phosphorus, and sodium than girls.

Observations of gender differences in obesity are not new. For decades researchers in developed nations have consistently reported disproportionately high obesity prevalence in women of low socioeconomic status (Borders *et al.* 2006; Brown and Konner 1987; Diez-Roux *et al.* 2000; Goldblatt *et al.* 1965; Matheson *et al.* 2008; Sobal 1991; Stunkard 1988). Despite the consistency of this finding, there has been little effort to describe the pathway through which this gender difference arises. In adults, some gender difference in BMI is explained by physiology: higher BMI in women is attributable to greater fat stores and hormonal processes related to fertility

(Lovejoy 1998); lower BMI in men is attributable to greater fat-free body mass in the form of muscle and bone (Gallagher *et al.* 1996). However physiological explanations do not account for the interaction between gender and socioeconomic status and obesity. And they do not account for gender differences in obesity prevalence in preadolescent children.

Matheson *et al.* (2008) suggest that dieting behaviours may account for the observed gender differences in obesity among adults. Women of low socioeconomic status tend to exhibit fewer and less persistent dieting and physical activity behaviours than either men or high-socioeconomic status women, perhaps due to limited access to resources that facilitate dieting and exercise such as income, education and leisure time (Matheson *et al.* 2008). Other research suggests that the burden of multiple roles may have a negative impact on the dietary and exercise patterns of low socioeconomic status women. Adult women's roles in wage labour, domestic chores, child care, food procurement and preparation may constrain food choices and physical activity options (Matheson *et al.* 2008). The impact of these factors on women living in rural areas has not been studied, although we may surmise that the added challenges of limited health services, education, employment and transportation in rural communities may further constrain women's diet and physical activity options.

The effect of these types of constraints on children's food consumption and body size in rural settings is as yet unknown. Crooks (1999a) has suggested that gender differences in children's obesity risk in a rural Kentucky setting may be influenced by cultural assumptions about greater protein and energy requirements in boys. I would like to explore this idea further with a brief discussion about gendered ideas around body size in rural communities. In Chapter 2 I refer to recent claims in the literature that traditional socioeconomic indicators, such as income, education and employment status, may give an incomplete picture of the elements that contribute to obesity (Braveman *et al.* 2005; Marmot 2000). I also referred to Lock and Kaufert's (2001) construct of "local biologies", wherein the continuous feedback of biological and cultural factors occurs within a highly localized context and which reflects the particular priorities of groups of people. With these ideas in mind, I take this opportunity to explore two elements of rural Canadian culture that may contribute to gender differences in child nutrition and growth: farming and hockey.

In the planning stages of the present study, I prepared myself and my research assistant to respond to children's questions and comments regarding body size. I anticipated that the majority of questions would come from girls comparing their bodies with media portrayals of thin young women. As discussed in Chapter 4, members of the McMaster Research Ethics Board took the same view, and provided the opportunity for me to respond to mock scenarios in which children expressed negative views of their own large body size. During data collection, I did receive comments and questions from children. However these were exclusively from boys and all expressed concern over being considered too small. Boys wanted to know if they "weighed enough" or "were tall enough". They compared themselves to role models, often athletes and family members, which they described as large and muscular. The sport of hockey figured prominently in their descriptions: "I want to be big like Sundin"; "I want to be big enough to make the rep team next year"; "I want to be so big that nobody can knock me down".

An early interpretation of the results of anthropometry was the hypothesis that gender differences in body size and nutrition among rural children stemmed from cultural values in rural communities around farming. Differential child feeding has been observed among pastoralists and agriculturalists (Ross 1987), where energy and protein resources are disproportionately high in the diets of boys and men. My own memories of my father receiving the extra pork chop at dinner reinforce this stereotype of traditional farm life.

But a demographic analysis of the region suggests that farming is not a predominant industry. Fewer than 11% of the adult population of Grey-Bruce is employed in agriculture and even fewer actually live on farms (Statistics Canada 2001). The average age of farm operators is increasing, as costs rise and commodity prices drop, attracting fewer young farmers to the occupation. Many existing farm operations are unsustainable. Between 2001 and 2006, roughly 20% of dairy and 10% of beef farms (the predominant farm type in Grey and Bruce Counties) shut down (Statistics Canada 2006). The decline of farming as an industry does not, however, mean that farming is without influence on rural culture. Many rural and small-town residents may have been raised on or near farms. Traditional farm values around diet, health and body size may influence contemporary rural biologies. The ways in which farm culture may interact with socioeconomic status and gender have yet to be explored. However it is possible that, through both cultural and socioeconomic means, farm women bear the brunt of caregiving and on-farm chores as either they or their partners seek employment off-farm to sustain the economic viability of the operation. The factors listed above (fewer opportunities for dieting and physical activity, lower income and education, less leisure time) may constrain women's, and therefore children's, food and physical activity choices. Children's diets and physical activity options may reflect traditional farm values which favour physical strength and large body size in boys and dietary restraint or sacrifice in girls. The influence of farm culture on rural children's growth and nutrition has yet to be studied in detail and therefore offers a promising avenue for future qualitative research.

The predominance of hockey in children's comments around body size led me to explore the influence of this sport on children in this population. Each of the school communities in the present study has its own hockey arena. According to a 2005 census of facilities, Grey-Bruce is home to 2.7% of Canada's arenas (Hockey Canada 2005), with only 0.5% of the population (Statistics Canada 2001). The City of Owen Sound, in Grey County, has a large arena complex (the Harry Lumley Bayshore Community Centre) which houses two Ontario Major Junior franchises (the Owen Sound Greys and the Owen Sound Attack) as well as minor league teams. In villages and towns throughout the region, hockey arenas exist in communities too small to sustain stores, schools or postal outlets. In dietary recalls, children reported consuming many meals en route to hockey games, both as players and spectators. Boys spoke of early morning, late night and weekend practices and games, amounting in some cases to four or five times weekly, throughout the school year. Hockey was a pervasive feature of children's lives.

Sport is commonly viewed as a motivator of children's physical activity. The idea that sport may motivate unhealthy eating seems counter-intuitive. However the sport of hockey is a highly commercial enterprise. Vending and concessions are present in every arena. Brand name advertising is prominently displayed and opportunities for non-nutritious food consumption abound. It is small wonder that children make the connection between the large body size of successful male hockey players and the food available where hockey is played or viewed. While there have been numerous recent government initiatives to reduce food marketing in public spaces such as schools and daycares, there is little impetus to change marketing practices in hockey arenas.

While girls in the sample also reported playing hockey, they did not make reference to the desire to be large. It is probable that role models for women's hockey differ significantly in size from those for men's hockey. There are currently few opportunities for women in professional hockey and therefore women's hockey lacks the caché of the men's game. At the professional level, men's hockey is characterized by high media visibility, corporate sponsorship and lucrative player contracts. In the same way Brewis (2003) described Mexican mothers giving special primacy to male children, parents for whom hockey is important may place higher values on boys as avenues through which parents experience the game.

I suggest that in rural Canadian communities, where hockey is a prominent part of children's lifestyle, the effect of hockey culture on children's nutrition and growth cannot be overemphasized. Hockey can be viewed as a set of cultural ideals that becomes embedded in the biology of rural children. It may be that infant and child feeding practices are informed by societal values which idealize rapid, extensive growth in boys; as a result boys receive more servings of meat and grains and more energy and micronutrients than girls. Widespread acceptance of larger body size in boys and men may be underscored by a culture which values the size and strength epitomized by professional hockey players. The concept of health may even be conflated with the physical qualities of hockey players (qualities, such as large size, which in themselves may or may not be healthy) rather than the manner in which those qualities are produced. Hypotheses of this type could be explored through qualitative means, perhaps by interviews and focus groups with rural children and adults. I contend that embodiment of "hockey culture" represents a plausible biocultural pathway for the construction of large body size in this population of rural boys.

(iii) Conclusion

This afterword has permitted me to canvass a subject too briefly discussed in the preceding paper: the gender differences observed in the present study. Existing research suggests that gender and socioeconomic status work together in adults to produce a gender difference in obesity in some adults, namely greater obesity prevalence in women of low socioeconomic status (Brown and Konner 1987). However the effect of this interaction on children, especially rural children, is yet to be discovered. Two plausible pathways – embodiment of farm culture and embodiment of hockey culture - are advanced to explain the gender differences in diet and obesity observed in the present study.

6.9 Afterword II: Applications of Growth and Nutrition Data

(i) Introduction

From the outset it was my intention to produce research that was useful not only to the academy but to the partnering community organizations that supported the study. The extent to which this was achieved varied among the study partners. However I am certain that on some level each found the collaboration successful.

In a series of exit interviews conducted in Spring 2007, I gathered feedback from agency representatives regarding the impact of the research on policy and programs provided by their respective organizations. The following sections document my knowledge translation activities and catalogue the contributions of the research to policy and program change.

(ii)The Grey-Bruce Health Unit

My partnership with the Grey Bruce Health Unit was facilitated through communication with Lynda Bumstead, Public Health Dietician. In her role as consultant to community programs, Lynda Bumstead was eager to support any research into nutrition and healthy body size in children. At the time the research was undertaken, the Grey Bruce Health Unit was promoting a number of programs designed to support early nutrition in children. The Good Food Box Program purchases fresh fruit and vegetables in bulk and distributes these at low cost to families on fixed incomes (Grey Bruce Health Unit 2006b). According to Lynda Bumstead, the impetus for this program came from anecdotal data that low-income families in Grey Bruce were experiencing episodic food shortages based on cyclical fluctuations in household income. Health unit staff felt that these food shortages must be impacting the quality of children's nutrition in Grey Bruce. However there was no contemporary local data on childhood nutrition.

The present study provided the health unit with local cross-sectional data on the dietary intake of a large sample of schoolchildren between 7 and 13 years of age. Summary tables of the nutritional data were provided to the health unit in the Fall of 2005, at the same time that parents and children received this data in the form of newsletters (Appendix 5).

A second program underway for several years in Grey-Bruce prior to my arrival was Eat and Learn (Grey Bruce Health Unit 2005). This program was a response to the public health literature linking breakfast with children's performance in school. According to Lynda Bumstead, there was widespread anecdotal evidence that many children in Grey Bruce were arriving in school without having consumed breakfast. All participating schools operated some form of breakfast program, although these differed widely in schools. Schools with full-service cafeterias offered breakfast selections for sale. A number of schools offered free food and beverages for breakfast, served by volunteers and funded jointly by the Grey Bruce Health Unit and the Canadian Living Foundation (2007).

The present study offered support for public health and community school breakfast initiatives. The results of the dietary recall analysis indicated that 64% of children did not consume breakfast prior to arriving at school. A goal of future analysis of the nutrition data is the comparison of breakfast food consumption at schools with and without this free breakfast service. The conditions under which breakfast was served also varied within schools. Future analysis will compare the operation of breakfast programs in differing schools to see what factors affect the rates at which children utilize this service.

At the time of the study, Alanna Leffley, Public Health Epidemiologist for Grey Bruce, was working with Dr. Rob Nolan (2007) of the University Health Network, Toronto General Research Institute, on the Community Outreach Heart Health Risk Reduction Trial (COHRT). Funded by the Heart and Stroke Foundation of Ontario, COHRT was a four-year study of cardiovascular disease risk 3 Ontario populations (Grey Bruce Health Unit 2006a). Roughly 300 residents of Grey-Bruce participated in the trial. While the adult data would prove significant in the lobby for provincial funds in support of public health programs for rural Ontarians, Alanna Leffley expressed concern over the lack of a similar data set for children living in the region. It was felt that the lack of data on children living in Grey-Bruce might hamper local efforts to convince provincial public health officials of the serious and long-term nature of obesity and diabetes risk in this population.

At the request of Ms. Leffley, the results of the anthropometry data were provided to the health unit at the same time as the results were provided to students and parents in the form of school newsletters (Appendix 5). The epidemiologic tables have subsequently been published in the *Canadian Journal of Public Health* (Galloway 2006). At the invitation of the health unit, the results were also presented at a local event designed to raise awareness of the issue of obesity held in the Fall of 2004 (Appendix 6: Galloway 2004b). I participated in a number of media interviews designed to publicize this event (Appendix 7: Galloway 2004 a, 2004b). At the request of the health unit, I also participated in television and newspaper interviews designed to support subsequent public awareness campaigns in Grey-Bruce (Appendix 7: Galloway 2005a, 2005b, 2005c, 2005d).

As one of its wider goals, the Grey Bruce Health Unit endeavors to link research to practice, forming partnerships with academic researchers in order to foster evidence-based policy and programs. According to Lynda Bumstead, the collaboration in the present study meets the Ontario Heart Health Resource Centre (2007:1) definition of partnership, an "alliance among two or more parties that pursue a set of agreed upon goals." Our successful partnership served as a model for future initiatives designed to foster communication between scholars and the public health officials who serve Grey and Bruce Counties. The health unit is currently involved in a long-term health surveillance project with the University of Waterloo Health Studies and Gerontology Program. On behalf of the Grey Bruce Health Unit, Ms. Bumstead expressed the opinion that "it is exciting for rural Ontario to be part of these linkages with academic research" (Personal Communication 2007a).

(iii) The Bluewater District School Board

At the outset of the present study, The Bluewater District School Board was considering action on provincial policy initiatives designed to increase physical activity in schoolchildren (Ontario Ministry of Education and Training 2005a, 2005b; Ontario Society of Nutrition Professionals in Public Health School Nutrition Workgroup 2004). I approached Marianne Alton, Superintendent of Elementary Schools for the Bluewater District School Board, regarding the board's willingness to partner on a school study of child growth and nutrition. Her reaction was extremely positive due to the fact that the current board nutrition policy was, in her words, "intentionally vague; you could drive a truck through it" (Personal Communication 2007b).

