Self-Reported Eating Behaviour, Physical Activity, and Learning Engagement of Grade 3 and 6 students during the School Day

by

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ABSTRACT

Background: The school environment is an important contributor to children's health. This thesis assessed student perceptions of physical activity, eating behaviors, and learning engagement throughout the school day.

Methods: Surveys were distributed in grades 3 and 6: three schools using the Balanced School Day (BSD) schedule, and three using the Traditional School Day (TSD) schedule. Students self-reported physical activity, eating behavior, and learning engagement, at key times in the school day. Student perceptions by grade, gender, and schedule were examined. Data were expressed as frequencies and percentages and the variables were cross-tabulated and analyzed using Chi-Square analyses.

Results: In total, 173 students participated in this study (response rate of 54%). Girls self-reported being less physically active than boys at recess. Grade 3 students experienced hunger more frequently than grade 6 students. There were no significant hunger or physical activity differences between schedule types. All students reported high hunger and lower learning engagement at the end of the school day.

Conclusion: We recommended age/gender specific schedule modifications to reduce hunger, and increase physical activity and learning engagement at school.

Keywords: school schedule, physical activity, eating behavior, balanced school day (BSD), children's survey

CO-AUTHORSHIP STATEMENT

Chapter 3.0 is presented as a manuscript for publication.

Author contributions:

Sarah-Jane MacDougall assisted with the conceptualization of the study, led the collection data, conducted all data analyses, and wrote the manuscript.

Dr. Sandra C. Dorman conceptualized the study, supervised the collection of data, assisted with data analyses and reviewed the manuscript.

Dr. Alain P. Gauthier conceptualized the study, assisted with data analyses and reviewed the manuscript.

Dr. Céline Larivière assisted with the study design, data analyses and reviewed the manuscript.

Bridget T. Jaunzerins co-led the collection of data, and assisted with data entry.

Michelle Laurence assisted with the data collection and with data entry.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

For children, the home environment is often cited as the primary ecosystem for fostering health (Leitch, 2007). However, most Canadian children, aged 4 and older, spend almost half of their waking hours at school; it is therefore important to acknowledge the education system, as a key place for community-led health interventions, and as such, one of the most influential community-based agents in determining children's health (Ontario Agency for Health Protection and Promotion, 2013).

As advisor to Canada's Minister of Health, Kelli Leitch stated 10 years ago that Canadians believe our society is one in which our children and youth should enjoy lives that are happy and full of health (Leitch, 2007). Leitch's statement (2007) reveals a Canadian desire to not only foster a national environment that optimizes the health and wellness of our children, but an understanding that in ensuring the health of our children today we also secure the future health of Canadian society (Raphael, 2014).

In seeking to optimize Canadian children's health, it is important to consider Bronfenbrenner's Ecological Model (1977). This model describes an individual or population's overall health outcome as determined by a multitude of key environments, or ecosystems, that interact with each other in complex ways (Green, Richard, & Potvin, 1996). Bronfenbrenner's Ecological Systems theory proposed that an individual's development is shaped by the environment around that individual, and the way in which different structures in that environment interact. Bronfenbrenner envisioned 5 main "layers" of environmental interactions, which are often described as concentric circles or "Russian dolls". In this model, the individual is at the center of the circles, and

each subsequent circle represents environmental interactions that affect the individual with lessening intimacy. For example, a child's microsystem includes key individuals or structures that have a bi-directional relationship with the child; parents, caregivers, and coaches, all who directly impact and are impacted by the child.

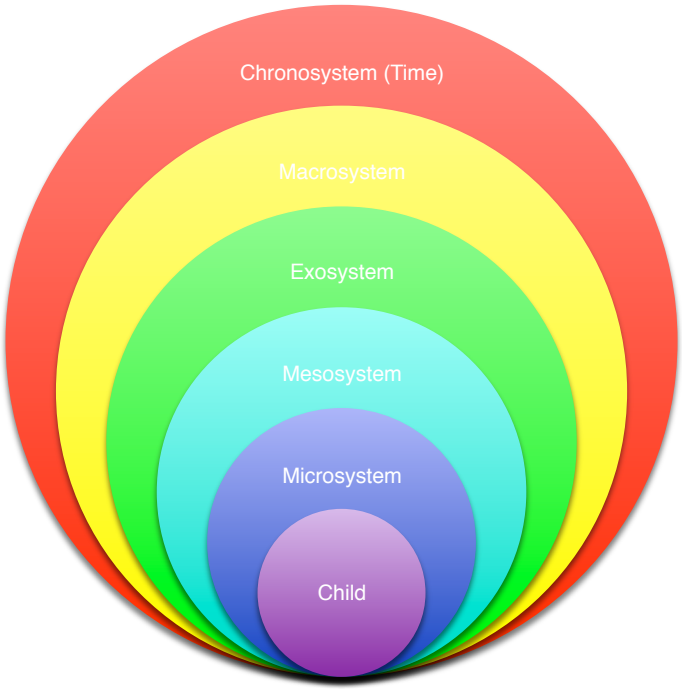

Figure 1: Bronfenbrenner's Ecological Model

School is traditionally seen as part of the mesosystem; that is the second "layer" of this model. Instead of recognizing the direct impact that the school has on the child it is regarded as a place where key structures from a child's microsystem can interact, like parents and teachers, and thus one layer removed. However, given the direct impact that the school environment has on a child's physical activity, eating, and learning behaviors, and the way that one child's behavior can affect the school environment, we argue that the school should therefore be considered a most-intimate part of the child's growth and development—part of the microsystem. Understanding the school as a microsystem is important because an ecological perspective to commu-

nity health suggests that health promoters look to optimize children's health by targeting specific microsystem's in a child's life.

Historically, an understanding of the prominent role that the school environment plays in children's overall health has resulted in a "school health" movement in the health promotion field. Targeted interventions such as breakfast clubs, health curriculum, and the availability of health services on school premises use the school setting as a vehicle to ensure students have nutritious snacks before school and information about healthy choices (Green, Richard, & Potvin, 1996). While these interventions have increased health opportunities for students in Canada and the United States, there is limited research about how the overall structure of the school day contributes to student health, specifically: eating behaviors, physical activity, and learning engagement. Given the duration and frequency of time that most Canadian children spend at school, it is important to ensure that the school environment is not merely used as layer in which to insert health interventions, but that the structure of the school day itself is seen as a microsystem, an intimate environment, to optimize student health.

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CHAPTER 2

REVIEW OF THE LITERATURE

2.1 Children and the School Environment

2.1a. School as a Community Health Tool

As previously stated, the school can be viewed as a key microsystem influencing children's health. The idea of the school as a community health tool is not new. In 2004, the Ontario Minister of Education, Gerard Kennedy, acknowledged that schools should be consolidating nutrition and physical activity theoretical knowledge with practical implementation (Kennedy, 2004). In addition, the Education Act articulates the responsibility that teachers and principals have: a duty of care (*Ontario Regulation 298*, 1990, s. 11 (3)e, f, q). While the Ecological model theoretically positions schools as an influential microsystem for children's health, the Education Act ethically and legally mandates that schools are more than merely academic institutions, but must also answer to the overall well-being of their students.

In Canada, the publicly funded school system is the responsibility of each provincial government. Therefore, every province has their own Ministry of Education, which acts as the supervisor for the multitude of school boards within the province. In Ontario, there are 72 district school boards throughout the province, which host 3,974 publicly-funded elementary schools (Education Facts, 2014-2015). According to the Ministry of Education, the scope of influence for Ontario schools is significant: the most recent count of Ontario children attending publicly funded schools was 2,003,237. This accounts for a little over one-sixth of the entire Ontario population (Education Facts, 2015-2015).

Recognizing the opportunity and responsibility for schools to influence children's health, and considering a decade of reports on the declining health of students, Canadian Federal and Provincial governments have focused attention on modifying components of school-based physical activity programs and food behaviors with the goal of improving children's overall health. One such modification was part of former Ontario Premier Dalton McGuinty's 2007 election platform. As part of the campaign, the McGuinty team proposed the "Healthier Schools" Strategies: asserting that increasing opportunities for physical activity and promoting healthy eating behaviors at school could improve overall health and learning engagement (Ontario Ministry of Education, 2006a). Part of this strategy allocated $20 million to school boards, with the intent that schools use the funding to boost infrastructure and become centers for community health initiatives. The ministry also mandated daily physical activity (DPA) for grades 1-8: a mandatory, 20-minutes of teacher-led physical activity, in addition to physical education classes (Ontario Ministry of Education, 2006b).

Just prior to the physical activity reforms that were being proposed in schools, reforms seeking to positively influence eating behaviors also found their way into educational discourse. The Ministry of Education partnered with Dieticians of Canada (a national organization aimed at improving health through food and nutrition) to identify unhealthy eating behaviors among Canadian children, and develop strategies for the school setting to resolve these concerns. Using multiple studies from the Dieticians of Canada, which demonstrated that children frequently choose soft drinks and foods that are high in sugar and low in essential nutrients, the ministry believed that limiting students' access to "unhealthy choices" during the school day would improve children's school health (Kennedy, 2004). The role of vending machines in schools was especially high-

lighted as contributing to students' unhealthy food behaviors. In response, the Healthy Food for Healthy Schools Act of 2008 attempted to move beyond merely recommending better food choices, and amended the Education Act to establish nutritional standards for all foods that were provided/made on school property. Theoretically this would remove unhealthy options in vending machines, at bake sales, and cafeterias (Legislative Assembly of Ontario, 2008).

In the 2013 review of the Healthy Schools Strategy (the outline which later accompanied the Legislation of the Healthy Schools Act), Auditor-General Bonnie Lysyk reported that the physical activity and eating behavior legislation was not effective. Though the Healthy Schools Strategy proposed initiatives to improve the health promoting nature of the school environment, the implementation and compliance with this strategy was lacking. In Lysyk's review, she notes a dramatic increase in the number of overweight and obese school children in Ontario, a seemingly opposing outcome to the goals of the strategy (Lysyk, 2013, 104-120). This strategy saw the implementation of the new dietary standards in schools and DPA, both initiatives that were purported to improve student school health. However, Lysyk chastised the Ministry for the failure of the strategy according to four main measures: 1) an non-existent monitoring system to ensure the food sold in schools was in compliance with the new Food and Beverage standards, and that DPA recommendations were being met 2) missing data, that would help determine if the new policy contributed to better eating habits, and physical activity; 3)lack of training for teachers on how to better promote healthy eating and DPA in the classroom; and 4) an inability properly monitor healthy eating and quality of physical activity in schools. Though the school environment was importantly recognized as a key contributor to student health, by the end of 2013, the Healthy Schools Strategy was considered an "embarrassing failure" (Annual Report,

2015). It is worth noting that neither the Healthy Schools Strategy nor the Auditor's report recommended asking students to provide input to help understand of the problem children's health at school, or to address and develop interventions.

2.1b Physical Activity at School

The Canadian Society for Exercise Physiology (CSEP) recognizes the important role that physical activity plays in the healthy growth and development of children. In line with this, CSEP guidelines recommend that children between the ages of 5 and 11 achieve a daily accumulation of 60 minutes of moderate-to-vigorous-intensity physical activity (MVPA) (Tremblay et al., 2016). In addition, it is recommended that every week, at least three MVPA sessions should include activities that strengthen muscle and bone (e.g. pushing, pulling, carrying, jumping) (Tremblay et al., 2016). Since 2011, Canada's ParticipACTION Report Card has reported that very few children and youth in Canada meet these recommendations for physical activity (Barnes, Colley, & Tremblay, 2012). In fact, only 7% of 5-11-year-old children and 4% of 12-17 year old children achieve CSEP recommendations (Tremblay et al., 2016). This failure to achieve the baseline physical activity levels has resulted in national studies examining the school environment (among others) as a means for increasing MVPA among children. Partially this is because, as outlined above, the school is a microsystem for children's health, but also because school provides a multiplicity of physical activity opportunities (i.e. physical education class, recess, team sports, etc.). A recent study by Jaunzarins et al. (2014) found that children achieve almost half of their total daily step counts during recess. This means that recess is an important period during which time children can accumulate part of the recommended 'dose' of daily physical activity. If students are not exploiting the opportunities to be physically

active during recess, they might not otherwise get the chance to meet their daily physical activity requirements. The 2015 Participation Report Card (Tremblay et al., 2016), recommends a variety of measures schools should employ to ensure physical activity levels (duration and intensity) of students are met at school, including:

- Policies (e.g., a policy around the quantity and quality of physical education classes per week), and
- Organizational factors (e.g. experts instructing physical education classes; opportunities for physical activity, such as children playing before eating).