The school board nutrition policy, in its entirety, reads as follows:

> It is the policy of the Bluewater District School Board that the nutritional value of food regularly sold or provided will be considered in decisions related to available food choices. Bluewater School Community Councils may provide input at the school level on school-based services related to the provision of food including breakfast programs, lunch programs and any other food that is sold or provided to students during the school day or at other school sanctioned events. (Bluewater District School Board 1999)

According to Ms. Alton, nutrition programs were highly variable between schools, with food sales and fundraising incorporating many non-nutritious food items. Of additional concern to Ms. Alton was the sale of carbonated beverages and juices in schools in accordance with a board-wide vending contract. In response to a provincial mandate (Ontario Ministry of Education and Training 2004c), the school board was in the process of renegotiating the terms of its vending contract. However Ms. Alton felt that at the time school nutrition practices were not in accordance with public health recommendations for nutrition in children.

Ms. Alton viewed the present study as an opportunity for nutrition education in schools. The Board provided the study with meeting facilities and paid release time for teachers and principals to attend meetings and workshops as part of the study. For example, just prior to the distribution of newsletters to students in the Fall of 2004, Ms. Alton arranged for me to present the results of anthropometry and dietary recall to all principals in the board at a venue in Owen Sound ON

(Appendix 6: Galloway 2004b). Similarly, the results formed part of a board-wide staff retreat (Appendix 6: Galloway 2005a) and a board-wide parent council event (Appendix 6: Galloway 2005b), both held in the Fall of 2005.

The staff retreat was an event worthy of remark. It was convened by Ms. Alton and held in the Bayshore Community Centre, a large arena complex in Owen Sound. The speakers included Dr. Hazel Lynn, Grey Bruce Medical Officer of Health and Randy Calvert, Program Manager, Children's Exercise and Nutrition Centre, McMaster Children's Hospital, and myself. We spoke to the assembled staff of the Bluewater District School board, some 1900 employees, about the benefits of healthy lifestyle and nutrition. In a conversation in May 2007, Ms. Alton described the overwhelmingly positive response of board staff to the presentations. Employees have embraced the recommendations for improving children's nutrition practices in schools. The number of teachers who participate in healthy snack programs has increased. The number of teachers who permit children to carry water bottles has increased. Efforts to improve nutrition, such as the Balanced Day[4], have received widespread staff support, though these changes initially proved challenging due in part to staff resistance. The number of school principals volunteering for the Balanced Day schedule change has increased.

[4] "Balanced Day" is a recent initiative in schools designed to lengthen the time allotted for children's nutrition breaks. The majority of school schedules contains two brief (15 minute) outdoor morning and afternoon recesses, during which children may or may not consume snacks, and one long "lunch hour" in which children are allotted a brief indoor period (10 minutes) to consume lunch followed by a longer period (usually 40-50 minutes) of outdoor recess. With the Balanced Day program, this schedule is altered to provide two 40 minute periods, morning and afternoon, each consisting of a 20-minute "nutrition break" followed by a 20-minute outdoor "activity break". Proponents of the Balanced Day suggest that its benefits include improved nutrition from slower and increased consumption of food and fewer injuries from less fatigue on the playground. However school and public health officials in numerous Ontario districts have experienced resistance to the change from parents, who find it challenging to select food for two breaks, and teachers, who find the altered schedule disruptive. Efforts to soften this resistance include helpful suggestions on how to pack lunches for the balanced day (see Regional Niagara Public Health Department 2007, for example).

At the board level, the most significant contribution has been heightened awareness of the need to consider nutrition and physical activity in school board programs. Ms. Alton credits the study with providing empirical data which supports the need for significant program change in the area of child nutrition. However she expressed frustration that, as yet, the study has not resulted in meaningful policy change. The existing nutrition policy remains unaltered, and therefore proposed program changes are not supported by board policy. School principals, staff, parents and volunteers may alter their nutrition practices but they are not required to do so by board policy. The result is continued variability in the quality of nutrition children receive in Bluewater elementary schools.

On reflection, I attribute the inertia in policy change to public lassitude regarding the extent and nature of the problem of childhood obesity. Despite, or perhaps because of, concerted efforts on the part of public health planners and health policy advocates, little has been achieved in the area of obesity outcomes for children. In the late 1990s, as US data emerged documenting soaring childhood obesity rates, health planners called for directly-measured data on child growth in order to assess the extent of childhood obesity in Canada (Tremblay 2004). The present study is a response to that call. However, more recently, as the extent of the problem in Canada is documented, our research focus needs to shift to elucidating the environmental processes through which poor nutrition and physical activity are perpetuated in society. School-board-level resistance to nutrition policy is an interesting piece of the puzzle. Why, in the face of local data, are board members and policy-makers reluctant to write nutrition policy that requires, rather than recommends, improved nutrition in schools? What role does food-related fundraising play in school budgets? Who is appeased (parents, children, local businesses, larger corporations) by the continuance of current modes of foodservice and fundraising in schools? These questions warrant future study.

(iv) The Schools

The bulk of my applied research efforts took place in schools. To begin with, children's participation in the research process was itself a form of experiential learning. Participants and non-participants alike were exposed to classroom presentations at several stages of the research process.

The first of these presentations occurred in the Fall of 2003. Prior to the collection of data, and by way of introducing the study and distributing consent forms and letters of information to parents, I conducted classroom presentations to all children in grades 2-8 at participating schools. These presentations included description of the scientific method, the stages of research, and the processes of sampling and consent. These concepts form part of the Ontario elementary school mathematics and science curriculum and were therefore configured using age-appropriate curriculum guidelines provided by the Ontario Ministry of Education and Training (2003).

After data collection, in the Fall of 2005, the results of the anthropometry and dietary recall were presented to all students and families of children in all grades at participating schools in the form of a newsletter (Appendix 5). In addition, I arranged for distribution of newsletters to grade 9 classes in secondary schools attended by students who had completed grade 8 in study schools. In this way, the study results were widely disseminated in very readable, accessible form. Following distribution of the newsletters, I attended parent council meetings at all seven study schools. My attendance at these meetings was publicized in the schools' monthly newsletters beforehand and accompanied the study newsletters home, so that parents and community members wishing to discuss the study results with me could do so. The response from parents and community members was large; many attended the parent council meetings to discuss the implications of the study findings.

In the Fall and Winter of 2005 I conducted classroom workshops with children in grades 2-8 at participating schools. Through the permission of the Bluewater District School Board, and with the approval of the McMaster Research Ethics Board, I made these presentations to all students, regardless of whether or not they had participated in the study. The intent was to ensure that all children would benefit from the information. In total, I conducted 37 workshops to some 1036 children. Each workshop lasted approximately 40 minutes.

The workshops consisted of interactive demonstrations of serving size selections from Canada's Food Guide as well as comparisons of nutrient and sugar content in nutritious and non-nutritious snack items. For example, students measured and compared the volume of sugar contained in white milk, chocolate milk, fruit juice, fruit punch and cola. A highlight was the measurement of the sugar content in a popular gas-station beverage (280mL or 56 teaspoons). Another component of the workshops was a demonstration of the variability in height among children of a given age. Children traced life-sized models of height from across the percentile range of a growth reference and engaged in a lively discussion of the factors that influence growth, such as genetics, biology, nutrition, immunity, and environment. At one school, the local newspaper provided media coverage of the event, including an article and photographs of children measuring servings of milk.

The Superintendent of Schools informed me that the school board was currently permitting a wide rage of nutritional services offered at different schools. These included Breakfast for Learning programs, snack and lunch timing and modalities (stand-up, sit down, indoor and outdoor, classroom or gymnasium[5]). There was also a wide variety in the nutritional content of foods served and sold in schools. Working with the Public Health Dietician, I provided consultation to the Superintendent, principals, cafeteria operators and volunteers seeking input on school nutrition programming as well as changes to menu and vending machine items.

Overall, much has been accomplished in terms of program change in schools. However there is continued resistance to effective nutrition programming remains from both teachers and families. Efforts at program changes in study schools have been thwarted by parents concerned with maintaining the status quo. For example, in one study school the principal discontinued a program of monthly food sales from a local fast food hamburger restaurant. In response, a number of parents organized their own informal program to deliver food from this restaurant to children at school. Parents' entrenched ideas about "treating children" have in many cases not

[5] One such comparison was the use of cafeteria-style tables in two schools. These foldable, stackable cafeteria tables were set up each day in the gymnasium for use by particular grades: grades 7-8 in one school, grade 8 only in another. In focus groups students were extremely positive about this lunchroom arrangement, which they called "Harry Potter-style", as it permitted lively, face-to-face discussion during lunches. Students also expressed pleasure at eating in a room other than their classroom, despite the lack of windows in the gymnasiums. School custodial staff, on the other hand, expressed displeasure at the extra workload required in order to set up and take down the tables. In a tragic footnote to this story, a number of young children in Canada and the US have been killed by collapses of these folding cafeteria tables in schools (McLeod 2006). The US Consumer Product Safety Commission (2007) has recommended that children not be permitted to move or play with these tables.

been overcome by our use of the data from this study. Teachers' classroom practices continue to reflect greater concern for comportment and cleanliness than for hydration and nutrition.

Other school-based nutrition research has met with similar resistance (Gortmaker *et al.* 1999; Nicklas *et al.* 1998; O'Neil and Nicklas 2002; Sallis *et al.* 1993). Thomas (2006) suggests that lack of parental engagement may hamper school-based efforts targeting childhood obesity and suggests that qualitative research may illuminate some of the barriers hindering policy change and improved nutrition outcomes in children. Such barriers might include the structural relationships between parents and the authority figures in schools, an issue examined in detail in Chapter 4.

(v) Future Directions

While the results of anthropometry and dietary recall have been widely disseminated in the study area, more knowledge translation remains to be done in the area of school nutrition. In the coming months I will return to the region to disseminate the findings of the focus group portion of the data collection. In a series of staff meetings still in the planning stages, I will endeavor to engage principals and teachers in a discussion of the nutritional implications of food rules and rewards.

I also have plans to conduct a more detailed analysis of the nutrition data as it relates to the scheduling of lunch and snack times at school. Currently, there is little existing data supporting the nutritional benefits of the Balanced Day school schedule. I would like to provide this information to this and other school boards implementing this program in order to evaluate its efficacy.

(vi) Conclusion

In summary, the present research afforded me many opportunities for applied anthropology. Through involving children in the research process, through opportunities for education and knowledge translation, and by informing program evaluation and change, the present study represents the creative application of knowledge that is the hallmark of applied anthropology.

According to Ervin (2000), effective application of anthropological knowledge requires a wide range of skills, effective communication, consultation with community stakeholders and a focus on policy. The present research provided me opportunity to exercise these four requirements. My skills as a researcher and educator were applied in the pursuit and interpretation of high-quality data that proved useful to the research community. My skills as a communicator were challenged in venues that ranged from meetings of school principals, teachers and parents to classrooms of 7-year-old children (the children were by far the more challenging audience). Consultation with public health providers ensured that the results were representative of and applicable to the population under study. And while policy remains relatively unchanged, school and public health programs informed by the research are leading policy-makers in the region to consider changes to school nutrition policy.

Chapter 7 Children's Perceptions of School Mealtime Experiences: Controlling Children's Bodies and Behaviour through Food Rules and Rewards.

Manuscript prepared for *Social Science and Medicine*

7.1 Preface

The following paper presents a qualitative analysis of children's food-related experiences in the school environment. One of the goals of the research was to explore the school context of children's nutrition. My choice to conduct the focus groups in a largely open-ended fashion quickly led to the realization that children perceived themselves inundated with food-related rules and restrictions while at school. The experience of eating meals at school, it appeared, was unlike the experience of eating meals elsewhere.

The anthropometry and dietary recall data will be used by the research partners to modify policy and programs around school nutrition and physical activity. However in numerous jurisdictions school-based interventions have demonstrated only limited effectiveness in changing children's eating behaviours (Guenther *et al.* 2006; Thomas 2006). While the source of the tractability of eating behaviours undoubtedly stems from wider cultural processes, I believe it is useful to examine those processes within the context of the school. As an institution, school is a vehicle for broader societal constructions of gender and power. This paper mines the literature on childhood, school culture and gender in order to explore the messages conveyed to children during their school snack and lunch times.

At this writing, the results of the focus group analysis have not yet been returned to partners at the health unit or the school board. I have approached the school board about holding workshops for teachers and principals in which the results are discussed and strategies considered that build on the knowledge and experiences of classroom teachers. I anticipate the exchange of this information will make for lively discussion and constructive efforts to restructure the school meal experiences of children.

7.2 Abstract

This paper reports findings from a qualitative analysis of children's perceptions of the school nutrition environment. Focus groups were conducted with 144 schoolchildren (72 boys and 72 girls) ages 8-13 years. Open-ended questions were used to encourage students to describe the physical and social environments in which they consume school snacks and lunches. The results suggest that a wide range of rules and restrictions are imposed on children's activities during school meals. The majority of these rules govern the physical location, movement, and social interaction of students, suggesting a significant degree of institutionalized control over children's bodies and interactions. Few of the rules and restrictions were perceived by children to relate to their nutrition or health. And the imposition of these rules and restrictions occurs in a gendered fashion, creating a climate in which school and societal stereotypes about boys' and girls' behaviour are normalized. In addition, food rewards constitute an important avenue for the communication of values and norms around food and children's behaviour. Educators and health workers need to be cognizant that school-based programs and policies aimed at decreasing childhood obesity prevalence occur in a wider context of institutional rules and practices that communicate their own powerful messages about food and children's bodies.

7.3 Introduction

Due to widespread concerns with the prevalence of childhood obesity, there is an emerging literature on the role of school nutrition programs in promoting healthy eating. Much of this research takes the form of evaluations of local- and state-level initiatives to increase fruit and vegetable consumption (Gortmaker *et al.* 1999; Lowe *et al.* 2004; Reynolds *et al.* 2000; Sadeno *et al.* 2000) and decrease sweetened beverage consumption (Cullen and Thompson 2005; James *et al.* 2004; James and Kerr 2005) among schoolchildren.

School-based feeding programs are widely acknowledged as a fundamental tool for improving child health (Florencio 2001; Hay 1999). However children, as the constituents of these programs, are rarely consulted in their design, implementation or evaluation. A case in point is the US CATCH program, the largest school-based intervention trial ever funded by the National Institutes of Health (Luepker *et al.* 1996). Begun in the early 1990s, the program has been implemented in ninety-six schools in California, Louisiana, Minnesota and Texas. In 2003, in an effort to evaluate the tractability of negative health behaviours and the "school climate" of nutrition in study schools, researchers conducted interviews with 199 key informants (Lytle *et al.* 2003; Parcel *et al.* 2003); none of them were children.