Historically, the idea of changing the school environment to promote physical activity was considered a deviation from the ultimate academic mandate of the school. A study by Bevans et al. (2010) highlights research that examines some of the barriers to implementing a physical activity policy and organizational change. According to Bevans et al. (2010), school-based physical education programs face numerous challenges including the concern that devoting time and resources to physical activity competes with academic priorities (Bevans, Fitzpatrick, Sanchez, Riley, & Forrest, 2010). However, research on physical activity and student academic success indicates that these concepts are not mutually exclusive (Keeley & Fox, 2009; Trudeau & Shephard, 2008).

2.1c Physical Activity and Learning

The connection between physical activity, and mental health have been well documented (Kohl III & Cook, 2013). Regular physical exercise is shown to: reduce stress (Martikainen et al., 2013), improve mood, and increase satisfaction with self (Keeley & Fox, 2009; Strong et al.,

2005), as well as treat depression (Janssen & LeBlanc, 2010).

There has also been much research examining the connection between physical activity and positive academic outcomes. Contrary to historical beliefs, physical activity is seen to enhance academic function, not distract from it. Children better perform cognitive tasks after being physically active (Hillman et al., 2009; Tomporowski, 2003). Additionally, students are more attentive to learning, that is they feel less tired and more engaged, when physical activity is scheduled between periods of learning (Grieco, Jowers, & Bartholomew, 2009). This attention improvement is seen across the spectrum of students, even in those who were previously diagnosed with attention difficulties. For instance, a study by Pontifex and colleagues (2013) found that the benefits of physical activity on academics is statistically significant, even for students diagnosed with attention deficit hyperactivity disorder (ADHD).

The academic benefits of physical activity has been fueled in the mainstream media, by a book called 'Spark' (Ratey & Hagerman, 2008), which highlights research from Dr. John Ratey's group. Though not published in peer-reviewed journals at the time, their book describes their research, which examines the implementation of fitness programs in select Illinois schools. In these schools, dramatic improvements in academic outcomes were achieved in combination with increased intensity of physical activity (as measured by heart rate). Based on the success of Ratey and Haterman's book (2008), in 2012, the Sudbury District, the Rainbow District School Board [RDSB] invested $6,000 in five schools to hire fitness instructors who would, in the morning, lead group-fitness classes to engage the entire school in physical activity. In a Northern Life article published the same year, each student had the opportunity to participate in

Spark programming twice during the school week (Ulrichsen, 2012). Though an improvement, alone, the new "Spark Programming" did not ensure students met the physical activity recommendations by Tremblay et al. (2016). Although conceptually appealing, considering the positive literature surrounding John Ratey's book, the results of this RDSB pilot study were not shared publicly. Despite the positive results from the initial Ratey studies in Illinois (Ratey and Hagerman, 2008), the RDSB did not formally commit to SPARK programming following the 2012 pilot in Sudbury.

Although Pellicer-Chenoll et al. (2015) note that the link between physical activity and academic performance in the literature, many of the methodological designs are only short-term linear studies. However, a review of the literature by Pellicer-Chenoll (2015) reports that no negative effects of exercise on children's academic achievement have been reported. Encouragingly, a research brief by (Castelli, Glowacki, Barcelona, Calvert, & Hwang (2015) confirmed what Sibley and Ether found in their extensive 2003 literature review: students who are deemed as 'physically fit', show significantly better performance during standardized math and reading tests (Sibley & Etnier, 2003). Additionally, there is demonstrably a positive relationship between increased physical activity and increased learning engagement in children (Etnier, Nowell, Landers, & Sibley, 2006).

2.1.d Eating Behaviors at School

Nutrition is a fundamental determinant of childhood growth and development (Katamay et al., 2007). As addressed in the 2007 release of Canada's food guide, food concerns are generally divided into two broad categories: 1) Achieving daily nutrient requirements, by consuming nutrient

rich food and beverages; and 2) Consuming necessary kilocalories while avoiding calorie excess; that is, the over-consumption of protein, fat and/or sugar (Katamay et al., 2007).

Canada's Food guide recommends specific foods, to ensure daily nutrition requirements are met, and provides age-specific guidelines for overall energy consumption (Health Canada, 2012).
In terms of total kilocalories, it is recommended that low-active female children in the 8-12 age-range eat between 1600-1800 kilocalories a day, and that male children in this age range eat between 1750-2000 kilocalories a day. These kilocalories come from a combination of: 6 servings of Fruit/Vegetables, 6 servings of Grain products, 3-4 servings of Milk/Milk Alternatives, and 1-2 servings from Meat/Meat Alternatives (Health Canada, 2012).

In Canada, what children consume at school is still guided primarily by parents and caregivers, as most students bring home-packed lunches to school. Although the thought of a "home-packed" lunch sounds more delicious than mass-produced cafeteria fare, studies indicate that a "home-packed" lunch does not automatically constitute a nutritious meal (Hur, Burgess-Champoux, & Reicks, 2011). A recent study by Dorman et al. (2013), analyzing the content of students' home-packed lunches, found that while students consume roughly one-third of the total daily recommended calories at school, these calories were derived from foods with high sugar and low fiber, and low fruit and vegetable content. Food consumption was assessed by photographing meals and entering food items into a diet analysis program. This program provided both the total nutritional value in home-packed lunches, and the food consumed by students in grade 3 and 6. The study included one catholic and one public school, of average, socio-economic status (as measured by the Ontario School Finder). While the study offered some valuable insights into

the high sugar, low protein and fiber content of student lunches, to what extent these home-packed lunches reflect the quantity and quality of the food children consume at home, is not known.

In Ontario, the new School Food and Beverage Policy (Ontario Ministry of Education, 2010), effective Sept 1, 2011, officially followed the failed Healthy Food for Healthy Schools Legislation (Legislative Assembly of Ontario, 2008). The new policy explicitly outlines the role that schools play both in educating children about healthy food choices, and enabling an eating environment that reinforces the nutrition education that children receive in class (Ontario Ministry of Education, 2014). The policy bans the sale of food and beverages that contain few or no essential nutrients and/or contain high amounts of saturated fat, refined sugar, and/or sodium (e.g., fried foods, confectionery foods). While these measures are positive first steps, current policies do not restrict students from bringing foods from home, which are not permitted for sale under the Ontario Food and Beverage Policy, or from consuming these foods while at school.

The absence of school lunch programs in most schools in the province further underscores this problematic scenario. If schools are prohibited from selling or giving away food that does not meet the rigorous standards of the Food and Beverage Policy, yet students are still brining this banned food in their packed lunches, the standards are really doing little to effect nutritional change in schools. Furthermore, students from low socio-economic households and remote communities are at a significant disadvantage, as nutritious, home-packed lunches requires access to healthy food at home, the financial ability to purchase healthy food, and an education on what constitutes nutritious food choices.

In addition to *what* children consume at school, it is important to look at *when* children consume their lunches at school. The timing of: when, and for how long, children are given to eat their food also impacts their nutrition; these factors are dependent on the school day schedule. Canada's National Food Guide notes that children and youth have small appetites and should eat small snacks and meals on many occasions throughout the day (Katamay et al., 2007). The Canadian Paediatric Society (CPS) also recommends this, and suggests that daily food intake times should look like three traditional meals (i.e. breakfast, lunch, and dinner) with three small snacks. These intermittent snacks should provide children with the necessary energy to make it through the day without entirely suppressing feelings of hunger for mealtimes (Canadian Paediatric Society, 2016). Although Health Canada does not specifically recommend when students should consume their meals and snacks, they do recognize that children prefer to eat on a regular schedule, should not feel rushed, should eat when they are hungry, and in a familiar setting (Health Canada, 2012). Health Canada also notes that the amount of food eaten at each meal and snack may vary daily depending on appetite, fluctuations due to activity level, and growth spurts. Daily eating patterns, specifically the times when children eat and how much time children are given to consume their meals before and during school are directly or indirectly affected by their school schedule (Noftall, 2012; Ontario Agency for Health Protection and Promotion, 2015; Story, Kaphingst, & French, 2006) . As such, school scheduling, which does not consider small appetites, the need for frequent snacks, or individual differences does not actually allow for a child to eat, and therefore obtain the necessary nutrients, when needed.

To fill in the gaps between children's required nutrient intake and recommendations from Health Canada, a variety of charity programming is in place to provide food at school (Picard, 2013). Although access to such programming varies by school, national statistics regarding the scope of these programs indicate the immense role that these programs play in meeting nutrient needs for children in Canada. Some of the most notable programs are listed below:

- Breakfast for Learning, which feeds approximately 300,000 children;
- Breakfast Clubs of Canada, which feeds approximately 120,000 children daily;
- Kids Eat Smart Foundation, which feeds approximately 50,000 children;
- Farm to School, which feeds approximately 20,000 or more children.

The research behind these programs, notably funded by Breakfast for Learning, has greatly contributed to the early discourse that links eating behavior and a feeling of satiation, with academic success (Picard, 2013).

2.1.e. Eating Behaviour and Learning

In his Ecuadorian study, Torres (2016), notes that beyond its requirement for physical growth and development, proper nutrition also plays a critical role in children's ability to learn. Recent scholars who have also highlighted the significant influence that food and food-related practices have on children's education (Benn & Carlsson, 2014; Nelson & Breda, 2013; Weaver-Hightower, 2011).

Per a literature review by Fu, Cheng, Tu, & Pan (2007), the connection between eating behavior and academic success is generally organized into four main categories:

1. the effects of iodine or zinc supplementation in nutrient-deficient children;

2. the relationship between anemia, iron supplementation, and learning;
3. the effects of insufficient food intake on learning engagement; and
4. the importance of breakfast for readiness to learn

Common to all the above research is the finding that deficiencies in nutrients are linked with decreased cognitive function and increased academic difficulty. A seminal study by Bautista et al. (1982) shows that when children, who were deficient in either iodine or zinc, are given zinc and iodine supplements, their cognitive abilities and intelligence quotient scores increase significantly. Additionally, researchers have demonstrated that children who have iron deficiencies have reduced capacity to learn (Pollitt, 1993); and conversely, those who receive adequate nutrition have improved ability to learn. A review of the literature by Grantham-McGregor (2001), found that anemic children have reduced cognition and school achievement when compared with non-anemic counterparts. Iron deficiency is associated with decreased dopamine transmission, resulting in decreased cognition (Grantham-McGregor, 2001). A study, among adolescent girls in 1996, showed that iron supplementation improved verbal learning and memory (Bruner, Joffe, Duggan, Casella, & Brandt, 1996).

While the links between nutrient consumption and ability to learn are well documented, it is also necessary to consider that the mere presence or absence of adequate calorie consumption can also improve student academic achievement and learning engagement throughout the school day. For instance, children who do not receive enough energy intake exhibit lower IQ and poorer academic achievement (Fu et al., 2007). They have poorer attendance, learning engagement, and overall behavior problems (Alaimo, Olson, & Frongillo, 2001). Similarly, a study by Taras in 2005 noted that the ability to learn is seriously affected amongst children who do not have suffi-

cient food and are hungry throughout the day. The literature also confirms the positive connection between breakfast and cognitive function (Hoyland, Dye, & Lawton, 2009). Children who eat breakfast show greater ability for logical reasoning and increased ability to remember their learning (Wesnes, Pincock, Richardson, Helm, & Hails, 2003). Students who eat breakfast are quite simply better able to learn in school (Mahoney, 2005). For instance, kindergarten aged children who have regular breakfast have increased performance on IQ tests (Liu, Dickerman, Compher, 2013). Conversely, children who are hungry during school are prevented from maximizing their learning potential (Maggi, Irwin, Siddiqi, & Hertzman, 2010; Winicki & Jemison, 2003). Essentially, children who are hungry throughout the school day are simply not as successful in school.