The absence of child representation in the literature on school nutrition is representative of larger themes in research. Numerous authors observe that child informants are under-utilized in child-centred research (Corsaro 1997; Christensen and James 2001a; Mayall 2000), despite their demonstrable reliability as interview and focus group participants after the age of 7 years (Fine and Sandstrom 1988; Lytle *et al.* 1993; Mauthner 1997). In the school context, Jenks (2000:64) contends that the absence of children's voices from education research unconsciously communicates the view that schools are populated by "passive, malleable and fundamentally non-intentional learners". This view undoubtedly permeates assumptions about the role of children in school-based research and wider research about children and childhood (James 1998; James and Prout 1990; Hendrick 2000; Mayall 1996; Qvortrup 2000; Schwartzman 2001).

Research has begun to incorporate children's voices in the area of adolescent health, where the impact of individual and group identity-making is widely acknowledged to have an effect on food purchasing and consumption. The results of this research have produced insights into the role of the school environment in shaping teens' and pre-teens' dietary habits. The food choices of 141 teens in a US study were influenced primarily by taste, appearance, cost and convenience (Neumark-Sztainer *et al.* 1999). In focus groups with 26 New England pre-teens, kids viewed the presence of high-fat convenience foods and sweetened beverages as a barrier to healthy eating in their schools: "how can we stay healthy when you're throwing all this in front of us?" (Bauer *et al.* 2004:34).

Focus groups with younger children demonstrate the profound impact of the school environment in shaping children's eating habits. Children as young as 7 years report a lack of school support for proper nutrition, proposing strategies for healthier eating such as "not taking money to school" due to the poor menu choices available (O'Dea 2003). In addition, children report gender differences in school food rules and practices. These include frequent admonishments to boys by teachers to finish their food or eat quickly, while similar instructions are less frequent or omitted for girls. Hart *et al.* (2002) suggest that through actions such as these, teachers socialize children early into the idea that boys should be fed to satiety while girls should exercise food restraint.

Among adults, ethnographic techniques such as interview and focus groups are becoming increasingly common in community-based research, as authors seek to understand the contexts underlying area-level variation in health outcomes (Hanrahan 2002; Paluck *et al.* 2006; Towle 2006, for examples). Aronson *et al.* (2006) and Worthman (1999) suggest that broad, anthropological and ecological approaches to research are required in order to fully explore the myriad levels at which health is determined, including among others genetics, biology, behaviour, family, society, culture, economy and environment.

The present study arises out of the Bluewater Nutrition Project, a study of children's growth and nutrition in rural Ontario, Canada. Between January and June 2004, anthropometry, 24-hour dietary recalls, and focus groups were conducted with children. The results of anthropometry and dietary recall demonstrated marked differences in the study population. Boys have significantly greater obesity prevalence than girls (Galloway 2006); while mean daily intake of fibre and micronutrients was equally low for both boys and girls, there were significant gender differences in nutrient intake, with boys consuming more servings from the meat and grain food groups and greater energy, protein, carbohydrate, calcium, iron, phosphorus, and sodium than girls (Galloway 2007).

In light of these differences, it was desirable to examine aspects of the school nutrition environment that might contribute to gender differences in child growth and nutrition. As well, the focus groups offer an ideal opportunity for providing feedback to the schools on their nutrition rules and practices.

7.4 Methods

(i) Sample and Methods

The study sample was drawn from the populations of seven elementary schools in the Bluewater District School Board, located in the Georgian Bay region of Southern Ontario. The schools serve a diverse range of community sizes: the smallest school communities are entirely rural, with all children bused from surrounding townships; the largest school is located in a small city, population 21,000. All school communities fall under the Statistics Canada (2001) definition of "rural non-metropolitan".

Letters of information were distributed to 1042 students in grades 2-8 (ages 8-13 years)[1]; the guardians of 535 children returned written consent for children's participation in the study (51.3% participation rate). From each classroom's pool of study participants with parental consent, four children were randomly selected to participate in the focus group discussions. A total of 144 children (72 boys and 72 girls) took part in 37 focus groups. The majority of focus groups in this study were comprised of four participants. There were five groups with only three participants and one group of five. Verbal assent was elicited from children prior to each focus group. In addition, Ethics approval was provided by the McMaster Research Ethics Board, McMaster University, as well as from the Bluewater District School Board and the Grey Bruce Health Unit.

[1] While a number of children were 7 years of age during the anthropometry and dietary recall portions of data collection, all were aged 8 years and above by the time the focus groups were conducted in late spring, 2004.

Focus groups were led by the investigator and conducted in private on school premises during school hours. Each discussion took approximately 20 minutes. A research assistant made digital audio recordings of the discussions and took notes. Open-ended questions were designed to elicit information about the physical and social environments children experience during snack and lunch times at the schools, for example: How do you know when it's time for snack? Describe the place where you eat your snack; what is it like? Are there any rules about snack time? The questions were used as prompts with extra verbal explanation provided by the investigator to stimulate discussion where necessary.

(ii) Data Analysis

The focus groups were transcribed verbatim. Analysis of the content of the audio recordings took place in two stages. First, following Knodel (1993), a grid was developed to analyze each group's responses to the interviewer's series of questions. The second stage of analysis was guided by a form of theory construction whereby "concepts are captured; links are explored, created, and tested; ideas are documented and systematically reworked" (Richards and Richards 1998: 216). Through this iterative process, a form of grounded theory, insights are derived from the data itself, rather than developed from an external model (Strauss and Corbin 1998). The transcripts were examined for concepts, categories, descriptions and patterns of conceptual ordering used in participants' responses.

The majority of children's discussions centered on the quality of the snack-time and lunch-time environment. This paper focuses on the way in which that environment is shaped by rules and restrictions surrounding the consumption of food and beverages at school. There was, moreover, significant discussion among focus group participants regarding food rewards. Thus, I also examine the implications of the use of food as incentives and disincentives to behaviour within the school.

7.5 Results

(i) School Foodscapes

The six study schools displayed a wide range of diversity in food-related rules and practices. Two schools offered full-service cafeterias, selling a selection of hot and cold entrees as well as snacks and beverages. The remaining four schools offered hot items on a weekly or biweekly basis. The majority of hot entrees available consisted of pizza, hamburgers and chicken burgers. In the two cafeterias, efforts were underway to align menu items with Canada's Food Guide to Healthy Eating (Health Canada 1977), resulting in increased consumption of healthy entrees, such as salads and soups, at those schools.

There was a wide range of snack items on offer. Schools sold popcorn, snack mix, licorice, chocolate bars, cookies, fresh fruit and vegetables. All schools sold milk, with orders taken on a monthly basis. Chocolate far outsold white milk in every case. All schools had beverage vending machines in their main lobbies. These machines contained a variety of juice and sweetened juice beverages as well as bottled water. In addition, two schools had soft drink beverage machines in their staff rooms.

Despite the range of food and beverages on offer, by far the majority of students brought lunches from home. That said, about half of students supplemented their lunches with food or beverages purchased at the school.

Four of the participating schools operated on the traditional scheduling pattern of two short (15-minute) recesses morning and afternoon, with an hour-long lunch/recess break at noon. At these schools, students were given 10 minutes in which to purchase and consume food. Two schools operated on the "balanced day" schedule, which gives students two 20-minute "nutrition breaks", morning and afternoon. Each nutrition break is followed by a 20-minute outdoor activity period. Interestingly, the issue of time pressure was not raised by students, suggesting that they had adequate time to consume lunches and snacks under either scheduling system.

In the majority of cases, snacks and lunches were supervised by the classroom teachers themselves. At one small school, with limited staff, a single teacher patrolled the halls outside three classrooms, monitoring children's behaviour at intervals. At another, larger school, older (age 12-13-year) students were employed as lunchroom monitors. Children expressed a preference for supervision by lunchroom monitors, rather than teachers, as they were "less strict".

(ii) Food Rules

Children perceived a wide array of rules and restrictions on food-related activities within the school. These were grouped according to the categories listed in Table 7.1.

Table 7.1: Food rule categories elicited from the transcripts

Category	Description
Food prescriptions	Obligation to eat certain foods or types of foods
Food restrictions	Restriction of certain foods or types of foods
Ordinal rules	Rules around the order in which foods are consumed
Timing	Rules around the timing of food or beverage consumption
Physical location	Spatial restrictions on consumption of food
Physical movement	Restriction of children's mobility during meals and snacks
Noise	Rules governing the audible environment
Cleanliness	Rules associated with personal hygiene or perceived environmental cleanliness
Safety	Rules associated with perceived risk of injury

Table 7.2 provides examples of children's perceptions of the rules governing food consumption at school. Analysis by age reveals that younger children reported far more food prescriptions, restrictions, and ordinal rules, as well as more rules governing their physical movement and the level of noise in the environment. Children reported both positive and negative qualities of food and drink: "snack gives us energy to play, like basketball or soccer" (10-year-old boy) but "juice makes me hyper" (11-year-old girl). Rules about the order, timing and location of food consumption dominated young children's accounts: "lunch at 12:15 to 12:25…if you're not finished you have to take it outside with you" (10-year-old girl). Many young children spoke of physical limitations on where they could eat: "in our room" (8-year-old boy); "at our desk" (9-year-old girl); "no getting up" (8-year-old boy).

Table 7.2: Children's quotes illustrating the food rules they perceive at school

Category	Quote	Speaker
Food prescriptions	"It has to be healthy food because if you didn't have healthy food then you wouldn't be growing fast enough and you wouldn't be healthy."	9-year-old boy
	"Snack gives us energy to play, like basketball or soccer."	10-year-old boy
	"Water is better for you."	12-year-old girl
Food restrictions	"No juice in your water bottle; if you're drinking juice then you could get dehydrated."	8-year-old boy
	"If we buy too much (junk food) we could get sick and you might have to go home and you might miss out."	8-year-old girl
	"You can only drink (from water bottle) at snack or lunch."	8-year-old girl
	"Like if you spill (juice) on your book it will stain your book, but with water it can just get cleaned up."	10-year-old girl
	"Juice makes me hyper."	11-year-old girl
Ordinal rules	"We have to eat our sandwich first."	8-year-old boy
	"If we don't have a sandwich we have to eat the healthiest thing first."	9-year-old girl
	"We have to eat our sandwich before we play."	8-year-old girl
	"If you have a sandwich and the teacher sees you eating a snack then sometimes they'll check your lunch."	11-year-old boy
Timing	"The bell rings. Then we have to be done before the next time the bell rings."	8-year-old girl
	"We can't eat our snack until after first recess."	9-year-old boy
	"Lunch is 12:15-12:35…if you're not finished you have to take it outside with you."	10-year-old girl
Physical location	"In our room."	8-year-old boy
	"At our desk in the room."	9-year-old girl
	"We're not allowed to eat outside."	10-year-old boy
	"Grade six and up you can eat in the cafeteria, you don't have to just stay in your room."	12-year-old girl
	"You can't eat in the hall."	13-year-old boy
Physical movement	"No getting up (during lunch)."	8-year-old boy
	"No going to the bathroom at lunch without permission."	8-year-old boy

(Table 7.2 continued)

Category	Quote	Speaker
	"Sometimes if you get out of your desk she'll turn the lights out to know that we have to listen to her."	8-year-old boy
	"It's okay (to have a water bottle at desk) as long as you don't play with it while you're working."	9-year-old boy
	"You're allowed to move around to somebody else's desk."	10-year-old girl
	"You have to sit down and eat...it helps you digest it better."	10-year-old boy
	"We're supposed to stay in one spot but I like to move around."	11-year-old boy
	"We're allowed to get up (during snack)."	11-year-old boy
	"You have to sit down."	11-year-old girl
	"If you're walking around you can't be eating."	12-year-old boy
Noise	"You can talk...you have to whisper though."	8-year-old girl
	"No talking loud; you can whisper to your neighbour."	8-year-old boy
	"And if you're sitting with somebody and you're too noisy the teacher on duty will say go to your own desk."	9-year-old girl
	"You have to be quiet. (How quiet?) Very quiet; you can talk but not loud."	11-year-old boy
	"Noise can bother other kids."	11-year-old girl
Cleanliness	"No throwing food."	10-year-old boy
	"If your water bottle falls then (the teacher) tells you to throw it out because it's got germs on it."	10-year-old boy
	"Juice stains our paper."	11-year-old girl
	"You can lose the privilege of eating at different desks by leaving our chairs around and being messy."	11-year-old girl
	"If we have a big mess after lunch then we have to sit in our desks for a week."	12-year-old girl
	"We have to drink water, not juice...because if you spill juice it's sticky and it stains."	12-year-old girl
	"If we make a mess in the classroom, then we don't get to sit with our friends at lunch."	12-year-old girl
	"We're not allowed to eat outside any more because they're so worried about their stupid grass looking good."	13-year-old boy

(Table 7.2 continued)

Category	Quote	Speaker
Safety	"We aren't supposed to bring our food outside because of the bees."	8-year-old boy
	"Plus there are a lot of people that are allergic to bees and wasps."	10-year-old girl
	"People litter and there's bees...I got stung three times."	10-year-old boy
	"And um choking because people are running around."	10-year-old girl

Children reported having their lunches inspected by the teacher and, on occasion, having foods removed from their lunches and returned at the end of the day. For example, one child reported that "if you have a sandwich and the teacher sees you eating a snack then sometimes they'll check your lunch" (11-year-old boy). In interviews, teachers explained this activity as a form of preventative behaviour management. Teachers linked children's disruptive behaviour with consumption of pop and sugary snacks. Young children were required to eat their sandwiches first and to leave unhealthy or sugary snacks to the end of their meal. The majority of students under the age of 12 were required to eat at their desks in their classrooms, either reading or engaging in quiet social interaction. In some instances, the freedom to move within the classroom was viewed as a privilege which was withdrawn by teachers as punishment for loud or inappropriate behaviour.

Children at the upper end of the age range (12 and 13 years) reported greatly increased freedom of movement within the school environment: the majority were permitted to leave their desks during snack and lunch times in order to socialize with other students. There appeared to be an increased tolerance for greater levels of environmental noise among teachers of older students.