Because children's nutrient needs throughout the day are greater than adults, due to the cognitive and physical demands of growth and development, children require more frequent nutrient input; that is, they need to eat healthy food, more often, than their adult counterparts (Health Canada 2012). Inadequate energy intake, either acutely (i.e. over several hours) or chronically (i.e. over several days) is a recognized problem for some children and can limit their ability to achieve academic success (Taras 2005). As discussed above, chronic hunger can be mitigated through school food programs; however, acute hunger is also impacted specifically by school schedules. The time when school starts and finishes and time-spent-traveling to and from school, impacts when home meals and snacks are offered (Salmon, 2011). In addition, the school schedule itself determines when children will eat their packed lunches and how much time they will be allotted to consume them (Thirkill, 2016).

While school snack and breakfast programs provide important means of increasing nutrient intake for students, children who find themselves hungry, due to scheduling, may still be at a disadvantage. This hunger disadvantage is heightened for students who experience lack of nutrition on a regular basis - systemic malnutrition makes the children "particularly susceptible to moment-to-moment metabolic changes" (Sorhaindo & Feinstein, 2006, i). Hungry children, who are either not consuming enough total kilocalories in a day, or not enough kilocalories over a given time frame, are likely to experience added difficulties throughout the school day (Taras 2005).

The Centre for Research on the Wider Benefits of Learning Research Report No. 18. revealed that "optimizing learning cognition" is achieved through maintaining "adequate levels of glucose throughout the day" (Sorhaindo & Feinstein, 2006, i). This mirrors Health Canada's recommendation for children to eat many small meals during the day, understanding that eating small meals means avoiding extreme glucose highs and lows (Health Canada, 2012). The Learning Research Report suggests that satiety and "short-term" nutrition or little snacks throughout the day may limit hunger and positively impact student participation and engagement while at school (Sorhaindo & Feinstein, 2006). Snacking and small meals throughout the day can be easily accommodated in the home setting. However, allotting time for children (as a group) to snack when they are hungry throughout the school is more complex: when will children get a break to eat?, how long will they have to consume their food? who will supervise these children eating? Each scheduling decision has implications for the organization of the school day, as will be discussed below.

2.2 SCHEDULING

2.2.a. Ministry Guidelines

Legislation for physical activity and eating breaks existed in the earliest iterations of the Ontario Education Act (OEA). The OEA mandates that every school day must include a morning and afternoon recess (between 10-15 minutes in length) and a lunch break (between 40-60 minutes in length) (Operation of Schools (1990). Regulation 298, 3(1)). This regulation leaves scheduling decisions to be tailored to individual school needs, and prior to 2003 most schools in Ontario found a "Traditional School Day" timetable met these needs. The Traditional School Day (TSD) was based on a total of 300 minutes of instructional time, interrupted by two 15-minute recess breaks, and one 40-60-minute lunch break. In the last decade, school needs have undergone substantial changes. In her comparative study of school lunches, Neilson (2014) notes the evolution in the lunchtime environment at school. Neilson (2014) notes that only 9-16% of students now go home for lunch; with most students now remaining at school to eat, therefore schools do not have to accommodate travel time for students to go back and forth to their parent/guardian during the lunch break. Papke & Gardiner (2003) also reference the evolution in children's lunch routines, as many children stay at school for the entire day. The OEA-mandated 300-minutes of instruction time has not changed; however, the change in student lunch patterns has allowed schools to redesign the allocation of 300 minutes, principally, by implementing a novel schedule called the Balanced School Day.

2.2.b. Balanced School Day

In 1998, in the context of poor provincial test scores, principal Michael Walmsley, of the Peel District School Board, examined the idea of changing the school's timetable with the aim to im-

prove student learning. Walmsley proposed that his staff reconstruct the traditional school day, maintaining the current start and end times of the school day and adhering to the 300-minute OEA guidelines, but; shifting to a Block Schedule (Shantz, 2006). Block scheduling is defined as any schedule format with fewer but longer instructional periods than traditional schedules (Schoenstein, 1995). There are many forms of block scheduling such as 'the intensive block', 'the 4 x 4 block', and 'the modified block' (Schoenstein, 1995). Woehrle, Fox, & Hoskin (2008) note that, although largely anecdotal, reported benefits of block scheduling included improved grades and attendance rates. The hypothesis was that with longer teaching 'blocks,' teachers could cover more material and include a wider variety of instructional techniques thereby achieving better learning (Rettig & Canady, 1996; Schoenstein, 1995). Walmsley and his staff developed a new type of block scheduling, which they called the Balanced School Day Schedule (BSD) and applied this schedule to schools within the Peel District School Board.

The BSD schedule combined the lunch and recess requirements of the OEA into two, 40-minute breaks: one in the morning, and one in the afternoon (Woehrle et al., 2008). They coined these "nutrition breaks." See Table I to compare Traditional School Day and Balanced School Day schedules.

Table I: Comparing Balanced and Traditional School Day Schedules

BSD: **300 minutes of instruction time**		**TSD:** **300 minutes of instruction time**	
Morning Instruction	100 minutes	Morning Instruction	75 minutes
Nutrition Break	40 minutes • 20 min eating • 20 min recess	Recess	15 minutes
Mid-day Instruction	100 minutes	Mid-morning Instruction	75 minutes
Nutrition Break	40 minutes • 20 min eating • 20 min recess	Lunch	50 minutes
Afternoon Instruction	100 minute	Early Afternoon Instruction	75 minutes
		Recess	15 minutes
		Late Afternoon Instruction	75 minutes
Total Time: 380 minutes		Total Time: 380 minutes	

Although Walmsley developed the BSD to address academic success, other proposed benefits of the program were quickly advertised on school board and community health unit websites; none of which had been proven or even studied at the time. Some of these claims are still posted on school board websites. For example, the Rainbow District School Board website currently reports that the BSD provides the following (Rainbow District School Board, 2016):

- An enhanced learning environment,
- Improved student concentration and energy levels,
- Positive influence on student achievement and health,
- More time for students to relax and enjoy their lunch,
- Improved physical fitness for both students and educators,
- More time for daily physical activity and play, and

- Greater use of school gymnasiums and outdoor playground facilities.

During the same time frame, the new collective bargaining agreement for Ontario teachers mandated that teachers have a 40-minute, uninterrupted break for lunch; this was significant at the time because teachers covered the majority of student lunch and recess supervision (Ontario Education Act). The province-wide adoption of Walmsley's BSD was likely accelerated because it readily solved the supervision problem for schools, imposed by this new agreement, that is: one group of teachers supervised the first 40-minute nutrition break, while another group received their 40-minute lunch break. The supervision / lunch break duty could then switch during the second nutrition break (Cassidy, 2005). The BSD was therefore able to satisfy teachers' unions and administrators alike, with no added cost required.

The creators of the BSD schedule cite Brain Compatible Learning (BCL) Research, as foundational to the schedule (Neilson, 2014). However, an examination of both primary documentation and secondary literature does not reveal the sources or studies that the Peel school board used to inform their decision-making (Neilson, 2014). As Neilson (2014), identifies in her literature review, BCL Research has its roots in educational psychology and cognitive neuroscience focused on maximizing brain behavior and learner abilities. While this research is used to inform teaching methods, create classrooms that are engaging, and challenge past assumptions of how students learn (Cram & Germinario, 2000), BCL research is about maximizing learning, not student health. The BSD may be in line with BCL research, however, the persistent linkage of the BSD to health outcomes by School Boards, without corresponding nutrition and physical activity research, is concerning.

Recognizing the need to assess and evaluate the success of the BSD schedule, after its inception in the 2000-2001 school year, a few pro-BSD studies were conducted, as stakeholders adjusted to a re-organization of their school day. The results of these studies are ambiguous (Halton District School Board, 2003; Neilson, 2014), in particular given that most of the studies were completed and presented by individual school boards who had already adopted the BSD timetable and were in favour of its adoption. Two main sources of data about benefits of the BSD exist. The first is survey data, collected by a few schools in southern Ontario, asking parents, students, and staff how they feel about the BSD schedule compared to the school's former schedule. These surveys are not published sources of information and therefore most cannot be reviewed by external sources (Chater and Laflond, 2003; Walmsley, 2001). The Halton District School Board has provided their survey online (HDSB, 2003); however, it is difficult to interpret some of the results. After piloting the Balanced School Day timetable in eight schools for seven months, the Halton District School board surveyed the students, teachers, and parents in the pilot schools. At the end of the survey they concluded that the BSD was better than the previous, TSD schedule (Halton District School Board; 2003). However, most of the student ratings were modest at best, whereas principals, teachers and care-takers were more likely to prefer the BSD schedule, potentially because of reduced supervision time and enhanced school cleanliness. Similar results were found in a comparable study of the Peel Board's limited BSD trial (Walmsley, 2001). In all studies, the stakeholders in the very program that was being evaluated did the research. As noted by Shulha and Cousins (1997) this can cause a conflict of interest as often program personnel demonstrate favorable attitudes and behaviors as a persuasive tool to secure funding, or to legitimize a program (Saab, 2009; Shulha & Cousins, 1997). Therefore, it is not just the viewpoint of students that has been overlooked, but the "adult" viewpoints may very well be biased.

The other primary and most quoted source of information regarding the BSD is from a two-year study carried out in the Hamilton-Wentworth District School Board during the 2002-2004 school years (Woerle, 2008). This study compared four schools using the BSD with four schools using a traditional schedule, as well as one school that used a traditional schedule in 2002-03 and the BSD in 2003-04. They found increased learning time with the BSD primarily due to fewer transition times (i.e. putting on/taking off outerwear). However, their results were mixed with respect to student concentration and playground aggression. Similarly, results were mixed for outdoor time and eating time. Important concerns regarding diet and exercise included decreases in perceived 'time to play' for primary and junior students, although this was reversed for intermediate students. Similarly, primary and junior students felt they did not have enough time to eat using the BSD schedule. Overall, although Woehle et al. attempted to compare some of the important health consequences of the new schedule, large gaps still exist in our knowledge regarding these effects.

A little over one decade after its inception, a quick Google search shows most of Ontario school boards use BSD schedules, although the Ministry of Education has no official data report on the schedules used by each school. According to Wu, Macaskill, Salvadori, & Dworatzek (2015), an email communication with an entrepreneur selling balanced day lunch bags in Ontario, suggested well over 1000 schools in Ontario are now following the BSD. The popularity of the BSD is important because it demonstrates that widespread schedule changes can be achieved in a relatively short time, when seen to be beneficial by parents and administrators. As of today, no study has

expressly connected the BSD, or any one schedule for that matter, with consistently positive physical activity or nutrition outcomes for students.

2.2.c. Physical Activity and School Schedule

When the BSD was first implemented in 2003, some schools used the extra nutrition break to expand opportunities for intramural sports, yoga, dance, and other activities. The traditional schedule, with a single lunch period, only allowed for one time-frame in which to schedule structured extra-curricular activities; two nutrition breaks provided opportunity for two periods of organized activities. A Thames Valley School Board Media release stated that schools indicated that two nutrition breaks offered additional practice slots for intramural sports, and more sustained time for outdoor play (Thames Valley District School Board, 2011). However, it is not known whether the Thames Valley District School Board moved from the theoretical availability for more intramural practice to the actual increase of physical activity because of the additional 40-minute break.

It was also argued in the Woehrle study that two longer time blocks for recess provided an increased opportunity for students to engage in up to 20 minutes of continuous physical activity, compared to previous schedules where students had recess time that was limited to only 10-15 minutes (Woehrle et al., 2008). Again, there was no follow-up study to demonstrate that the extra time for physical activity was indeed used strategically.

Yet, creating opportunities for children's physical activity does not automatically translate into children using those opportunities to achieve MVPA. Gauthier et al., (2012), the first group to

study physical activity (PA) trends between BSD and TSD schedules, found that students who followed the TSD schedule, accumulated on average more step counts per day than students in the BSD schedule. This finding is consistent with a previous study done by Mahar and colleagues in 2006, which found that short, planned, ten-minute sessions of PA increased overall step counts for students during the school day, compared to longer unstructured breaks (Mahar et al., 2006). Although one limitation of these studies is that step counts do not provide evidence of the PA quality or intensity, both studies demonstrate that perhaps an increase in the length of time blocked for PA, as is the case in BSD scheduling, does not result in increased PA for students. The ParticipAction Report Card on Physical Activity for Children and Youth 2016 notes that more research is needed to evaluate the actual quality of physical activity at school (Active Healthy Kids Canada, 2016).

2.2.d. Eating Behaviour and School Schedule

A preliminary study was performed by Dorman et al., (2013) of the school setting, comparing food consumption of children in grades 3 and 6, using either the traditional or BSD scheduling. This study highlighted the importance of assessing scheduling changes and their impact on food behaviors, prior to their implementation. While the students in the BSD schedule did not have significantly healthier lunch content, Dorman et al. (2013) found that parents/guardians typically packed two beverages for children using the BSD schedule; presumably because this schedule offered two breaks for eating, versus the one break in the traditional schedule. A study done by Neilson in 2014 confirmed that BSD student lunches contain additional beverages, most often sweetened, as well as additional "snack food" items (Neilson, 2014). Both studies suggest that

the BSD does not have a positive effect on the quality of packed lunches, and Neilson's study suggests that the BSD might actually have a negative effect on student's health (Neilson, 2014). Despite this literature, some school boards and health unit websites, articulate the "nutritional benefits" of the Balanced School day (ex. Grand Erie District School Board, 2010; Ottawa Carleton Assembly of School Councils, 2012). These claims are however, unsubstantiated and reveal a gap in understanding in the links between student nutrition and the school schedule. In previous studies on nutrition at school, including the Healthy Schools Act, there is a focus on choosing healthy foods, and categorizing what is in student lunches (Laurence, 2012; Neilson, 2014). There is a need for additional studies, unconnected to ministry and school board economics, to provide valuable insight into student physical activity, nutrition, and engagement at school.

Canada's food guide sees children's nutrition as extending beyond merely *what* students eat, and looks at the eating environment *around* food consumption. The school schedule directly impacts these students' eating environment by setting the timeframe: when, and for how long students eat. While the Traditional School Day fit with the typical family schedule of eating three main meals spread over the day, it did not provide official snack breaks. Meanwhile, the Balanced School Day increased the number of official food breaks from one to two, but reduced the total time allowed for eating during the two food breaks. The impacts of these scheduling differences on both student hunger and academic success, has yet to be elucidated.

2.3 Physical Activity and Food Intake Behaviors Per Gender and Age

2.3.a. Gender

It is important to consider gender differences when examining school-based physical activity, and eating behaviors. There is much evidence in the literature that PA and food intake behaviors vary between boys and girls. Interestingly, research demonstrates that boys' food preferences are consistently less healthy than their female counterparts, at every age (Cooke and Wardle, 2005). Differences in physical activity are noticeable between the genders as well: girls often gravitate towards one-on-one and pretend-play, while boys typically enjoy more physically active and group play (Blatchford, Baines, & Pellegrini, 2003). Additionally, research by Thirkhill et al. (2016) and Gauthier et al. (2012), indicate that regardless of age, boys are more active, measured in step counts. It is therefore plausible that gender should also be given consideration when implementing broad school-based changes, including schedule changes.

2.3.b. Age

Likewise, the literature shows differences in both physical activity and nutrition based on a child's age. It is well documented that as children age, their voluntary participation in physical activity declines, even when accounting for differences in gender (Colley et al., 2011; Gauthier et al., 2012; Nettlefold et al., 2011). A child's age also influences their eating behaviors. For example, a child's ability to predict outcomes of their behavior improves with age (Atance & Meltzoff, 2005); thus a child in Grade 6 may understand that if they do not eat their lunch during their 20-minute nutrition break, they might be hungry afterwards; whereas a younger child might struggle with this concept. A health-promoting school schedule should therefore also adequately address age differences to optimize eating conditions and physical activity participation.

2.4 SELF REPORT

Important to any understanding of how to properly assess health indicators, is an understanding of the stakeholders (Ontario Agency for Health Protection and Promotion, 2015); one of the key stakeholders in children's school health are the children themselves.

Asking children to comment on their opportunities for eating and activity during the school day, and how they use these opportunities, is key to understanding how to optimize the school day for student success. Drawing from research by Morrow (2008), this study was designed with the understanding that children have the competency and skills to contribute to the creation of their optimal environment, in this case, the policy development for their school schedule. Children are not merely static characters in research but, can and should be allowed to have opinions on the way their environments are constructed (Mayall, 2001). In this thesis, we wanted to create space for them to participate in the structures that shape their lives: that is their daily school schedule (Mayall, 2001). Although adults and children do not always agree in their respective assessments of the child's health and well-being, children as young as six are accurate reporters on key health measures, when questions are presented in an illustrated or informative format (Riley, 2004). Exploring how students feel about their own eating environment, physical activity, and learning engagement at school, gives agency (Mayall, 2001, p.1-11) to a group often not consulted. In studies previously examining the BSD, while administrators and parents' positive opinions seem to initiate the implementation of the schedule change, children's less than favorable, or conflicting results, often are not considered and addressed (Woehrle et al., 2008). For example, in a survey study by Woehrle et al. (2008) one question in the survey asked key stakeholders to

report on their overall satisfaction with the BSD schedule on a scale of 1 to 5. Principals were most satisfied with the schedule, followed by custodian staff, parents, and teachers. The students, both junior and intermediate, were least satisfied with the new schedule (Woehrle et al., 2008). The schedule was adopted anyway.

There is currently very little research considering the perceptions of children regarding their school schedule, their PA, food-intake behaviors, and learning environment. Furthermore, the children's perceptions are often not considered when developing school policies. This may limit how the school environment can optimize children's academic and health outcomes.

2.5 RATIONALE

While acknowledging that the school is a microsystem influencing children's health, the current study aims to understand if, and how, students use opportunities for physical activity at school and aims to better understand the eating behaviors and the levels of learning engagement of students, within a typical school day. Additionally, the study seeks to prioritize children's voices and elevate the profile of a demographic that is often not directly consulted, particularly when changes to school schedules are proposed and adopted. Accordingly, the unique aspect of this study is that the dependent variables (physical activity, eating behavior and learning engagement) are self-reported by students.

2.6 PURPOSE

The purpose of this thesis was three-fold:

1) To give children a voice to describe their physical activity and eating behaviors and learning engagement at school;

2) To compare physical activity, eating behavior, and learning engagement at school, according to grade (3 versus grade 6), gender (boys versus girls), and schedule type (Balanced School Day versus Traditional School Day);

3) To provide recommendations for optimal school day scheduling based upon the student's perceptions of physical activity and eating behaviors and learning engagement.

2.7 Research Questions

Bearing in mind the above literature review, we sought answers to the following research questions:

1) Do grade 3 and grade 6 students have perceived differences in their physical activity levels, eating behaviors, and level of learning engagement during the school day?

2) Do boys and girls have perceived differences in their physical activity levels, eating behaviors, and level of learning engagement during the school day?

3) Do students with different school day schedules have perceived differences in their physical activity levels, eating behaviors, and level of learning engagement during the school day?

2.8 Hypotheses

We hypothesized that

1) For grade 3 and grade 6 students:

   a) grade 3 students would be hungrier, more often, during the school day;

   b) grade 3 students would report higher levels of physical activity than grade 6 students during recess and physical education classes;

   c) grade 3 students would report lower learning engagement throughout the day (measured by levels of fatigue and ability to focus).

2) For boys and girls:

   a) Boys would be hungrier more often during the school day, than girls;

   b) Boys would report higher levels of physical activity, than girls, during the school day;

   c) Boys would report lower learning engagement throughout the day (measured by levels of fatigue and ability to focus), than girls.

3) For students following the BSD or the TSD:

   a) Students using the BSD schedule would be hungrier than students using the TSD schedule, at key times in the school day;

   b) Students using the TSD schedule would report higher levels of physical activity than students using the BSD schedule;

   c) Students using the BSD and TSD would report similar levels of learning engagement throughout the day (measured by levels of fatigue and ability to focus).

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CHAPTER 3

MANUSCRIPT

A Grade 3 and 6, Student Self-Report: Eating Behaviour, Physical Activity and Learning Engagement During the School Day.

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ABSTRACT

Background: This study aims to describe the physical activity levels, eating behaviors and learning engagement levels as perceived by school-aged children in grades 3 and 6.

Method: Students in grades 3 and 6 completed surveys about school related physical activity, eating behaviors, and learning engagement at six schools: three, using the Balanced School Day (BSD) schedule; and three, using Traditional School Day (TSD) schedule. Students self-reported physical activity, eating behavior, and learning engagement, at key times in the school day. Student perceptions by grade, gender, and schedule were examined. Data were expressed as frequencies and percentages and the variables were cross-tabulated and analyzed using Chi-Square analyses.

Results: One hundred and seventy-three students (54% response rate) in grades 3 and 6 participated. Girls were less active during unstructured physical activity. Grade 3 students were hungrier and had greater difficulty focusing before their first food break. All students reported significant hunger and decreased learning engagement at the end of the school day. A greater percentage of TSD students reported being often-always active during physical education classes.

Conclusion: Daily structured physical activities should be offered to adequately address age and gender differences in participation levels. Younger children should be allowed snack breaks throughout the day to address hunger. Scheduling changes should incorporate considerations for differences between age and gender.

Keywords

Schedule, students, School, balanced day, physical activity, survey, eating behavior, nutrition

3.1 INTRODUCTION

Most Canadian children spend approximately 1/3 of their day in publicly funded schools. The school system is therefore a significant contributor to the public health of Canadian children (Ministry of Education, 2015a; Pascal, 2009). As such, it is understood that schools are not only academic institutions, but also hold some responsibility of ensuring the overall well-being of their students, as one of the key "environments" influencing Canadian children's health (Ministry of Education, 2014; Mũkoma & Flisher, 2004). Additionally, there is a reciprocal nature to a school's investment in students' health and increasing academic success. Physical activity throughout the school day has been shown to improve student achievement and readiness to learn, in addition to enhanced learning engagement (Ministry of Education, 2006a; Trudeau & Shephard, 2008; U.S. Department of Health and Human Services: Centers for Disease Control and Prevention, 2010). Similarly, research indicates that student-eating habits directly impact learning engagement, including: concentration, memory, and grade performance (Gunter & Daly, 2013; Taras, 2005).

Ontario Legislation for recess and food consumption at school existed in the earliest iterations of the Education Act, not only for student health reasons, but also to accompany the collective agreements for educators. Initially school days were designed around a typical parental, work-week schedule. Currently, the Ontario Education Act mandates that every school day must include a morning and afternoon recess (between 10-15 minutes in length) and a lunch break (between 40-60 minutes in length) (Ontario Education Act, 1990). Although this regulation leaves scheduling decisions to schools to meet their individual needs, prior to 2003 most schools in On-

tario followed a "Traditional School Day" timetable. The Traditional School Day (TSD) was based on a total of 300 minutes of instructional time, interrupted by two 15-minute recess breaks (morning and afternoon), and one 40-60-minute lunch break (midday).

Since 2003 however, school scheduling has undergone substantial changes: most students now remain at school for lunch, and administrators have reorganized the school to accommodate this change. Thus, many schools in Ontario have adopted the "Balanced School Day" (BSD) timetable. The BSD is a block schedule, consisting of two, 40-minute breaks: one in the morning, and one in the afternoon (Woehrle et al., 2008). During each of these breaks students have 20 minutes for eating and 20 minutes for recess, randomized amongst classrooms, in order to minimize the number of students on the playground.