Children reported listening to music during lunch, which they enjoyed primarily in itself and secondarily for the reason that the presence of music afforded some privacy for their social conversations. Interestingly, all grade 7 and 8 students who reported listening to music were supervised by male teachers.

Analysis of these food rules by gender (Table 7.3) reveals a number of interesting differences. Girls were much more likely than boys to describe rules and restrictions around what they should or shouldn't eat: "water is better for you" (12-year-old girl); "if we buy too much (junk food) we could get sick" (8-year-old girl). Indeed paradoxically, while girls described prescriptive and restrictive food rules with greater frequency, teachers reported more concerns with the content of boys' lunches and food-related behavioural issues in boys. Girls made far more statements about the nutritive value of food and the relationship between diet and health. And girls were far less likely than boys to report rules governing their physical location or bodily movement.

Table 7.3: Frequency of food rules reported by children in each food rule category by gender

	Boys	n	Girls	n
Most frequent	Physical movement	64	Cleanliness	41
	Cleanliness	44	Food restrictions	35
	Noise	42	Noise	31
	Physical location	39	Food prescriptions	30
	Safety	19	Ordinal rules	27
	Food prescriptions	14	Timing	25
	Ordinal rules	9	Physical location	14
	Food restrictions	9	Physical movement	4
Least frequent	Timing	8	Safety	4

Conversely, the majority of food rules reported by boys governed the physical movement and location of their bodies. Boys reported restrictions on their mobility within the classroom and even at their own desks, where they were not permitted to stand up or to "fiddle" or "play" with objects such as their lunch items or water bottles. For the majority, any deviation from the default, such as visiting a friend's desk or going to the washroom, required special permission from a teacher or lunch monitor.

For children of either gender, the issues of cleanliness and noise control pervaded discussions of lunch and snack time rules. Many food restrictions involved controlling the potential for spills and messes in the classroom. Almost all children reported restrictions on the contents of their drink bottles, but children's perceptions of the reasons behind teachers' preference for water were almost universally associated with desktop and classroom cleanliness, rather than health: "if you spill (juice) on your book it will stain your book" (10-year-old girl); "we have to drink water not juice…because if you spill juice it's sticky and it stains" (12-year-old girl). At schools where children were required to snack outdoors, students and teachers expressed concern for the outdoor environment. Both found litter, the presence of wasps near garbage cans, and the presence of gulls unpleasant: "people litter and there's bees…I got stung three times" (10-year-old boy). However children who were required to snack outdoors expressed frustration at the interruptions in their games and activities necessitated by eating snacks and disposing of trash.

Both boys and girls reported restrictions on the volume of noise permitted in their classrooms. The majority of children less than 12 years of age reported being required to eat either in silence (reading or being read to) or engaging in limited, whispered conversation: "no talking loud…you can whisper to your neighbour" (8-year-old boy); "you have to whisper" (8-year-old girl). I observed few instances of whispered lunchtime conversations; children engaged in animated discussions. However I can confirm that teachers frequently and emphatically enforced rules controlling the volume of children's voices.

(iii) Food Rewards

Table 7.4 lists examples of behaviours for which children reported receiving food rewards in school. Small food reward items, such as hard candies, soft chewable candies, and licorice, were given to students by homeroom teachers, substitute teachers, and, occasionally, office staff. At all schools, a significant number of rewards were reportedly given during French-language instruction. The remainder of rewards given for academic work tended to reinforce work habits, and foster competition among students: "if you do a really good story you can go to the office and she'll (secretary) give you a gummie bear and you can read it to her" (8-year-old boy). Students reported getting food rewards "if we answer the most questions or win a game" (11-year-old girl). Food rewards were also given to children for non-academic tasks that foster communication between home and school, such as having parents sign tests and homework planners, and for participation in a range of civic duties within the school context such as fundraising and helping in the cafeteria: "if you get your planner signed (by parents) for the whole month then you also get a treat" (10-year-old girl); "cafeteria helpers get to eat the leftovers" (12-year-old girl); "office helpers and bus monitors get a pizza party at the end of the year" (13-year-old girl).

Table 7.4: Children's perceptions of behaviours for which food rewards are given in school

Category	Quote	Speaker
Academic work: French	"speaking French"	boys and girls, all ages
	"in French she sometimes has little games whoever wins you'll get like candy, a little wrapped up chewy thing"	10-year-old girl
	"if you work hard or get something right in French then she'll give you a candy"	11-year-old girl
	"if you don't get caught speaking English, you get a *bonbon* at the end of the week"	14-year-old girl
Academic work: other	"working independently"	8-year-old boy
	"if you do a really good story you can go to the office and she'll (secretary) give you a gummie bear and you can read it to her"	8-year-old boy
	"you get jujubes for putting one of the new vocabulary words on (the wall)"	10-year-old boy
	"reading"	11-year-old girl
	"getting right down to work"	11-year-old girl
	"if we answer the most questions or win a game"	11-year-old girl
	"working hard"	12-year-old girl
	"we had a pizza party after we were done the EQAO (standardized grade 6 testing)"	12-year-old boy
Non-academic tasks	"if you get your planner signed (by parents) for the whole month then you also get a treat."	10-year-old girl
	"getting your test signed by your parents"	11-year-old girl
Civic duties	"cafeteria helpers get to eat the leftovers"	12-year-old girl
	"if you help out a kid that's in a special class who gets frustrated sometimes"	12-year-old girl
	"for the class that raises the most money they get a pizza party"	12-year-old boy
	"office helpers and bus monitors get a pizza party at the end of the year"	13-year-old girl
Noise	"reading four books and being quiet"	8-year-old boy
	"if we're very quiet"	11-year-old girl
	"working quietly"	12-year-old boy
Cleanliness	"if you pick up the floor and help tidy up or if you listen"	8-year-old girl
	"if you clean up the floor or help (the teacher) she sometimes gives a treat"	9-year-old boy
Observing conventions	"if you ask her (teacher) politely for a pencil she'll give you a candy"	9-year-old girl

(Table 7.4 continued)

Category	Quote	Speaker
	"not shouting out your answer"	12-year-old girl
	"putting up your hand"	12-year-old girl
General comportment	"from our supply teacher...she hands out jelly beans if we be good"	9-year-old boy
	"if you're bad you have to go up and circle a warning on the sheet. But if you don't get any for the whole week then you um get, you can either pick from a bunch of things like computer times but you can also get a sucker."	10-year-old girl
	"if you have a substitute (teacher) and being good"	11-year-old boy
	"we're supposed to get a pizza party for being good, but the teacher usually forgets about it"	13-year-old boy

Noise and cleanliness figure largely in students' descriptions of behaviour which garner food rewards: "if you clean up the floor or help (the teacher) she sometimes gives a treat" (9-year-old boy). Food rewards are also given for general comportment and adherence to social conventions: "if you ask her (teacher) politely for a pencil she'll give you a candy" (9-year-old girl). Students are rewarded for "putting up your hand" (12-year-old girl) and "not shouting out your answer" (12-year-old girl).

7.6 Discussion

(i) Nutrition Messages in Schools

It is immediately apparent that very few of the rules and restrictions around food and beverage consumption in schools are couched in terms of nutrition or health. In the Canadian context, school curriculum requirements fall under the jurisdiction of the provincial Ministries of Education. The Ontario curriculum contains guidelines for nutrition instruction in the areas of healthy eating and daily physical activity (Ontario Ministry of Education and Training 2003, 2005a, 2005b). In addition, children's nutrition has been the subject of recent education policy initiatives aimed at reducing rates of childhood obesity (Ontario Ministry of Education and Training 2004a, 2004b, 2004c). There is little doubt that, at an academic level, positive nutrition messages are being conveyed to children. But it is surprising that these messages are largely absent from children's perceptions of the rules and restrictions governing their lunch and snack times.

Very few children referred to either positive or negative health consequences of consuming certain foods and beverages. Teachers' preference for water over juice was occasionally mentioned in association with either the hydrating effect of water or the negative effects of high-sugar beverage consumption. But the preference for water was overwhelmingly associated in children's minds with issues around environmental sanitation. In some classrooms, the "privilege" of having a water bottle at one's desk was denied or revoked. In many, the use of the water fountain was strictly regulated. The "water bottle issue" is clearly a case where teachers are missing an opportunity to reinforce nutrition curriculum with a broader contextual message about the positive health benefits of proper hydration.

In a similar way, students' knowledge about the negative health effects of "junk" food was at odds with the institutionalized presence of junk food in the schools: "at the cafeteria you have two lines and one is the hot food and the other is like the pop and chips" (11-year-old girl). Not only were students acutely aware of the negative health consequences of poor nutrition, but they associated those negative effects with the availability of junk food in the school: "Say the cafeteria was selling pixie sticks[2]. Um, everybody would be buying like five or six…and they'd be eating them really quick and people would be getting diabetes" (10-year-old girl).

A number of authors have observed school nutrition environments that undermine nutrition and health education. Bauer *et al.* (2004), Neumark-Sztainer *et al.* (1999), and Story *et al.* (2002) report numerous barriers to healthy eating in US schools, including high-fat cafeteria foods, limited availability of vegetables and fruits, and the presence of snack carts and vending machines selling non-nutritious snacks and beverages. Australian students in grades 2-11 cite the availability of junk food and junk food advertising in schools as contributors to poor diet (O'Dea 2003). As Crooks observes: "school is a primary source of information about good nutrition, one that can affect snack consumption outside of school and has the potential to undermine both short- and long-term nutrition goals" (2003: 191). Strategies to improve children's nutrition need to address not only the explicit nutrition messages contained in curriculum but the implicit messages conveyed in the wider school environment.

(ii) Controlling Children's Bodies and Behaviour

The array of rules and restrictions addressing children's location, movement and noise levels suggest that teachers and staff require children's comportment during snack and lunch times to closely mirror that of the larger school day. The majority of children sit in desks, in rows, in their classrooms during school meals. Their movements and the volume of their voices are closely regulated, thus limiting the degree of social interaction possible during meals. In contrast, children view snack and lunch times as highly social occasions. The rules governing their bodies impinge on their stated desires to move and vocalize freely.

[2] "Pixie sticks" are plastic straws full of sugary candy.

The social norms around meals are highly ritualized and differ widely between families and communities (Douglas 1997). Schools and other institutions impose restrictive conditions on dining that are not present in the home. Meals and snacks are timed, supervised, and take place in physical settings quite unlike those experienced elsewhere. Children, not surprisingly, seek to replicate aspects of the dining experience that are possible within the bounds of the institutional environment. Activities such as conversation, discussion, food sharing and experimentation represent attempts by children to normalize the institutional meal experience. Requirements to read or be read to during lunch were viewed negatively by students as efforts by teachers to keep classrooms quiet, rather than provide a pleasant atmosphere. While some children expressed complaints about the level of noise during lunch, the majority found noise rules intrusive and expressed a desire for social interaction and conversation.

The rules governing children's bodies limit their ability to engage in the social interactions which are the norm for adults and children outside the institution. Paradoxically, teachers at the study schools did not themselves experience the institutional restrictions imposed on the children. After supervising students' lunches, teachers left their classrooms and ate lunch in communal staff rooms, engaging in the highly social behaviours of conversation, discussion, food sharing and experimentation.

Analyses of institutional regulation of children's bodies have not addressed the role of meals in social control and social reproduction. Willis (1977) and Haydon (1997) examine the role of schools in shaping a productive and disciplined workforce. Christensen and James (2001b:214) describe school as one of a number of "socializing structures that will both foster children's autonomy, as well as their ability to conform." While school is undoubtedly a site where the individual and civic identities of children are contested, research of this nature has largely focused on the instructional environment. To date there has been less emphasis on the role of the non-instructional school environment in the production and reproduction of normative values.

According to the 1904 Elementary Code, "health education, social development and sound discipline would implant in the children habits of industry, self-control" (Haydon 1997:104-5). These goals were explicitly linked to the goals of increasing economic competitiveness and viability in developing world markets. Elementary education was universalized, or offered to children of both sexes, with the express goal of broadening the pool of available productive labour. In the present study, the work habits rewarded are those which foster speed, "getting right down to work" (11-year-old girl), and diligence, "working hard" (12-year-old girl), qualities echoed in workplace demands for productivity (Willis 1977). Food rewards are given to students who "work independently" (8-year-old boy), a practice which may discourage children from asking the teacher for help. Competition is encouraged and winning individuals and groups are rewarded. Through these processes, food (primarily sweets that comprise the majority of food rewards) becomes associated with qualities that are highly valued both within and beyond the school: productivity, independence, competition, achievement and success.

There are both individual and group elements to the control exerted by teachers through the use of food rewards. On an individual level, foods serve as incentive to normative behaviour and as disincentive to non-normative behaviour. Substitute teachers in particular offered numerous food rewards. There is evidence that the subordinate professional status of substitute teachers is communicated to children and their parents (Weems 2003). It is likely substitute teachers resort to food incentives to achieve status and control in classrooms. Individual food rewards were also commonly dispensed by French teachers. In these English-language rural schools, French-language instructors face numerous challenges to child and parental engagement, not the least of which is significant geographic distance from a Francophone population centre. French is simply a tough sell, and French teachers appear to be frequent users of food as incentive.

At a group level, students' behaviour is frequently managed by food. Teachers of all subjects encourage peer-discipline by offering food rewards such as pizza parties for overall classroom comportment. Many link individual behaviour or achievement with group outcomes, by tools such as star charts or point systems. These tools are visibly displayed within the classroom, and the students exercise peer discipline on students whose columns fail to contribute to the aggregate. In some cases, food rewards are offered for circumstances beyond the student's control, such as the signing of planners or tests by parents. Similarly, the removal of items from a child's lunch may subject the child to discipline or reproof for circumstances beyond his or her control. Such actions on the part of teachers represent attempts to extend teachers' authority beyond the classroom and into the household or community.