Although many school boards across Ontario have adopted a BSD type of school day schedule, only a few peer-reviewed studies have examined these changes from both an academic and determinant of health perspective (Dorman et al., 2013; Gauthier et al., 2012; Thirkill et al., 2014; Woehrle et al., 2008; Wu, Macaskill, Salvadori, & Dworatzek, 2015). The study completed by Gauthier and colleagues (2012), revealed that students following the BSD did not experience increased step counts, when compared to TSD counterparts. The study by Dorman and colleagues (2013), demonstrated similar nutrient content in home-packed lunches, for students following both the BSD and TSD schedules. In addition, although health impact assessments are now being used across sectors in Ontario to monitor the health ramifications of certain policy and procedural changes (Rattle, 2015), as of 2016, no government-led health impact study has assessed the impact of school scheduling.

A school's schedule is important, because it regulates the frequency, duration, and time-of-day for 'breaks' – which are key opportunities for children to relax, take a mental break from the classroom, interact socially, obtain needed nutrients and engage in physical activity. We can hypothesize that an ideal schedule would be one, in which students have sufficient time and frequency for these activities to optimize learning engagement as well as alertness and readiness to focus during instructional periods. These opportunities are therefore key factors in a student's academic success and overall wellbeing.

Children's Contribution to their School Environment

Asking children to comment on their perceptions about opportunities for eating and activity during the school day, and how they use these opportunities, is key to understanding how to optimize the school day for student success. Drawing from research by Morrow (2001) we believe that children have the competency and skills to contribute to the creation of their school environment, by influencing the policies that organize their school day. Children are not merely passive participators in research but, as Mary Kellet argues in her book: *Rethinking Children and Research*, children should be encouraged to assess and communicate perceptions on their own lives. Fleming & Boeck (2012) also suggest research that involves children, should allow children to be reflective on their experiences (p. 15).

Although adults and children do not always agree in their respective assessments of the child's health and well-being, children as young as six are considered accurate reporters on key health measures, when questions are presented in an illustrated or informative format (Riley, 2004). Exploring how students feel about their own eating environment, physical activity, and learning

engagement at school, gives 'agency' to a group often only spoken for (Mayall [Introduction], 2001, 3). The articulated perceptions of our community's children, by our community's children, can and should impact current policy about the school day, as these children will most certainly be affected by any decisions (Leitch, 2007).

When examining the school environment for children, it is also important to consider the differences in health behaviors according to age and gender. For example, as children age, their voluntary participation in physical activity during the school day typically declines (Colley et al., 2011; Gauthier et al., 2012; Nettlefold et al., 2011). Differences in physical activity are noticeable between the genders as well; girls often gravitate towards one-on-one and pretend-play, while boys typically enjoy more physically active and group play (Blatchford et al., 2003; Mulvey, 2009; Woods, Graber, & Daum, 2012). At the same time, from a developmental perspective, a child's ability to predict outcomes of his/her behavior choices improves with age (Atance & Meltzoff, 2005); thus, a child in Grade 6 likely understands that if they do not eat their lunch during the 20-minute nutrition break, they will be hungry afterwards. A younger child may struggle with this concept. A health-promoting school schedule must adequately address gender and age differences to optimize opportunities for physical activity, eating and learning.

3.2 PURPOSE

The purpose of this paper was therefore three-fold:

1) to give children a voice to describe their physical activity and eating behaviors and learning engagement at school;

2) to compare physical activity, eating behavior, and learning engagement at school per grade (grade 3 versus grade 6), gender and schedule type (Balanced School Day versus Traditional School Day);

3) to provide recommendations for optimal school day scheduling based upon the student's perceptions of physical activity and eating behaviors and learning engagement.

3.3 METHODOLOGY

Ethical approval for this study was granted by the two participating school boards and the research ethics board of Laurentian University (See Appendix A). Using the school information finder on the Ontario's Ministry of Education website, ten schools, five from each school board, were approached to participate in the study, of these six agreed to participate in this study. The school information finder, on the Ministry of Ontario website was used to ensure that there was an equal representation from schools of differing socio-economic status, and all schools were within a 20km radius from each-other.

Student participants were recruited from grades three and six from the six elementary (Grades JK-8) schools among two school boards in the same community in Ontario. In school board I, three of four schools used the BSD, the fourth school followed the TSD. In school board II, both schools used TSD. Of these six schools: three had above the provincial average for parental education levels and household income and three schools had below the provincial averages for the same.

Study Design

In the participating schools, parents and guardians who had a child in either grade three or grade six were given an information package about the study and were asked to provide informed consent for their child to participate. On the day of the survey administration, students who had received parental/guardian informed consent were asked to provide written assent, confirming their personal decision to participate in this study. Students were not excluded for any reason except lack of parental/guardian consent and/or lack of personal assent. Of the 320 students who were invited to participate, 173 students completed the School Physical Activity, Eating Behaviour and Learning Engagement Survey (SPAEBLES) survey (54% response rate). Table I describes participants by grade, gender and schedule type.

Table I: Description of Participants

		Participants	
		%	N
All Students		100	173
Gender			
	Boy	54.9	95
	Girl	45.1	78
Grade			
	3	49.1	85
	6	50.9	88
Schedule			
	BSD	45.7	79
	TSD	54.3	94

Survey data were collected in the month of June at six elementary schools. All participating classes in each school were surveyed at the same time. One research assistant was assigned to each classroom to collect consent forms, set the context for the survey, collect assent forms, and to administer the survey. The research assistants read a script that was developed by the research team, to ensure consistency of messaging. The research assistants had training in childhood development and learning, and had experience with the targeted age groups. Each student survey package contained two labels with a unique code. The code was used in place of a signature to identify unique student data, and to protect the identity of the student answers. After signing their assent forms, students were asked to take one of the coded labels, adhere it to their assent form and hand it in. Students attached the other label to their survey. Knowing that scheduling was one of the independent variables examined from the surveys, the schools who followed BSD schedules where coded differently than those from schools following TSD schedules. Surveys and assent forms were stored separately. Surveys took approximately 20 minutes to complete. (See Appendix B)

Survey Development

The School Physical Activity, Eating Behaviour and Learning Engagement Survey (SPAEBLES) was designed using Arlene Fink's series for graduate and undergraduate survey design and analysis: The Survey Kit, second edition (Fink, 2003). The final product was a 20-minute questionnaire containing three sub-sections:

i) Student perceptions of physical activity during their school day.

Five questions were posed about physical activity. Students were given a sliding scale and asked to circle if they were (not at all / hardly ever / sometimes / quite often / always) active during recess and physical education class. Additional survey items asked students to identify whether they were involved in a school-organized sport or activity during recess or after school, and whether they felt they received enough physical activity time during the school day. Minor adaptations to the PAQ-C survey (items 2-8) were used for the physical activity items in the SPAEBLES (Kowalski, Crocker, & Donen, 2004).

ii) Student perceptions of eating behaviors during their school day.

In total, nine questions were posed about eating behaviors. Three questions related to children's perception of their satiation levels at three different times of the day (10:00; 11:30; & 14:00); these times were strategically picked so that they did not fall during a scheduled eating break for any of the schools. Students were asked to record their personal hunger levels on a sliding scale (full; just right; hungry) for each time interval. Eating environment questions were derived from numerous visual analogue scales, to assist students in identifying the specific times they felt most hungry. Questions were added to assess student perceptions of their eating time (e.g. perception of duration and satiety levels)

iii) Student perceptions of learning engagement during their school day.

Six questions were posed about learning engagement (described as having difficulty focusing and being tired). Three questions related to children's perception of their ability to 'focus' at three different times of the day (10:00; 11:30; & 14:00); these times were strategically picked so that they did not fall during a scheduled eating break or recess for any of the schools. In addition,

students were asked to record when they felt the ‘most’ and ‘least’ tired at the same 3 time points.

The members of this research team reviewed existing surveys to identify relevant questions in developing the SPAEBLES. Questions from surveys were tailored per the objectives of this project. The compilation of vetted student engagement questionnaires, and the recommendations about student self-report, by Fredricks et al. (2011) were consulted in developing a scale for student responses, and in using direct times for students to assess their focus levels.

Members external to the research group reviewed the survey: including Ontario Certified Teachers, and children of the 7 to 12-year age-range. This ensured item clarity, wording appropriateness, and a reasonable time allowance for completion.

Statistical Analysis

The answers to each question were first coded numerically. Questions that had a yes or no answer were coded: 0 for no and 1 for yes. Questions that required students to rate their hunger levels were coded 1 for the chosen answer, and 0 for the other possible answers. For example, in the question asking students to comment on their hunger at 10:00am the options were: “I felt hungry”, “I felt just right”, or “I felt full”. If the student circled the option: “I felt hungry”, that option was coded as “1” and the other, unselected options, were coded as 0.

The frequencies of each answer were calculated for each question. The responses were then analyzed separately by each dichotomous variable: grade, gender, and schedule. Chi-square analyses

were conducted to determine if significant differences existed in the frequency responses: between boys and girls, between grades three and six students, and between students who followed the Balanced School Day (BSD) and those who followed the Traditional School Day (TSD).

All statistical analyses were conducted using SPSS statistical software (version 20.0 SPSS Inc.) For all analyses, statistical significance is reported at levels less than .05.

3.4 RESULTS

In total, 173 students participated in the survey: 94 boys and 79 girls. There were 84 students were in grade 3 and 89 students were in grade 6. There were 79 students from schools following the BSD schedule and 94 students from schools following the TSD schedule, who participated in the study (see Table II). Surveys were done in June, after EQAO testing was finished.

Student Perceptions about Physical Activity

Grade: Significantly more grade 3 students reported being 'always' or 'often' active during recess than their grade 6 counterparts: (Grade 3: 80%; Grade 6: 65%). A chi-square test was performed and a significant relationship was found between grade and level of activity at recess, X^2 (1, N = 173) = 4.591, p = 0.032. See Figure 1

During physical education class (structured physical activity time led by a teacher), grade 3 and grade 6 students reported similar activity levels. A chi-square test was performed and no signifi-

cant relationship was found between grade and level of activity during physical education class, X^2 (1, N = 173) = 1.610, p = 0.204. See Figure 1.

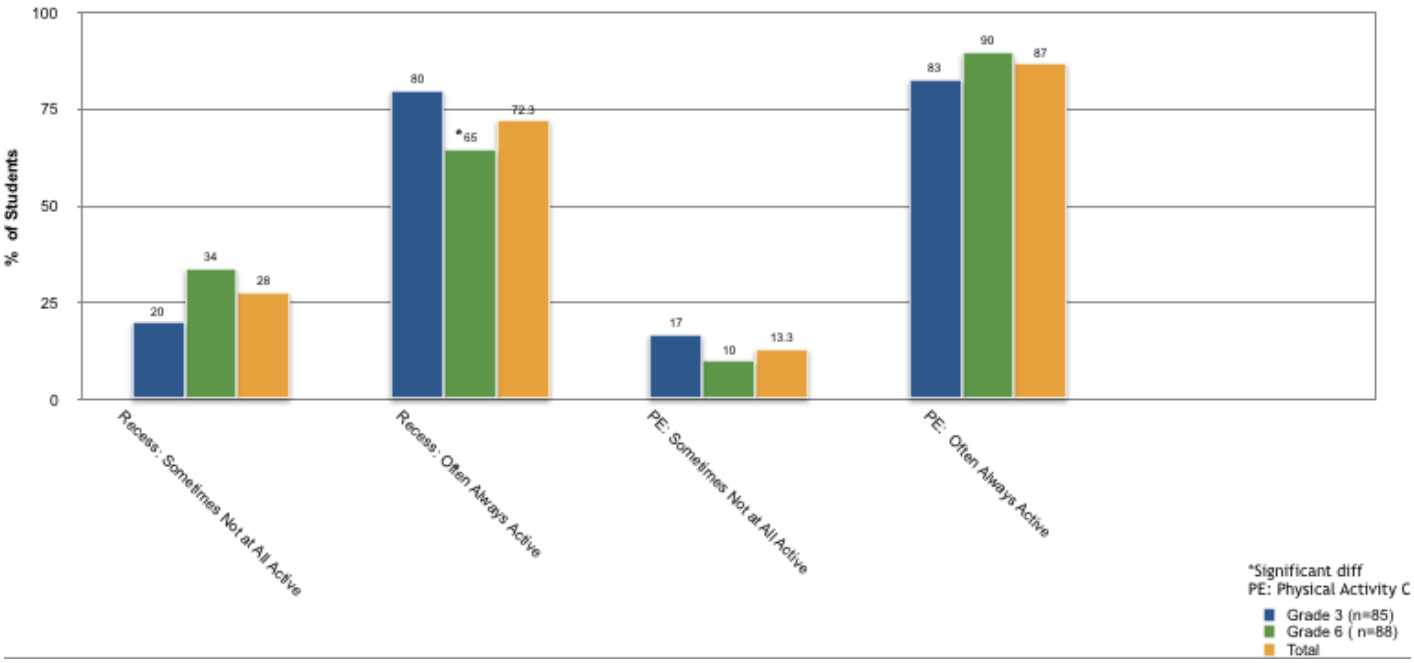

Figure 1: Comparison of Physical Activity by Grade

Gender: In our study, 87% of boys reported being 'always' or 'often' active during recess compared to 55% of girls. A chi-square test was performed and a significant relationship was found between gender and level of activity during recess, X^2 (1, N = 173) = 22.10, p = 0.000.

During physical education (PE) class, overall 87% students reported being often or always active. (Boys: 85; Girls: 89%). A chi-square test was performed and no significant relationship was found between gender and level of activity during physical education class,
X^2 (1, N = 173) = 0.540, p = 0.463. See Figure 2.

Students were also asked about participation in school-organized physical activities during school; a little less than half of boys and girls said they participated in school organized physical activities. (Boys: 44%; Girls: 47%). A chi-square test was performed and no significant relationship was found between gender and student participation in school-organized physical activity during school hours, X^2 (1, N = 173) = 0.130, p = 0.718. When students were asked about participation in after school physical activities, the results were similar (Boys: 37%; Girls: 48%). A chi-square test was performed and no significant relationship was found between gender and student participation in in physical activities after school, X^2 (1, N = 173) = 0.195, p = 0.166.

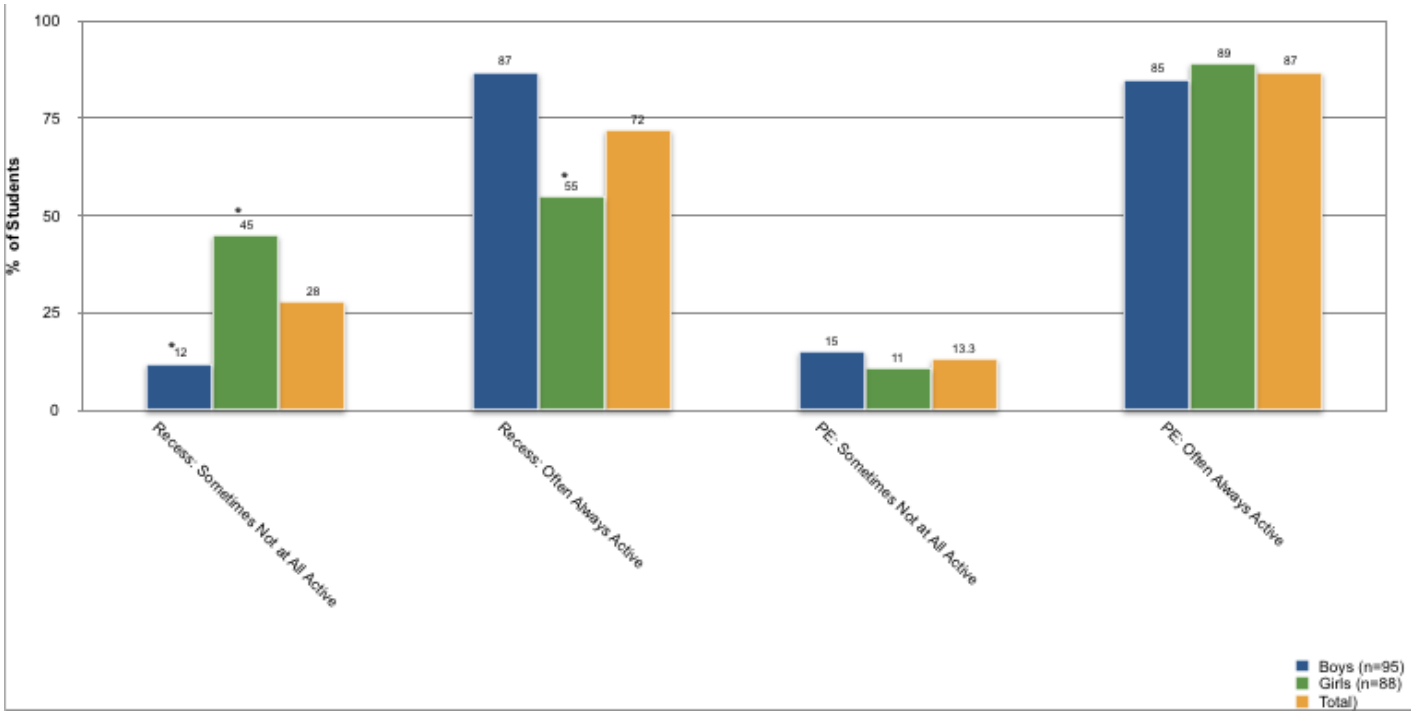

Figure 2: Comparison of Physical Activity by Gender

Schedule: Overall students on both schedules had similar levels of participation in recess. A slightly higher percentage (30%) of students on the BSD schedule reported being sometimes-not

at all active during recess, compared to students on the TSD schedule (26%)%), and more TSD students (75%) reported being often-always active at recess, compared to BSD students (70%). A chi-square test was performed and no significant relationship was found between students' perceptions of their level of physical activity during recess and their school schedule, X^2 (1, N = 173) = 0.503, p = 0.478.

A higher percentage (18%) of students in the BSD schedule, reported being sometimes-not at all active in PE class, compared to that of TSD students (10%), and more TSD students (90%) reported being often-always active in PE class, compared to BSD students (82%). A chi-square test was performed and no significant relationship was found between students' perceptions of their level of physical activity during physical education class and their school schedule, X^2 (1, N = 173) = 0.503, p = 0.478.

There were slight differences by schedule of participation in organized physical activities during school hours (BSD: 43%; TSD: 47%). A chi-square test was performed and no significant relationship was found between schedule type and participation in organized physical activity during school hours, X^2 (1, N = 173) = 0.315, p = 0.575.

Participation in organized physical activities after school hours also showed only slight differences by schedule (BSD: 41%; TSD: 44%). A chi-square test was performed and no significant relationship was found between schedule type and participation in organized physical activity after school hours, X^2 (1, N = 173) = 0.224, p = 0.636. See Figure 3.

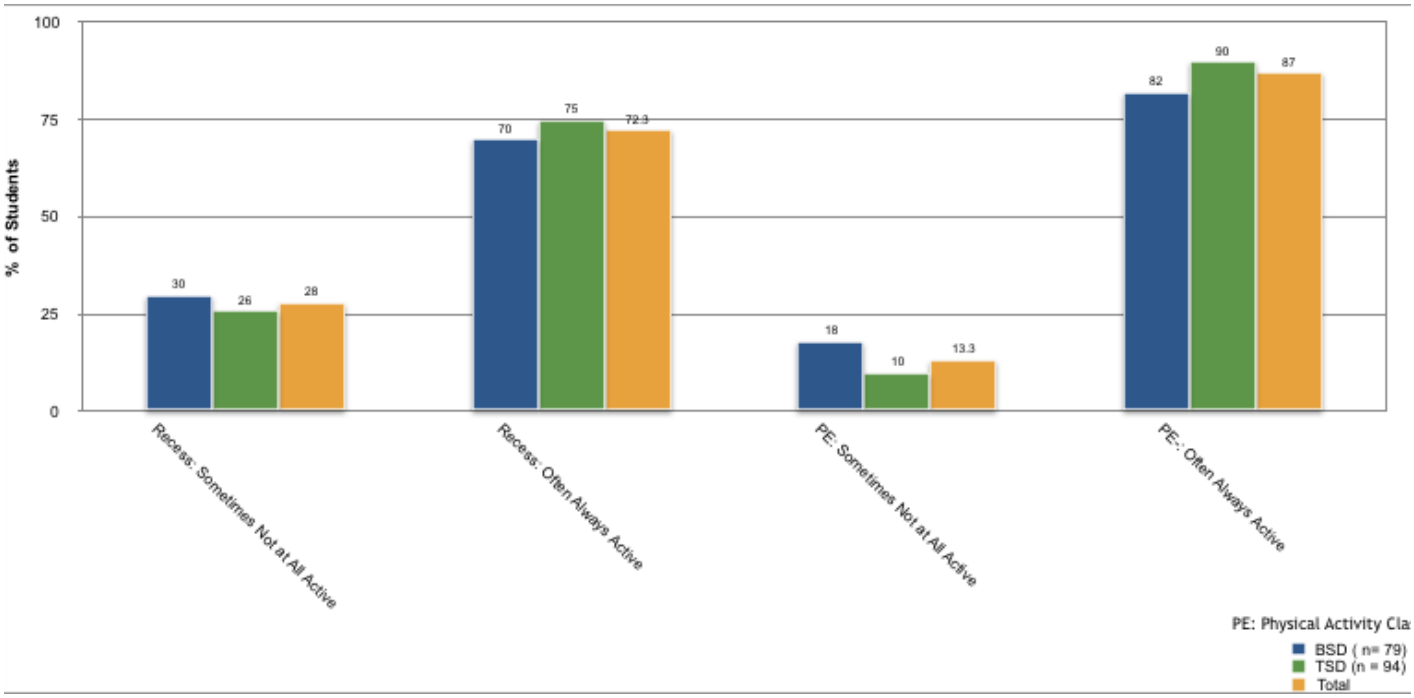

Figure 3: Comparison of Physical Activity by Schedule

Student Perceptions of Eating Behaviors

Grade: Most students reported that they 'ate breakfast before school,' (90% of grade 3 students and 96% of grade 6 students). A chi-square test was performed and no significant relationship was found between student grade and breakfast eating, X^2 (1, N = 171) = 1.811, p = 0.178.

However, 35% of the grade 3 students reported that when they arrived at school, they were hungry, whereas only 15% of grade six students reported being hungry once arrived at school A chi-square test was performed and a significant relationship was found between student grade and hunger upon arrival to school, X^2 (1, N = 172) = 9.621, p = 0.002. See Figure 5.

Though not significant, more grade 3 students consistently reported being hungry at 10:00, 11:30 and 14:00, than their grade 6 counterparts. A chi-square test was performed and no significant relationship was found between student grade and hunger at 10:00, X^2 (1, N = 172) = 2.110, p = 0.348, A chi-square test was performed and no statistically significant relationship was found between student grade and hunger at 11:30, X^2 (1, N = 172) = 3.917, p = 0.141. Additionally, a chi-square test was performed and no statistically significant relationship was found between student grade and hunger at 14:00, X^2 (1, N = 172) = 0.354, p = 0.552.

Many students also reported that they were hungry at the end of the school day (Grade 3: 70% and Grade 6: 70%). A chi-square test was performed and no significant relationship was found between student grade and hunger at the end of day, X^2 (1, N = 172) = 2.247, p = 0.325.

Most students reported eating at two separate times during the school day. More grade 3 students reported that they felt they did not have enough time to eat during these eating times (Grade 3: 32%; Grade 6: 18%). A chi-square test was performed and a significant relationship was found between student grade and feeling as though they did not have enough time to eat, X^2 (1, N = 171) = 5.636, p = 0.050. See Figure 4.