While time did not emerge as a constraint on children's mealtime behaviour in this study, it is certainly prevalent in the literature on school nutrition. Children and adolescents report that time restrictions limit their ability to purchase healthy cafeteria entrees and force them to purchase less healthy, convenience foods instead (Bauer *et al.* 2004; Neumark-Sztainer *et al.* 1999; O'Dea

2003). It is possible that young children in this study are socialized to the institutional limitations on their snacks and meals to the degree that they do not consider time a variable in their experiences.

(iii) The Role of Teachers

The use of food rewards by teachers has been documented by Kubik *et al.* (2002). In a survey of 490 elementary school teachers in Minneapolis-St. Paul, 73% of teachers reported using candy as incentive or reward for student behaviour. Other commonly used food items were: doughnuts, cookies, pizza and sweetened beverages. Female teachers tended to use food rewards more frequently than male teachers. By subject area, teachers of health-related curriculum, such as physical education and health, were the least likely to use food rewards or incentive. The use of rewards was negatively associated with years of teaching experience, suggesting that younger, less experienced teachers more commonly resort to food-related incentives or controls on children's behaviour than their older, more experienced colleagues.

Kubik *et al.* (2002) also observed that elementary school teachers, in general, do not role model healthy eating at school. In the Minneapolis-St. Paul study, teachers reported unhealthy cafeteria purchases and frequent vending machine use. In the present study, school administrators reported that soft drinks had recently been removed as a beverage option in school vending machines. Observation proved that this was indeed the case in school lobbies, where the machines were accessible to children. However soft drinks remained for sale in staff room vending machines. I observed that soft drinks were frequently purchased by staff and consumed in the classroom in front of children. In addition, I observed two occasions where teachers permitted students to purchase soft drinks from the staff room vending machines.

(iv) A Gendered Environment

In this study, there was little emotional reaction by children to the rules governing their bodily and vocal expression, suggesting these rules are longstanding and representative of institutionalized controls on children's, and especially boys', bodies. There was a significant gender disparity in the type and frequency with which these rules were applied. Boys reported significantly more restrictions on their physical movement than girls. Boys reported more instances of discipline during school meals and were the target of teachers' concerns regarding the content of their lunches.

Haydon (1997) traces the historical roots of universal education in the UK and finds gendered notions of pedagogy that are reflected in current education practices. School has historically provided a form of "domestication" that is directed at taming boys' bodies. As late as 1975 in Britain, curriculum reinforced stereotypical values of "gender-appropriate" roles and responsibilities, preparing boys for full-time labour and girls for menial or domestic work (Haydon 1997; Corteen and Scraton 1997).

Much has been written about the persistence of gender bias in British, North American, and Australian schools (Bannister 1993; Briggs and Nichols 2001; Connell 1989; Frank 1991a; Goldstein 1987; Hasbrook and Harris 1999; Sargent and Harris 1998). In a particularly poignant ethnographic example, Jordan and Cowan (1995) describe the institutional suppression of kindergarten boys' definitions of masculinity: through socialization to the school environment, boys "warrior narratives" are replaced with a public-sphere masculinity of rationality and responsibility (Jordan and Cowan 1995:739). Current teacher education texts contain images and text that perpetuate gender stereotypes (Zittleman and Sadker 2002). And while children's exposure to gender bias is not limited to the school setting (Messner 2000), school is a site where gendered treatment of boys and girls becomes institutionalized and normalized.

In this study, mealtime rules about bodily movement and comportment are a powerful illustration of the institutionalization of gender stereotypes. While the rules around physical movement and noise are purportedly the same for both boys and girls, boys appear to have much more difficulty adhering to them. Accordingly, the rules are reiterated and reinforced more frequently for boys. Boys are disciplined for violating the rules more frequently, and teachers are more likely to anticipate behavioural problems in boys. Girls, meanwhile, are largely exempt from this form of discipline, thus reinforcing their "self-control" and non-physical play.

Despite recent increases in the number of male teachers, the overwhelming majority of elementary school teachers are female (Kovařík 1994). Messner (2000:779) describes school as "an environment where mostly women leaders enforce rules that are hostile to masculine fantasy play and physicality." The effect is to create an environment in which both boys' and girls' physical behaviour is "domesticated" or controlled. These expectations are communicated by the verbal and non-verbal language of teachers and, eventually, the children themselves, forming a *gendered climate* at school.

More frequent reports of food prescriptions and proscriptions among girls are likely associated with this gendered climate, in which academic performance is linked to gender identity. I would suggest that, in this domesticated climate, girls themselves are socialized to expect higher academic performance than they do from boys. Their responses associating food with health may be an attempt to please, to provide the "right answer" to the researcher. This process may constitute a form of researcher bias based on the gender of participants which is extremely difficult to control. Alternately, it may be the case that curricular health messages are less well received by boys due to the repetitive association between food and their behaviour at school.

To date there is limited evidence for biological effects associated with these processes. I would suggest that this is due to limitations in the theory and methods underlying our research. In order to understand the breadth of influences shaping children's bodies, it may be necessary to step back from our present theoretical positions in health sciences or sociology and widen the scope of our analysis to include both disciplinary perspectives. Although we as researchers understand that children's bodies are biologically and socially constituted, we continue to measure children's growth, development and health in ways that elude complex understandings of the interaction of these variables. Krieger (2005:350-1) observes that much of epidemiologic research is characterized by decontextualized and disembodied bodies. In contrast, an embodied approach explores "how and why historically contingent, spatial, temporal and multilevel processes become embodied and generate population patterns of health, disease and well-being, including social inequalities in health." This biocultural theoretical approach offers the opportunity to create deep understandings of the interaction between culture and biology (Dufour 2006; Goodman and Leatherman 1998). In the larger Bluewater Nutrition Study, I found demonstrable differences in growth (Galloway 2006) and nutrition (Galloway 2007) between boys and girls. The gendered climate observable in the schools may be one component of a larger set of interactions between biology and culture that is shaping these rural schoolchildren's bodies.

7.7 Conclusion

Mealtimes at school are highly anticipated events for two reasons: (1) they give students the opportunity to appease hunger; and (2) they permit students to interact socially. Both of these reasons are extremely important to students because they fall outside the restrictions imposed on their behaviour by the institution of school. However, at school eating and drinking are tightly controlled behaviours. Social interaction and conversation, moreover, are viewed as threats to both productivity and discipline.

The rules and restrictions around children's comportment during school meals illustrate the extent to which teachers and institutions exert control over children's bodies and reinforce gender stereotypes. Even well-intentioned nutrition messages and practices are 'clotheslined' by school food policy as well as preoccupations with environmental cleanliness.

There are significant opportunities for improving the snack- and meal-time environments of children at school. As children themselves articulately suggest, the removal of negative stimuli in the school environment – unhealthy entrees, snacks, and vending machine items – would significantly advance the cause of improved nutrition.

There is a shift underway in studies of childhood obesity away from simple prevalence studies and towards research that explores the wider causes and correlates of childhood obesity. The present study demonstrates the value of ethnographic techniques to provide deeper understandings of the complex social and cultural systems underlying biological phenomena such as poor nutrition and obesity.

7.8 Afterword: Child-Centred Research on the Environmental Determinants of Nutrition and Growth

(i) Introduction

Christensen and James (2001a) have observed that much of the research on children is done without consulting them. While there is merit in observational studies of children's environment, these lack the richness of studies that seek to incorporate children's perspectives.

In 2004, Carter and Swinburn 2004 conducted research in New Zealand primary schools in order to determine whether factors in the school environment were contributing to high prevalence of childhood obesity. The researchers gathered data on physical, economic, policy and social factors in the school environment: whether schools provided foodservice; whether foodservice was run by the schools or by for-profit private companies; what rules existed around food sales and consumption; and what were the attitudes and perceptions of school administrators toward nutrition and healthy eating? Similar studies have documented schoolwide food practices that support frequent snacking and the consumption of high-calorie beverages (Kubik *et al.* 2005). The research is extremely useful in describing the policy and programs currently in place in schools, including nutrition and health curriculum and school health services. Crooks (1999a) has examined the paradoxes inherent in the sale of non-nutritious snack and lunch items at school in a high-poverty community where: (1) children often do not get enough to eat at home, so school kitchens need to serve foods that children will eat; and (2) the lack of school operating funds necessitates the sale of foods as a fundraiser to support school revenue. Other studies have documented factors in the policy environments of US schools which contribute to childhood obesity, including state and federal regulation and funding of school breakfast and lunch programs and the legislated use of commodity foods in support of US farming (Story *et al.* 2006).

Despite their focus on the school food environment, many studies of school nutrition do not include data on children's experiences. The results of the present study lead me to wonder whether children's perceptions of the school environment may be very different from those of school administrators. While adults, especially those in positions of authority, often "talk a good diet" (Eck *et al.* 1989), they may be reflecting desired or exemplary models of food policy and action rather than on-the-ground reality. Children themselves may have experiences that are qualitatively different from those of adults. McGarvey *et al.* (2006) assert that these experiences can be revealed through ethnographic research with children in order to inform obesity prevention programming. Such ethnographic work will undoubtedly reveal the significant influence of peer social relationships on school nutrition.

(ii) The Social Worlds of Children at School

After the family, school is perhaps the most significant social institution in children's lives. Research with children in the context of school plunges the researcher into the midst of numerous social relationships that are of great significance to children. This chapter has already alluded to the often-overlooked effect of research on children's relationships with adult authority figures at school, such as teachers and principals. Even less studied is the effect of research on children's peer relationships at school, and the impact, in turn, of those relationships on the research itself.

There is a large literature on the sociology of schoolchildren. Studies have illustrated the importance of children's social interactions (Alanen 2001; Bardy 1994; Belle 1989; Berndt 1989; Bryant 1989, 1994; Cochrane and Riley 1988; Näsman 1994; Nestmann and Niepel 1994; Warde 2001; Youniss 1994) as well as the complexity and nuance of communication among children (Donaldson 1986; Opie and Opie 1992). Numerous researchers claim that peer relations are the most significant component of a child's socialization to school (Hirsch and Dubois 1989; Mayall 1994; Oswald *et al.* 1994; Salzinger and Hammer 1988).

In terms of overall quality of life, the social networks of children appear to have a significant impact on well-being. Children's peer relations at school have been correlated with self-esteem (Blyth and Traeger 1988) and the ability to cope with psychological stress (Sandler *et al.* 1989), as well as grade point average and academic completion rates (Antrobus *et al.* 1988). Despite the widespread recognition in the sociological literature of the importance of children's social networks at school, the majority of the literature on school-based research fails to mention peer relations.

Given the significance of socialization to schoolchildren, it is inevitable that food and nutrition practices in schools will affect children's social interactions and, in turn, social processes will have an impact on children's nutrition at school. Ulijaszek (2007) has observed that studies of the environmental determinants of obesity lack analyses of the social processes which act within population groups to confer protection from obesity risk. Children, as social actors, certainly exercise cultural coherence in the sense Ulijaszek describes: they share common values and opinions about food and body size that develop over the course of their association with social groups. Although food marketing and promotion, and food availability are influential arbiters of children's consumption, children make food choices that demonstrate their identity and exercise conspicuous consumption in public settings just as adults do (Campbell *et al.* 2006): "children ask for these foods because children want to be like everyone else" (Crooks 1999b). While children may have limited control over the contents of their lunches, the actual consumption of foods in largely left to them. Children trade, barter and negotiate lunch items with peers. They dispose of undesired items. One school janitor told me during the research that classroom garbage cans contain many uneaten apples.

(iii) Body Image and Self-Esteem

An issue that arises from the social experience of children is that of body image. Children's perceptions of body size, their appraisals of and satisfaction with their own bodies arise from myriad factors in their social worlds. Though the production of body image in children is not well understood (Davison *et al.* 2003; Hayden-Wade *et al.* 2005), it is clear that children internalize societal notions of the acceptability of various body types. In a study of 3rd- to 6th-grade children, 50% expressed a desire to be thinner than their present size (Schur *et al.* 2000). Children as young as three years of age express a preference for thin body silhouettes, and ascribe negative qualities to images of overweight children (Cramer and Steinwert 1998). In a study of 5th- and 6th-graders, Latner and Stunkard (2003) found that children rated images of obese children lowest on a forced preferment scale.

Children's preference for thin bodies has enormous implications for their health. Children themselves may internalize a preference for a body type that is at odds with their own biology. In a longitudinal study of body satisfaction, Davison *et al.* (2003) found that girls' weight concerns at ages 5 and 6 years were significantly associated with their dietary restraint, eating attitudes, and likelihood of dieting at age 9. As extreme dieting and maladaptive eating behaviours such as binge eating and vomiting tend to emerge during adolescence (Davison *et al.* 2003), the identification of weight concerns in young children is critical.

Children may also exercise their preferences for thin body types by projecting their attitudes outward. Comparative research has shown a dramatic increase in the stigmatization of obesity among children over a 40-year period (Latner and Stunkard 2003). Recent studies demonstrate that teasing, bullying and peer victimization are routinely experienced by overweight children (Hayden-Wade *et al.* 2005; Lunde *et al.* 2007). Children report being teased most often by peers, followed by family members such as siblings and fathers. Interestingly, children also reported being called by disparaging nicknames related to both fatness (e.g. fatso, blubber butt, fat-ass) and thinness (e.g. stickman) (Hayden-Wade *et al.* 2005). These studies catalogue the experiences of children but do not go so far as to explore the suffering children experience as a result of teasing or the ways in which children's alter their behaviour as a result of teasing.

In the present study, the range of topics included in focus group discussions with children was limited by ethics board members' concerns over children's self-esteem. I agree with the board members that a focus group may not be the ideal venue for discussions of body image and weight concerns. In focus groups, children remain under the influence of peers who may report their statements to others after the conclusion of the interview. However the issue of body image is a relevant one in this population. It clear from the literature that more work needs to be done in this area (Ball *et al.* 2005; Davison *et al.* 2003; Hayden-Wade *et al.* 2005; Ikeda *et al.* 2006; Latner and Stunkard 2003). I would suggest that the present study has prepared me for ethical and methodological issues arising from school-based research with children on the topic of body size. I would employ interviews with individual children, supported by tools such as silhouettes, photographs and drawing exercises, to elicit children's perceptions of body size and satisfaction among their peers. Older children could make use of more sophisticated technologies (videography, drama) to explore these issues.

Finally, the issue of body image raises a final ethical and methodological issue central to the present study. If body weight and size carry stigma for some children, is it necessary to conduct anthropometric screening in schools? Do the health costs of obesity, which have led to calls for surveillance and widespread obesity screening, justify the possible psychological and social harm done to children who are identified as overweight? These questions are the subject of a recent paper by Ikeda *et al.* (2006), who assert that obesity screening carries with it a long list of potentially injurious implications, including lowered self-esteem for children, increased body dissatisfaction, behaviours such as sneaking and hoarding of food among children, the parental promotion of dieting, and the increased stigmatization of overweight and obesity. The authors argue that school is a location where the negative implications of screening are extremely injurious for children, who bear the constant social pressures of conformity and evaluation. School-based screening can be carried out in ways that are sensitive to the highly socialized environment of children, but only where the school climate is respectful, inclusive and protective of student confidentiality (Ikeda *et al.* 2006). My own experiences in conducting school-based anthropometric measurement demonstrate the challenges to ensuring the privacy and self-esteem of children (see Chapter 4).

(iv) Beyond School

The present study was set in schools. But beyond the tightly constrained school environment, there are other localized environments which interact with children's patterns of nutrition and growth: home, childcare settings, and other sites such as restaurants, arenas, grocery stores and community centres.

The foregoing paper describes processes in the school environment through which gendered notions of nutrition may be embedded in children's biologies. But this process undoubtedly occurs beyond the school environment. "Cultures of eating" are unique to each household. Children and parents report a wide range of food-related rules and practices in the home. There is a substantial literature on food availability in the home and its influence on child nutrition. Hanson *et al.* (2005) found a significant association between girls' but not boys' fruit and vegetable intake and household availability of these food items. There was also a strong positive association between boys' dairy intake and parents' practice of serving milk at meals at home. Other studies have demonstrated a relationship between the dairy intakes of mothers and girls (Grove *et al.* 1999). Children report pressure to eat, eat more, and "finish their plates" (Brewis 2003; Campbell *et al.* 2006; Campbell *et al.* 2007). Parents report rewarding and punishing children with food items or meals (Campbell *et al.* 2007). Food availability and parental intake of certain foods are highly influential in the dietary patterns of children (Campbell *et al.* 2006; Campbell *et al.* 2007; Hanson *et al.* 2005).

The results of the present study lend support to the notion that cultures of eating in rural areas may differ from those in urban locations. Crooks (1998:350) suggests in order to broaden our understanding of rural children's diet "we need to move beyond the school to individual households and then to the communities at large." In a study of families in rural Southeastern Missouri, Bante *et al.* (2008) found that the children of parents who encouraged dietary diversity through encouragement of children to eat new foods were significantly more likely to meet US dietary recommendations for fruit and vegetable intake. Conversely, children of parents who used traditional means of encouraging eating, such as requiring children to clean their plates or take at least one bite of each item on the plate, were less likely to meet dietary guidelines for fruit and vegetable consumption. In a study of rural Mexican children, Brewis (2003) found that mothers perceived feeding a child as an act of nurture. These findings findings, however, may not be specific to rural areas and may apply more widely to North American families. The present study, with its finding of gender differences in obesity prevalence and nutrient consumption, offers an opportunity for further investigation into the role of cultures of eating in rural children's growth and nutrition that may be distinct from urban cultures of eating . Like the present study, the finding of a gender difference favouring lower obesity prevalence in girls has only been observed in rural settings (Brewis 2003; Crooks 1999a).

No other studies to date have examined gender differences in the context of rural environments.

There is a strong gender bias in research on parental and children's intake in the home. The overwhelming majority of studies focus on the influence of mothers on children's intake. Grove *et al.* (1999) report that mothers' intake of high-energy fluids, sweet snacks, savory snacks, and take-out food is positively associated with boys' intake of these items. Mothers' intake of high-energy fluids is positively associated with daughters' consumption of those drinks. Throughout the literature, the influence of mothers is stressed. Mothers are cited as the arbiters of food availability in the home. Their consumption patterns are the focus of much research, though whether or how those patterns become internalized by children is not problematized. Mothers are blamed for pressuring children to eat, and being overconfident in adequacy of children's diet. Articles labels mothers' actions as "inappropriate feeding practices" (Bante *et al.* 2008) or "likely to promote fatness" (Campbell *et al.* 2006). I would suggest that there is little basis in the literature for the mother-centric focus of the majority of research surrounding child nutrition and obesity. The research community appears to have missed the opportunity to examine the processes inherent in the development of cultures of eating and the theoretical and practical basis for the presumed transference of parents' cultures of eating to children.

Lake and Townshend (2006) urge researchers to look beyond traditional environments such as school and home to examine the influence of the built environment on childhood obesity. Timperio (2005) has documented the influence of the neighbourhood environment on child growth. Parents' perceptions of child safety influence family decisions about whether or not children will walk to school or play in the neighbourhood. It would be beneficial to include children's perspectives in this research, through the use of ethnographic techniques.

(v) Conclusion

The present study, located in schools, permits the exploration of children's experiences of the school food environment. It allows us to examine some of the social processes contributing to patterns of food consumption, nutrition and growth in this population. As Ritenbaugh (1991:180) has observed, the body is created and recreated continually as part of a dialogue between culture and biology: "body shape speaks, bodies talk back, and the dialogue is interpreted in a variety of sociocultural contexts."

Children's bodies emerge within a rich social environment that is constantly exchanging influences with biology. While the present research affords us a glimpse of that process as it exists in school, portions of the process were not explored; for example the influence of peer social relations and self-esteem issues associated with body weight and size. In addition, other aspects of children's lives, for example cultures of eating in the home, offer opportunities for the exploration of environmental influences of growth and nutrition.

Chapter 8 Conclusion

8.1 Introduction

In conclusion, this chapter provides a summary of the present research and its findings. I will evaluate the results of the research in terms of the research questions and objectives established at the outset, as well as the contribution of findings to the literature on rural child nutrition and childhood obesity. I will comment on the theoretical basis of the research and the contribution of findings to biocultural studies of child nutrition and growth. I will conclude this chapter with suggestions for future directions for school-based research on child growth and nutrition.

8.2 Evaluation of Objectives

The present study had four main objectives, stated at the outset. This section discusses the extent to which the study objectives were met:

Objective 1: To evaluate the growth and nutrition status of a sample of rural Canadian schoolchildren.

Anthropometric measurements were completed for 504 children (253 boys and 251 girls) and compared to an international growth reference (Kuczmarski *et al.* 2002). Mean height and overall mean body mass index were significantly greater than that of the reference sample. The prevalence of overweight (18%) was significantly greater than the reference standard for both boys and girls. There was a significant difference in obesity prevalence between boys (15%) and girls (7%).

Dietary recalls were conducted with 352 children (170 boys and 182 girls). Mean daily servings of all four Canada's Food Guide food groups were below the recommended number of servings. Proportions of children with inadequate servings were high. Boys consumed significantly more servings of grain products and meat and alternatives than girls.

Among all children, mean daily consumption was low for most nutrients including calcium, magnesium, phosphorus, potassium, zinc, and total folate. Boys had significantly greater mean daily intake of energy, protein, carbohydrate, fat, calcium, iron, phosphorus, and sodium than girls. Boys were significantly less likely to consume inadequate iron than girls.

In all, food recalls demonstrated generalized nutrient inadequacy among both boys and girls that reflects the general trend in North American children's diets (Moffat and Galloway *in press,* Veugelers *et al.* 2005). The gender differences in nutrient consumption are less commonly observed (Crooks 1999a, 2000) and may reflect cultural factors operating in rural Canadian communities.

Objective 2: To explore the school context of children's diet and nutrition.

The present study included focus group interviews with schoolchildren. A total of 144 children (72 boys and 72 girls) took part in 37 focus groups. Led by the investigator, these 20-minute open-ended discussions explored issues surrounding school meal- and snack-times, as well as more general food and nutrition policy in schools. Children described a wide array of rules and restrictions surrounding the consumption of food and beverages in schools. Few of these rules related to nutrition curriculum; rules were more closely related to a school culture of discipline, cleanliness and quiet. Children, especially boys, evinced a strong sense of bodily control, including restrictions on their physical movement and verbal expression during school meals. Gendered notions of the body may influence children's experiences of the school nutrition environment and contribute to gender variation in diet and growth in this rural population of children.

Objective 3: To build knowledge useful for the development and implementation of nutrition policy and programs.

The applied nature of the present study arises from the goal of providing data suitable for the use of community partners planning and implementing nutrition policy. As discussed in Chapter 6, staff of the Grey Bruce Health Unit sought local data on children's diet and obesity prevalence in order to inform local initiatives directed at improving child health. The Bluewater District School Board nutrition policy was extremely vague and lacked the scope to deal with emerging provincial government recommendations to improve school nutrition programs.

The present study was well-received by both community partners as it provided local-level data on children's diet and obesity prevalence. Dissemination of findings assisted with local initiatives targeting school food sales and fundraising and lent support to public health and community school breakfast initiatives. Findings also filled gaps in epidemiologic data on obesity rates in Grey-Bruce, which to date included only data on adults.

Objective 4: To conduct nutrition workshops with children and parents in school and community settings.

With respect to children, this goal was amply accomplished through the presentation of workshops on healthy growth and nutrition to over a thousand children in the Bluewater District School Board. Child participants were both engaged and informed by a series of interactive demonstrations in which issues surrounding growth and nutrition were discussed.

With respect to parents, this goal was only partially accomplished. School administrators felt that information was best distributed to parents through both the newsletters and the existing structure of school community councils. Although council meetings where I spoke were well-attended and parents appeared engaged and informed by the research, I had the sense that I was "preaching to the choir." It appeared that meetings were attended by parents who had sincere and pre-existing interests in healthy eating and school nutrition policy. Certainly many parents did not elect to attend the workshops and those that did appeared well-informed on issues such as school nutrition policy and the Canada Food Guide to Healthy Eating. It is possible that parents' prior relationships with the school or school council, or the role of the council as policy advisor to the school, were off-putting to some parents.

A second parent organization exists at schools. Home and School[3] is a private organization, not funded by the Ontario Ministry of Education and Training, and therefore operates at arm's length

[3] The Ontario Federation of Home and School Associations was formed in Toronto in 1916 (Ontario federation of Home and School Associations 2007). Throughout much of its history it was a small organization attracting few

from the school's jurisdiction. Due to the separation between these organizations, I did not approach Home and School regarding parent workshops. However it is my sense as a parent that there are greater numbers of parents who are members of Home and School. It may be useful in future to reach parents through an arrangement with this organization.

8.3 Discussion of Research Questions and Contribution to the Literature

The present research explored three research questions, which raised a number of issues around child growth and nutrition in this rural community. The following is a summary of the issues raised during the course of this study, and their significance in terms of the wider literature:

Research Question 1: What is the prevalence of overweight and obesity in this sample? How do those results compare with findings from other studies?

The present research was a cross-sectional study of child growth in a mid-sized sample of rural Canadian schoolchildren. The collection of data on rural Canadian children represents a significant contribution to the literature on child growth and nutrition, most of which has been based in urban settings (Evers and Hooper 1995; Johnson-Down *et al.* 1997; Moffat *et al.* 2005). In addition, the study design allowed for directly-measured data, which is superior to the self- or parent-reported nature of the majority of national-level growth data on Canadian children (Tremblay 2004).

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members as the majority of schools each operated independent parent-teacher associations (PTAs). During the early 1990s, Ontario Premiere Michael Harris uncoupled PTAs from schools by discontinuing their funding, creating in their place the current School Council organizations. The response by parents has been a widespread boycott of School Councils and the subsequent flourishing of Home and School memberships. My sense is that the relationship between the two bodies is tenuous and politically charged.

The results of anthropometry indicate that while body mass index z-score is significantly high (indicating greater obesity prevalence than in the reference population), obesity prevalence found in the present study is not significantly greater than that found in Canadian and US studies. However the gender distribution of obesity prevalence is different, in that boys are at significantly greater risk of obesity than girls. This finding is of interest as it builds on a literature which has to date been inconsistent. While gender differences in obesity are common among adults, they are less so among children. It is only in rural North American communities that gender differences in obesity have been observed among children: Crooks (1999a) found greater obesity prevalence in rural boys compared with girls living in rural Kentucky. The present study, with its exploration of cultural processes in schools, offers insight into factors in the environment that might lead to varying "local biologies" among rural boys and girls.

While cross-sectional studies are the norm in growth research, a longitudinal cohort model would permit closer analysis of the variables underlying the gender differences in growth observed here. Through methods such as semi-annual measures of growth, it would be possible to observe fluctuations in the trajectory of growth as it plays out over the course of childhood. It is possible that children are especially vulnerable to changes in the nutritional environment during particular phases of development. It is also possible that a longitudinal study may reveal variations in growth between genders at different phases of development. The interaction between observable biological phenomena, such as stature or BMI, and patterns of nutrition, is of significant interest to those of us seeking to understand the phenomenon of childhood obesity.

Research Question 2: What are the results of nutritional analysis in this sample? How do those results compare with recommendations from Canada's Food Guide to Healthy Eating (Health Canada 1997) and to the Dietary Reference Intakes (Institute of Medicine 2000)?

The present study is a valuable contribution to the literature on dietary intake in rural children. Little is known about the dietary patterns of rural Canadian children as the majority of dietary studies are done with urban populations. Children reported inadequate intake in all four food groups. However prevalence of inadequate nutrient intake was higher than expected. In fact, prevalence of nutrient inadequacy exceeded 50% for magnesium, phosphate, Vitamin A, niacin, Vitamin B6 and total folate, although there are limitations on the interpretation of these results (see Chapter 5). Boys consumed significantly more servings from the grain and meat food groups than girls. While mean daily intake of fibre and micronutrients was equally low for both boys and girls, there were significant gender differences in nutrient intake, with boys consuming greater energy, protein, carbohydrate, calcium, iron, phosphorus, and sodium than girls.

Thus far, gender differences in nutrient intake have been observed only in rural studies of children, raising questions about the environmental factors that may contribute to gender differences in eating among rural children. Despite finding gendered application of food rules in schools, the present study does not adequately answer the question of why rural boys appear to be consuming more energy and protein than girls.