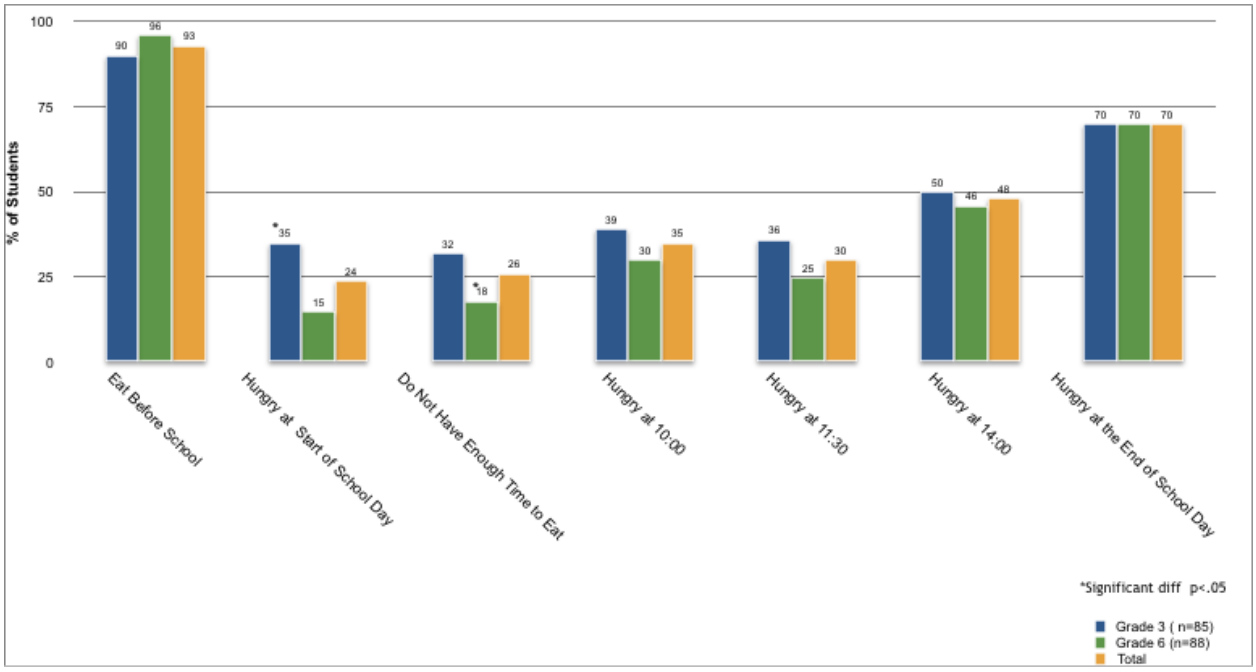

Figure 4: Comparison of Eating Behaviors by Grade

Gender: Most students, regardless of gender, reported that they 'ate breakfast before school,' (Boys: 95%; Girls: 92%). A chi-square test was performed and no significant relationship was found between student gender and eating before school, X^2 (1, N = 171) = 0.398, p = 0.333. There were no large differences between boys and girl's perceptions of hunger upon arrival at school: a chi-square test was performed and no significant relationship was found between student gender and hunger at the start of the school day, X^2 (1, N = 172) = 0.298, p = 0.585. A chi-square test was performed and no significant relationship was found between student gender and hunger at 10:00, X^2 (1, N = 172) = 0.861, p = 0.650; at 11:30, X^2 (1, N = 172) = 0.961, p = 0.619; or at 14:00, X^2 (1, N = 172) = 1.593, p = 0.207. See Figure 5.

Most students reported eating at two separate times during the school day. A little over one quarter of boys and girls felt that they did not have enough time to eat during nutrition breaks (Boys: 23%; Girls: 27%). See Figure 5.

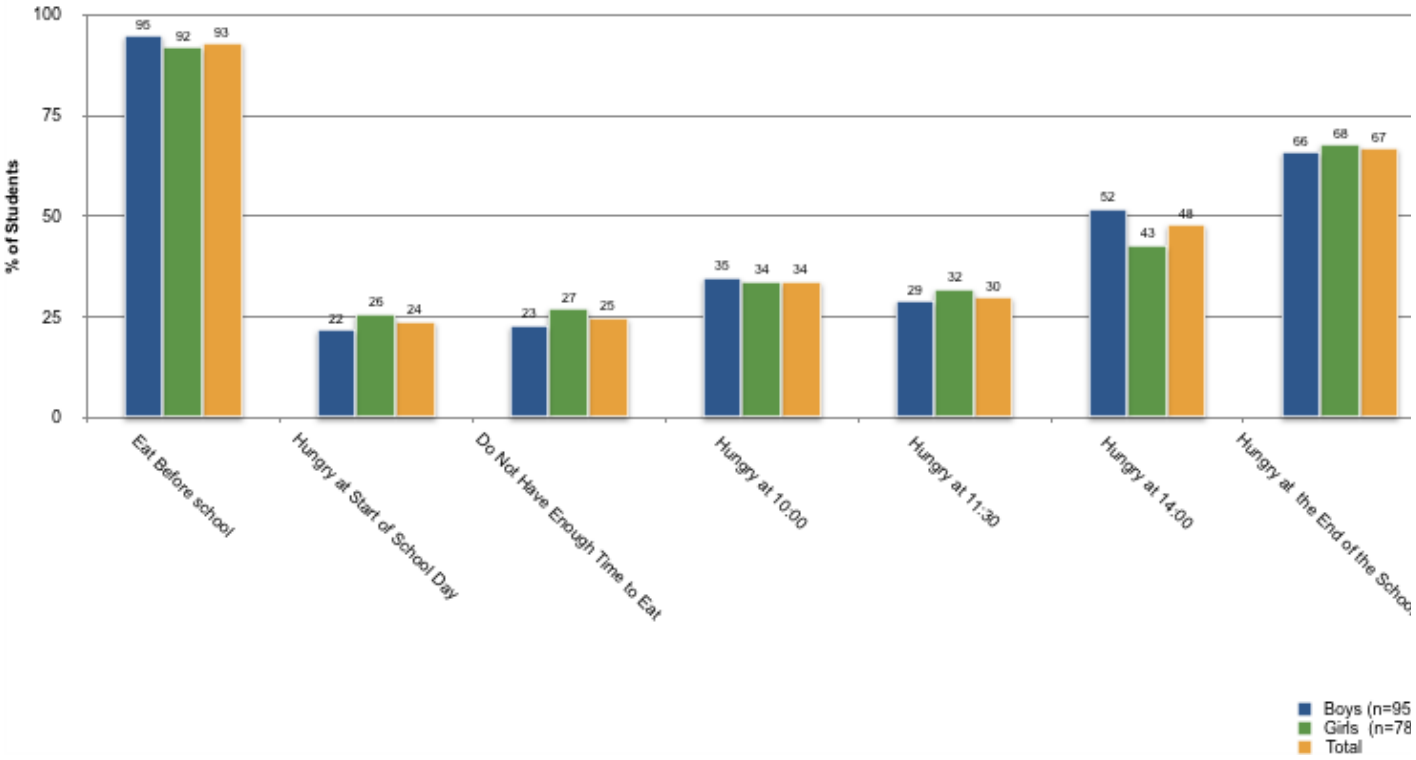

Figure 5: Comparison of Eating Behavior by Gender.

Schedule: There were no significant differences in breakfast consumption of students and school schedule type: most students, regardless of school schedule, ate breakfast (BSD: 93%, TSD: 94%). A chi-square test was performed and no significant relationship was found between breakfast consumption and school schedule, X^2 (1, N = 171) = .100, p = 0.752. A chi-square test was performed and student perceptions of hunger upon arrival were also not significant between schedule types, X^2 (1, N = 12) = .485, p = 0.486. Chi-square tests were performed and no significant relationship was found between student gender and hunger at 10:00, X^2 (1, N = 172) = 1.427, p = 0.490; at 11:30, X^2 (1, N = 172) = .1.492, p = 0.474; or at 14:00, X^2 (1, N = 172) =

1.061, p = 0.303, or at the end of the school day between the two school schedules X^2 (1, N = 172) = 1.538, p = 0.463. Most students reported eating at two separate times during the school day. One quarter of the students following each schedule, reported that they did not have enough time to eat during their scheduled eating times. See Figure 6.

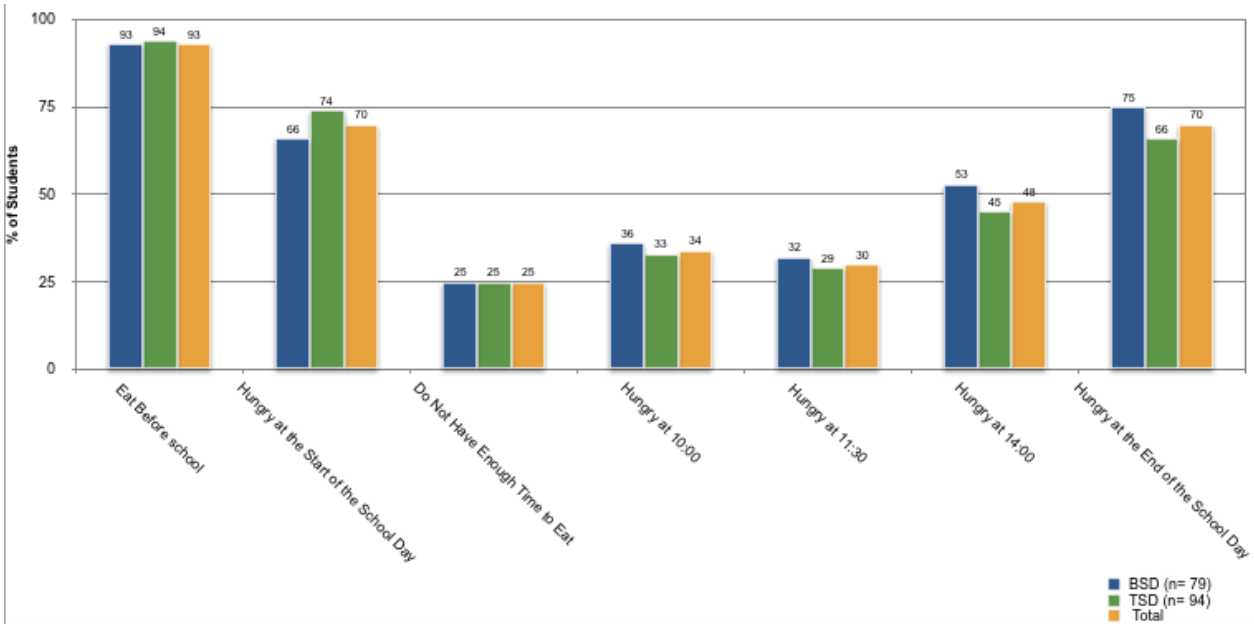

Figure 6: Comparison of Eating Behavior by Schedule

Student Perceptions of Learning Engagement

Although the students self-reported difficulty of focus on a scale, for the purposes of reporting the survey responses were dichotomized. This means that if a student reported that it was 'sometimes hard' or 'very hard' to focus at a given time, the results were analyzed to indicate that the student had "difficulty focusing" at the given time.

Grade: More grade 3 students found it 'sometimes hard' or 'very hard' to focus at 10:00, than their grade 6 counterparts (Grade 3: 37%; Grade 6: 25%). A chi-square test was performed and

no significant relationship was found between grade and difficulty with focus at 10:00, X^2 (1, N = 171) = 2.840, p = 0.092, but the number was approaching significance.

More grade 3 students found it 'sometimes hard' or 'very hard' to focus at 11:30, than their grade 6 counterparts (Grade 3: 40%; Grade 6: 25%). A chi-square test was performed and a significant relationship was found between grade and difficulty with focus at 11:30, X^2 (1, N = 171) = 6.063, p = 0.048.