Part of the issue may be methodological. Repeat measures of dietary intake could improve upon the methodology used here. Daily nutrient intake data is most accurate when constructed from averages of multiple dietary recalls (Domel Baxter *et al.* 2002; Domel 1997; Domel *et al.* 1994; Dwyer *et al.* 2003). Ideally, a long-term research model would reveal changes in children's dietary patterns with age and over time.

The issues raised in focus group discussions regarding gendered notions of control and discipline over children's bodies leads me to question whether there are similar processes or cultures of child feeding at work in homes. Does an emphasis on competitive sport (such as hockey) in boys lead parents to provide greater calories for boys, for example? Are there vestiges of farm culture in rural communities in which gendered patterns of child feeding are perpetuated? Are societal concerns with thinness among girls and women leading parents to exercise restraint in feeding girls, or are girls themselves exercising dietary restraint? How do these processes interact with socioeconomic status, which has been demonstrated to be a key component of the interaction between obesity and gender? To date these questions have not been addressed in rural populations.

Research Question 3: How do conditions in the school environment affect children's nutrition and growth? Do food-related policies, rules and practices in the school environment support the curriculum objectives of communicating positive nutrition messages from Canada's Food Guide to Health Eating (Health Canada 1997)?

Research question 3 was addressed through focus group interviews with children. Questions explored aspects of school meal and snack programs as well as the range of food-related rules and restrictions experienced by children at school. Qualitative analysis of school mealtime practices revealed a number of factors that may be counterproductive to the goal of providing positive nutrition messages at school. Among these were the sale of non-nutritious snack and lunch items and beverages in schools, food rules and restrictions which foster cleanliness, organization and productivity rather than health, and the social aspects of mealtimes in school. The rules and restrictions are imposed in a gendered fashion, creating a gendered climate in which school and societal stereotypes about boys' and girls' behaviour are normalized. In addition, food rewards constitute an important avenue for the communication of values and norms around food and children's behaviour.

8.4 Biocultural Studies of Child Growth and Nutrition

The present study has fallen victim to a dichotomy of assumptions about biocultural research. McElroy (1990:253) observes that the rigors of human biological research make it difficult for researchers to collect adequate "cultural" data: "cultural variables become operationalized differently depending on...how conveniently ethnography can be carried out." The tiny corner of children's experience that I have examined – that of their nutrition experiences during school snacks and meals – may be described as too narrow in its focus. Early reviews of the focus group data have brought comments on the lack of breadth of discussion, and the omission of questions pertaining to children's perceptions of body image and weight. However the breadth of focus group discussion was severely curtailed by ethics restrictions which prevented discussion of issues such as body image and perceptions of ideal weight and body size. I would argue that I have examined the subject of school meals thoroughly, from a child-centred perspective, and using theoretical constructs that permit deep, contextual understanding of the effect of gendered notions of authority and power on children`s bodies and school mealtime experiences.

In contrast, critics of biocultural studies have decried the lack of biological data supporting descriptions of cultural process (Cartmill, in Goodman and Leatherman 1998:7). The same is true for the present study. The comments of biologically-oriented reviewers have been critical of the small sample size of anthropometry (n=504) and dietary intake (n=364) data sets, and the lack of repeat dietary recalls. With an increase in sample size to the range suggested by reviewers (n=2000) and dietary recalls conducted three times in the school year, I would have been unable to collect the qualitative data so valuable to a biocultural understanding of the influence of the school environment on diet.

I believe others working from a biocultural perspective encounter similar criticisms of their research. However biocultural frameworks persist as theoretical structures for research because there is sincere commitment on the part of biological anthropologists to contextualize biology within its environmental milieu. The sense that biology is predictable from its historical and social antecedents is intuitive for many, and the biocultural paradigm, despite its unwieldiness, is best suited to these analyses.

Where the present study is weakest theoretically and methodologically, I believe, is in linking the societal and institutional influences observed in schools to children's biologies. I have demonstrated that rules and restrictions around food and eating in schools are communicated to children. But what is the actual process through which these social constructs become embodied? Perhaps children are making food selections that enable them to eat quickly in the time-sensitive environment of school. Or it may be that boys are more conscious of authoritarian constraints on their bodies and respond to them by ingesting high-energy foods quickly. Perhaps children lack the opportunity for experiential nutrition education or the application of nutritional concepts in their daily lives. Or it may be that school represents an environment where pre-existing patterns of diet are reinforced by a dominant school culture that emphasizes productivity and discipline over health and nutrition. The present study does not incorporate analytic methods suitable for exploring these hypotheses, such as observation of children's school meals, analyses by school meal, and comparisons of dietary intake in and out of school to determine whether the school setting influences meal choices. These methods would complement the present study by bridging the gap between children's perceptions and actions.

The process of embodiment is a dialectical one that results from "cumulative interplay between exposure, susceptibility and resistance" (Krieger 2005:352) to factors in the environment. Schell (1997) observes that exposure is not equally allocated; health risks can arise from unequal exposure to adverse aspects of the environment. By the same token, susceptibility varies among individuals, depending on antecedent characteristics and conditions. These epidemiologic concepts may be useful in describing the processes through which the school environment influences children's biologies. Future research in this area will explore these processes in greater detail, employing concepts such as Schell's (1997) risk focusing hypothesis, which focuses on the cumulative impact on health of environmental conditions that operate both within the lifetime and inter-generationally. Through depth interviews with children and family members, I will explore the process of how ideas about nutrition, child-feeding and body size are communicated within families and across generations.

A final type of analysis that may offer future insight arises from Dressler's (2001) concept of cultural consensus. According to Dressler, individuals will alter their behaviour in order to conform to societal norms and expectations. This process has also been described by Ulijaszek (2007). It may be that children consciously or unconsciously pattern their food consumption to reflect societal expectations. This concept offers a pathway by which girls' and boys' diet and growth could differ according to environmental stimuli. According to Dressler (2001), cultural consonance may at times collide with structural constraints on behaviour. This may be the case for children, whose agency may be constrained by household, peer and institutional structures in their environment. Future research on children's social worlds could explore the differential contribution of competing social forces in children's environments.

8.5 Future Directions

Public health officials are currently puzzled over the limited success of school-based nutrition and obesity prevention programs. Despite an enormous expenditure of resources in both Canada and the US, the results of obesity prevention programs remain extremely modest. Fifteen years after its implementation, the US 5-a-Day program has made no inroads into American students' fruit and vegetable consumption (Guenther *et al.* 2006). In a review of 57 randomized control obesity prevention trials, Thomas (2006) finds only four studies that report significant outcome measures for intervention groups (Thomas 2006).

The present research provides helpful insights into the limitations of school-based programs as they are currently conceived. My experiences accessing the schools through administrators illustrate the challenge of getting teachers to "buy-in" to nutrition programming. Under the current constraints of scheduling, classroom commitments, preparation time commitments and playground supervision obligations, many teachers have little desire to expand their workload to incorporate programs for which they receive no additional compensation. In addition, the current system of classroom rules and rewards surrounding food and children's bodies is deeply ingrained in school culture, indeed much of it stems from institutional and societal patterns of interaction that are difficult to change. Gendered forms of behaviour on the part of both adults and children in school ("good girls and bad boys") make it difficult to target large groups of children with nutrition interventions.

The challenge of developing school-based nutrition and obesity prevention interventions that really will work requires the application of knowledge from broad fields. A new goal for me is to assist policy-makers to act on the results of this research. Knowledge of children's experiences of the food environment in schools, coupled with data on their growth patterns, can inform nutrition and activity programming in Ontario schools.

This is certainly a worthwhile goal. Rural schools especially may benefit from an analysis of the interaction between biology and the school environment. There may be cultural processes, at home and at school, that are unique to rural communities and that are to date understudied. Canada's increasingly urban population is drawing municipal tax revenues to urban centres, a process that will produce further socioeconomic decline in rural communities in coming years. It may be crucial to investigate the effect of rural cultures of eating on children's growth since nutrition and health measures are poorest in high poverty communities.

8.6 Conclusion

It has been my great pleasure to follow in the footsteps of auxological and nutritional anthropologists in conducting a school-based study of child growth and nutrition. Using a biocultural theoretical framework and drawing on concepts from cultural and medical anthropology, this work begins what I hope will be a long a fruitful research career investigating the health and growth of rural children. It is my firm belief that a holistic view of anthropology, and a multidisciplinary approach to both theory and method, provides the breadth of scope necessary to understanding the complexities of human health. At the close of this thesis, I finally feel prepared to begin, rather than end, this work.

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APPENDICES

Appendix 1 Letter of Introduction and Consent Form for Child Participant

(on McMaster and Bluewater District School Board Letterheads)

Dear Parent or Guardian:

My name is Tracey Galloway and I am a registered nurse and researcher at McMaster University working in partnership with (name of school). I am writing to ask your permission to allow your child to participate in a study about nutrition. The purpose of the study is to understand how school programs affect children's nutrition and activity.

During the study, which will take place from January to June 2004, I will ask your child to participate in the following activities:

1. Have his or her height and weight measured.

2. On one occasion, tell me everything he or she ate the day before.

3. On one occasion, tell me what physical activities he or she has participated in during the last week.

4. Have a discussion with other students about the food and activity programs available at their school. Questions will focus on where and when students eat and participate in activities at school. An audio recording of this discussion will be made. Participating students will not be identified by name, and the recording will be destroyed after written notes have been made from it.

All of these activities will take place during class time.

Your child will be asked for his or her verbal permission each time we meet. If you and your child agree to participate in the research and then at a later date change your mind, your child is under no obligation to remain in the study. All of the information collected so far will be destroyed and no more questions will be asked of your child. The decision whether or not to participate in this study will have no effect on your child's grades.

Because come children may be sensitive about their weight and height, I will make sure they are measured in privacy, in an empty room at the school. They will only be asked to remove their shoes. A research assistant will assist me by recording measurements. All of the information collected will be nameless. Codes will be used instead of names and only I will have access to the identification of the children.

In September 2004 the school will send out a newsletter describing the results of the study. Information on child growth and nutrition in your community will be presented to children and community groups in October and November 2004.

I am asking for you to give permission for your child to participate in the hope that we can learn more about how local children are eating and growing. In order to learn as much as we can about the range of children's nutrition, we want the study will include children from a wide range of rural, town and small-city communities in Grey-Bruce, and from Canadian-born and non-Canadian-born families of different religious and cultural backgrounds.

We do not know much about the state of school nutrition in Canada. It is important that we have this information when setting nutrition policy. It is also hoped that your child will benefit by thinking and talking about what they eat and when they exercise.

If you have any questions or concerns, you can contact me, Tracey Galloway, at:

Department of Anthropology
McMaster University
Hamilton, Ontario L8S 4L9
(905) 525-9140 ext. XXXXX
sampleemail@serviceprovider.ca

This research has been reviewed and approved by the Bluewater District School Board, by the principal of your child's school, by the Grey-Bruce Regional Health Unit, and by the McMaster Research Ethics Board. If you have any concerns about your child's involvement in the study, you may contact:

McMaster Ethics Board Secretariat
C/o Office of Research Services
McMaster University
(905) 525-9140 ext. 23142
srebsec@mcmaster.ca

Thank-you,

Tracey Galloway MA, BScN, RN

Permission Form

Please detach this page and sign the following statement, and then return this form to your child's teacher.

Child's Name ________________________________

Child's Date of Birth (year, month, day) ____________________

Grade _________

Parent/Guardian's Name ___________________________________

Signature _________________________ Date __________________

Please Check One:

☐ **I give permission** for my child to participate in this McMaster University research study.

☐ **I do not give permission** for my child to participate in this McMaster University research study.

Optional:

☐ As a concerned parent, I am interested in being interviewed about my feelings on school nutrition. My telephone number is _____________

Please return to your child's teacher by November 14, 2003

Appendix 2 Letter to Parents Regarding their Children's Participation in Anthropometry Re-Measure

__ June 2004

Dear Parent or Guardian,

As part of the nutrition study at your school your child had his/her height and weight measured today. I performed the measurements using a measuring board and electronic scale in private with my research assistant, Korri Ellis, present to record the measurements.

In order to assess the accuracy of my measurements, I measured 10% of children a second time. Your child was included in this 10% and was therefore measured twice today, rather than once. I want to assure you and your child that the children measured twoce were *randomly selected* and not selected on the basis of their height or weight.

I wish to express my thanks to your child for participating in the study and for helping me test the accuracy of my equipment.

Should you have any questions about this portion of the research, feel free to contact me at any time.

Tracey Galloway
Department of Anthropology
McMaster University
Office (905) 525-9140 ext. XXXXX
Home (519) 349-2455

Appendix 3 Letter to Parents Regarding their Child's Participation in Focus Group

__ June 2004

Dear Parent or Guardian,

As part of the nutrition study at your school your child was randomly selected to take part in a focus group on school nutrition today. In each focus group, five children met with me and held a brief (15-20 minute) discussion about snacktimes and lunchtimes at the school. No personal questions were asked, and the children were asked to share information only about general school practices. For example, the children were asked where and when they eat, what they like about lunch and snack time, and whether they feel they have enough time to eat. My research assistant, Korri Ellis, was present during the discussions and took notes.

Should you have any questions about this portion of the research, feel free to contact me at any time.

Tracey Galloway
Department of Anthropology
McMaster University
Office (905) 525-9140 ext. XXXXX
Home (519) 349-2455

Appendix 4 Children's Focus Group Guide

Good morning. My name is Tracey Galloway and I'm a researcher at McMaster University. I study children's nutrition and growth. You have been taking part in the nutrition study here at (school name) since January. We have measured your height and weight, asked you to remember the foods you eat and the activities you do. Today's activity is called a focus group, and here we are going to talk about the nutrition and activity programs here at your school, _________.

Just like when we met before, I want you to know that what you tell me is confidential. That means that I don't tell anyone your names. By taking part in this focus group you are helping grown-ups learn about the food and activity choices of boys and girls your age. We can learn the most about children if you take turns speaking, let everybody have a turn, and try to tell the truth. ______ here (research assistant) is helping me by writing down what you say. This tape recorder will also make a record of your voices, so I can listen to the discussion later and remember what you've said. Is that all right with each of you?

I'm going to start by talking about morning snacks. Do children at this school eat a morning snack? Is it something that they bring from home or something the school provides? Where do they eat that snack: in the classroom or on the playground? What if it's raining?

Let's talk about lunch. Do all children at this school eat their lunch here? Where do children eat lunch? If you eat here, how do you know when it's lunchtime? Where do children eat their lunch? Do you like eating your lunch there? Why or why not? How do you know lunchtime is finished? Do you feel you have enough time to eat you lunch? What would you like to do differently at lunch?

Do children at this school ever buy lunch? Does the school sell healthy things for lunch? Do you think that children buy healthy things to eat for lunch?

What about afternoon snack: do children at this school eat an afternoon snack? Where do they eat that snack: in the classroom of on the playground? What if it's snowing? Do you like eating snack outside? Why or why not? Where would you like to eat your snack? Why?

Do children at this school ever buy snacks? Does the school sell healthy things for snack? Do you think that children buy healthy things to eat for snack?

When children are thirsty, what drinks are available? Can children get a drink whenever they want or are there rules? Are children in your grade allowed a water bottle at your desk? What rules about drinks would you like to change? Why?

Let's talk about gym. How often do children in your grade have gym classes? What are children's favourite games? What equipment do children like to use in gym? Do you think you have enough gym time? What would you like to do differently in gym?

Let`s talk about recess. What games do children in your grade play at recess? What are children`s favourite games at recess? What equipment do children use at recess? Do you think you have enough recess time? What would you like to do differently at recess?

The last things I want to talk about are treats. Do children at this school get food treats or rewards for doing things well? Who gives children food treats? Do children at this school get treats that are activities, such as a turn on the climbers or a longer recess? What do you think about food and activity treats at school?

Appendix 5 Sample School Newsletter

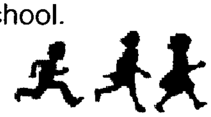
______________ District School Nutrition Project Newsletter

The Bluewater Nutrition Project is a school-based study conducted by Tracey Galloway, human biologist in the Department of Anthropology, McMaster University. The project involves seven schools in Grey and Bruce Counties and is the first of its kind in Canada to study children living outside metropolitan areas.

Goals of the Project

The overall goals of the project are:

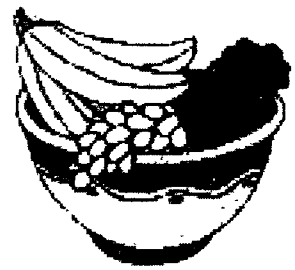
- to measure the physical growth of elementary school children;
- to assess the everyday diet of elementary school children;
- to examine aspects of the school's food environment that affect children's dietary intake;
- to help children, parents and educators learn more about students' growth and nutritional status and what they can do to promote healthy living, both at home and at school.



Activities

Between January and June 2004 we have:

- obtained permission from parents of children in grades 2-8. Please note that only students with permission participated in the following;
- measured the height and weight of each participating student;
- conducted interviews with students, asking them to recall their diet for the previous 24 hours;
- conducted brief group interviews with a sub-sample of students
- conducted telephone interviews with a sub-sample of parents.



Next Steps

In November and December 2004, the researcher will visit the classrooms of participating students and conduct 20-30 minute nutrition workshops. Students in those classes will take part in fun activities that explore food composition, healthy food choice, and appropriate serving sizes for active, growing children.

Inside this Newsletter

Because the numbers of children measured at each school are relatively low, the results of height and weight measurements are shown for the entire sample of 504 students at seven schools in Grey-Bruce. This also ensures the confidentiality of each child's measurements.

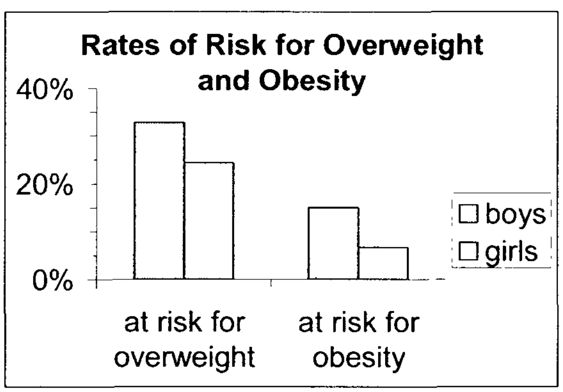
Height

►The heights of all of the students measured fall within the normal range of healthy body size for North American children. In fact, children in Grey-Bruce appear to be slightly taller, on average, than a comparison sample of American children of the same age.

age	minimum height	maximum height	average height
7	112 cm	138 cm	127 cm
8	117 cm	145 cm	133 cm
9	123 cm	152 cm	137 cm
10	127 cm	163 cm	144 cm
11	131 cm	168 cm	148 cm
12	140 cm	171 cm	153 cm
13	150 cm	172 cm	160 cm

►*Differences in height at any given age are normal for children. Each grows according to a unique pattern, which is determined by both genetic and lifestyle factors.*

►Children's height is an indicator of long-term health and nutritional status. The study results show that the children measured have experienced no long-term interruptions in nutrition or health that have compromised their growth.



What this graph shows:

This graph shows the percentages of children whose BMI is high enough to place them in a category of risk. 33% of boys and 24% of girls in the study are at risk of being overweight. 15% of boys and 7% of girls are at risk of being obese. There is also a significant gender difference: the numbers of children at risk are higher for boys than for girls in this sample.

Weight and Body Mass Index (BMI)

►Children's weight is an indicator of short-term health and nutritional status. There were no children measured whose weight fell below the range of healthy body weight. This fact assures us that children in the sample have not experienced recent food shortages or health problems severe enough to compromise their growth.

►However, there are greater than expected numbers of children whose body mass index (BMI) is high. BMI is a measure of weight relative to height. In adults, high BMI is linked to increased risk of heart disease and diabetes. While the link is less clear in children, it is of concern to parents and educators who promote children's healthy eating and active lifestyles.

►*Differences in weight at any given age are normal for children. Like height, body weight is regulated by genetic, hormonal, and lifestyle factors. However, weight is much more easily influenced by lifestyle factors such as diet and physical activity.*

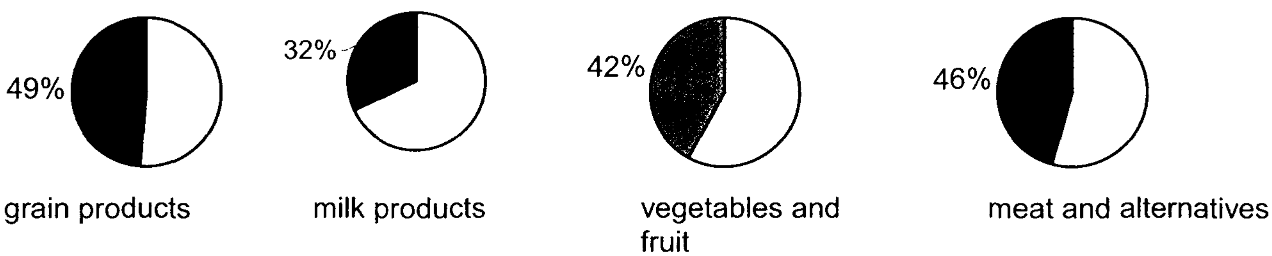
To calculate your BMI, measure your weight in kilograms (kg) and your height in metres (m).

$$\text{BMI} = \frac{\text{weight}}{\text{height}^2}$$

Diet interviews were conducted with a total of 362 students in grades 3-8 at seven schools in Grey-Bruce. Children were asked to recall all foods and drinks consumed on the day before the interview. In general, children report their food intake accurately, giving us a picture of the average child's intake on any given day. We used Canada's Food Guide to Healthy Eating to assess the quality of children's diets.

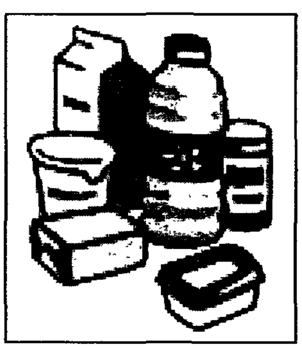
On average, children are not meeting their minimum daily servings from Canada's Food Guide:

Average child's daily servings	Recommended daily servings
4.8 grain products	**5-12** grain products
1.9 milk products (ages 4-9)	**2-3** milk products (ages 4-9)
2.2 milk products (ages 10-14)	**3-4** milk products (ages 10-14)
4.6 servings vegetables and fruit	**5-10** servings vegetables and fruit
1.6 servings meat and alternatives	**2-3** servings meat and alternatives



What these graphs show:

These graphs show the percentages of children who met the minimum number of servings in each food group. Less than half of all children met the minimum number of recommended servings of grains, meat, vegetables and fruit. Only a third of all children met the minimum number of recommended servings of milk products.

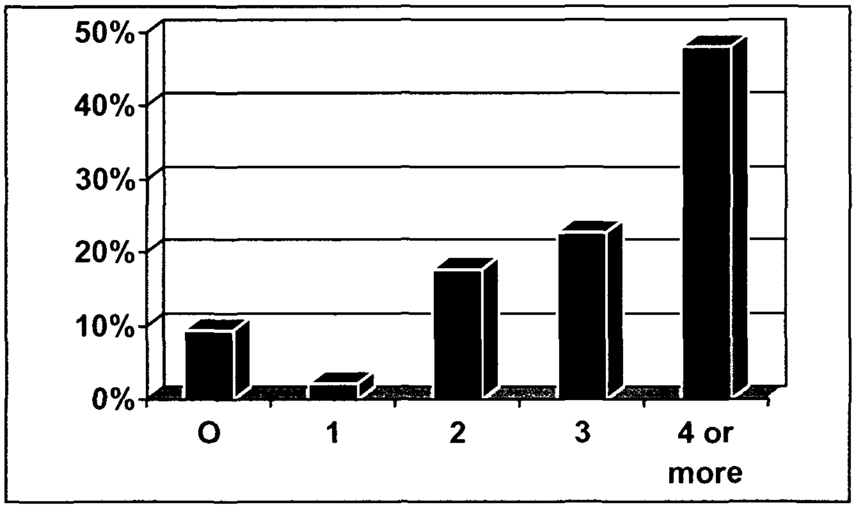


Too Much Fruit Juice?

Results show that in the vegetable and fruit category, children are getting 42% of their servings in the form of fruit juice. Because juice is sweet and most children love to drink it, it may be replacing milk in many children's diets. The high sugar content in juice may in fact be contributing to childhood obesity. The Grey Bruce Health Unit recommends that children ages 7-18 years drink no more than 1 to 1½ cups of juice per day. Look for the words "100% unsweetened fruit juice" or "100% pure fruit juice, no sugar added." Avoid fruit "drinks" or "punches" that may contain little or no real fruit juice. If kids are thirsty, offer water. Serve milk at meals.

Other Foods

On average, children reported eating foods from the "other" category four times per day. These foods included cookies, pastries, chips, pop and candy. As more than half of children are eating too few foods from the healthy food groups, it is likely that they are replacing healthy foods with servings from the "other" category.



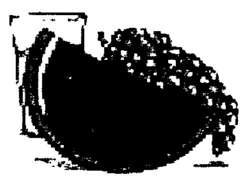
What this graph shows:

This graph shows the percentage of children eating 0 to 4 or more daily servings from the "other" category of foods. Only 7% of children reported eating none of these foods. Some children ate as many as 11 servings per day of "other" foods. While the Canada Food Guide acknowledges that treats can be tasty and fun, it warns that these foods are also high in sugar and fat. In order to preserve a healthy lifestyle, use these foods in moderation.

Acknowledgments

The following individuals and groups have donated time and/or funds to assist this study. I would like to thank them sincerely for helping us learn about children's growth and nutrition in Grey-Bruce.

- The children and families who generously consented to participate in the research.
- Principals, teachers, office and cafeteria staff, and volunteers at participating schools.
- The Bluewater District School Board
- The Grey Bruce Health Unit
- McMaster University School of Graduate Studies
- The Social Sciences and Humanities Research Council of Canada
- Korri Ellis, Research Assistant



If you or your child have any questions about the results of the study, please contact the researcher:

Tracey Galloway
Department of Anthropology, McMaster University
Telephone: (XXX) XXX-XXXX
Email: sampleemail@serviceprovider.ca

You can also get information on nutrition from the Grey Bruce Health Unit:

Lynda Bumstead, Acting Public Health Nutritionist
Grey Bruce Health Unit
Telephone: (519) 376-9420
1-800-263-3456

Appendix 6 Presentations to School and Public Health Partners

Galloway T. 2004a. The Bluewater Nutrition Project. Paper presented to Bluewater Elementary School Principals, 24 September 2004. Meeting sponsored by the Bluewater District School Board.

Galloway T. 2004b. The Bluewater Nutrition Project. Paper presented at We Can't Weight: Looking at the Obesity Epidemic, Owen Sound ON, 26 October 2004. Conference Sponsored by the Grey Bruce Health Unit.

Galloway T. 2005a. Results from the Bluewater Nutrition Project. Presented at Finding Your Balance: Living, Learning and Leading, Owen Sound ON, 23 September 2005. Conference sponsored by the Bluewater District School Board and the Bruce Grey Health Unit.

Galloway T. 2005b. Results from the Bluewater Nutrition Project. Presented at Bluewater School Community Council Network Symposium, Chesley ON, 01 October 2005. Symposium sponsored by the Bluewater District School Board.

Appendix 7 Media Presentations

Galloway T. 2004a. Interview with Bill Henry, Owen Sound Sun Times. Printed 27 September 2004.

Galloway T. 2004b. Interview with CKNX TV News. Aired 26 October 2004.

Galloway T. 2005a. Article written for The Dundalk Herald. Printed 2 February 2005.

Galloway T. 2005b. Interview with Bill Henry, Owen Sound Sun Times. Printed 28 September 2005.

Galloway T. 2005c. Interview with James Clark, Kincardine News, SunMedia. Printed 29 September 2005.

Galloway T. 2005d. Interview with Scott Miller, A Channel TV News, Stratford ON. Aired 6 October 2005.