More grade 3 students found it 'sometimes hard' or 'very hard' to focus at 14:00, than their grade 6 counterparts (Grade 3: 50% Grade 6: 57%). However, a chi-square test was performed and no significant relationship was found between grade and difficulty with focus at 14:00, X^2 (1, N = 171) = 3.077, p = 0.380. See Figure 7.

Although there was no significant relationship between grade and perceptions of tiredness at 10:30, 11:30 and 14:00, the data did show that over 50% of students found that they were most tired at 14:00.

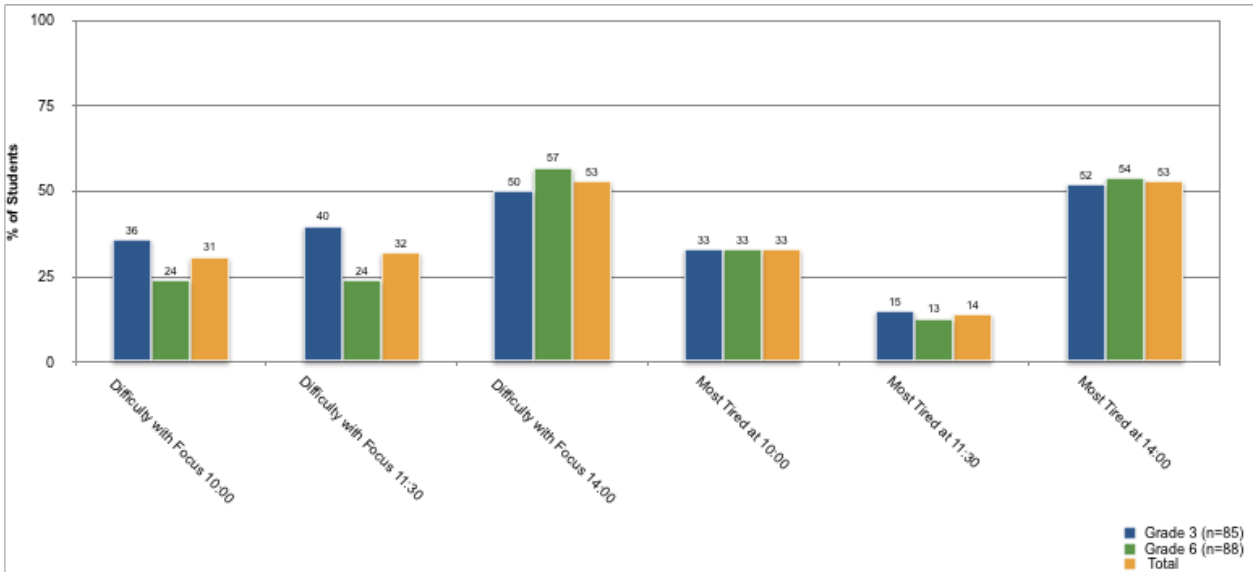

Figure 7: Comparison of Learning Engagement by Grade

Gender: Although more girl students found it 'sometimes hard' or 'very hard' to focus at 10:00, than their boy counterparts (Boys: 27%; Girls: 34%), a chi-square test was performed and no significant relationship was found between gender and difficulty with focus at 10:00, X^2 (1, N = 171) = 0.985, p = 0.321.

More boy students found it 'sometimes hard' or 'very hard' to focus at 11:30, than their girl student counterparts (Boys: 42%; Girls: 26%). A chi-square test was performed and a significant relationship was found between gender and difficulty with focus at 11:30, X^2 (1, N = 171) = 8.505, p = 0.014.

More boy students found it 'sometimes hard' or 'very hard' to focus at 14:00, than their girl student counterparts (Boys: 58% Girls: 49%). However, a chi-square test was performed and no

significant relationship was found between gender and difficulty with focus at 14:00, X^2 (1, N = 170) = 3.355, p = 0.340. See Figure 8.

Although there was no significant relationship between gender and perceptions of tiredness at 10:30, 11:30 and 14:00, the data did show that over 50% of students found that they were most tired at 14:00. See Figure 8.

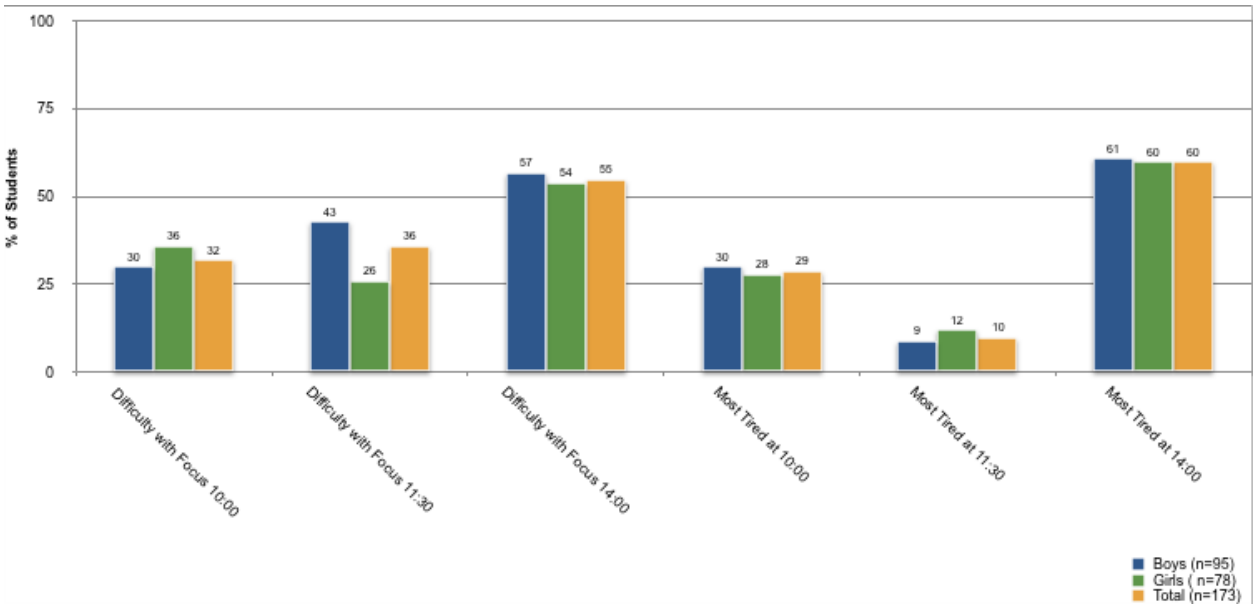

Figure 8: Comparison of Learning Engagement by Gender

Schedule: Although more BSD students found it 'sometimes hard' or 'very hard' to focus at 10:00, than their TSD counterparts (BSD: 35%; TSD: 26%), a chi-square test was performed and no significant relationship was found between school schedule and difficulty with focus at 10:00, X^2 (1, N = 171) = 1.435, p = 0.231.

More BSD students found it 'sometimes hard' or 'very hard' to focus at 11:30, than their TSD student counterparts (BSD: 38%; TSD: 28%). A chi-square test was performed and a significant

relationship was found between school schedule and difficulty with focus at 11:30, X^2 (1, N = 171) = 0.130, p = 0.076.

More BSD students found it 'sometimes hard' or 'very hard' to focus at 14:00, than their TSD student counterparts (BSD: 55% TSD: 51%). However, a chi-square test was performed and no significant relationship was found between school schedule and difficulty with focus at 14:00, X^2 (1, N = 170) = 2.990, p = 0.393. See Figure 9.

There were significant relationships between school schedule and perceptions of tiredness at 10:30, X^2 (1, N = 168) = 8.152, p = .017, and 14:00, X^2 (1, N = 168) = 8.152, p = .017. See Figure 9.

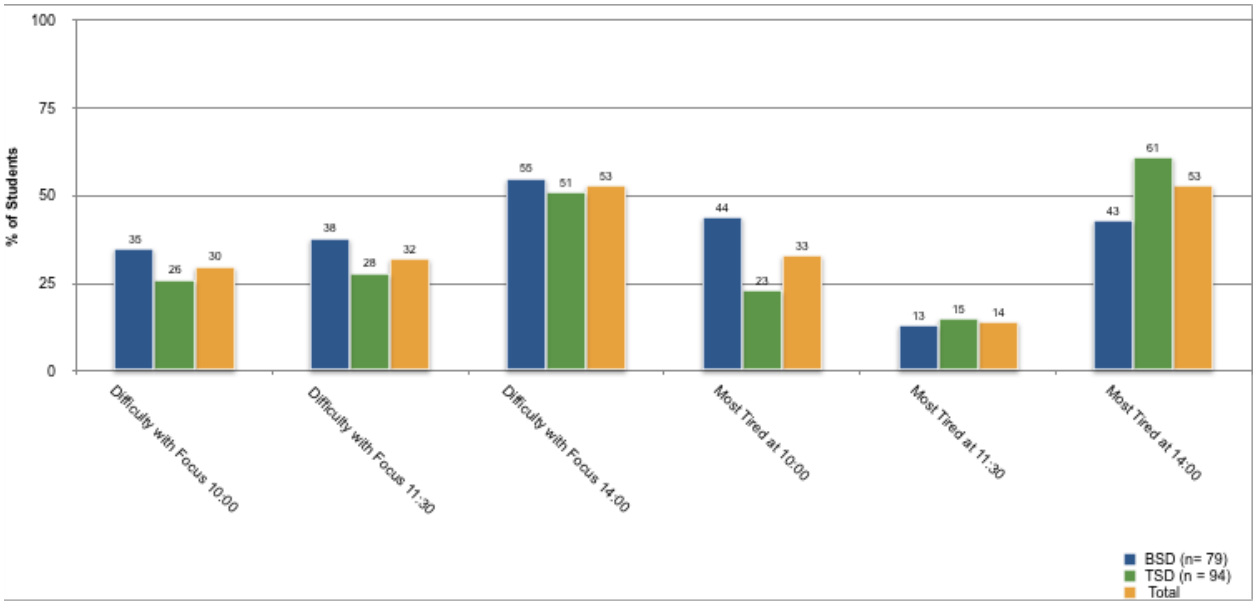

Figure 9: Comparison of Learning Engagement by Schedule

3.5 DISCUSSION

Students are rarely asked to comment on their personal perceptions of factors contributing to their health and wellbeing, as they relate to their school experience. This survey-based study attempted to gather information from students, about their school environment, regarding their perceptions on their physical activity levels, eating behaviours, and learning engagement. We compared student responses, based on grade, gender, and school schedule to find trends in student responses that indicate areas for future research and school-schedule modification. We summarize these findings below.

Student Perceptions about Physical Activity

It is important to note that many of the student's perceptions about their own physical activity directly reflect findings in the literature. Two key findings are highlighted with respect to physical activity. First, daily physical education classes are essential to the health of Canadian children. Research has consistently shown that older children are less active than younger children and girls are less active than boys (Gauthier et al., 2012; Nettlefold et al., 2011). Participants in this study also perceived this to be true. Significant differences in gender and grade associated with physical activity were found during recess; boys were more active than girls, and grade 3 students were more active than grade 6 students. Importantly, this difference was only seen during recess-time — time regularly scheduled for unstructured play—and is consistent with the literature that shows boys had more step counts than girls, and younger children had more step counts that older children(Jaunzarins et al., 2014; Thirkill et al. 2016). These findings, both in previous studies and in our own research, suggest that structuring physical activity during recess

could potentially recover the physical activity deficits for girls and older children during this time.. There were no differences in reported activity levels for gender or grade when students were engaged in structured physical activity during physical education class, also consistent with the literature (Tudor-Locke et al., 2006). Not only does this data highlight the critical nature of scheduled physical education classes for achieving recommend daily activity levels, but we would argue that it also underlines the fact that every school should have the means to provide opportunities for daily, structured physical activity, including but not limited to physical education class. Ideally, schools should also employ a physical education specialist who is capable of structuring activities as well (reviewed in Thirkill et al. 2016).

Second, students in this study also reported lower participation rates in structured school activities for students in grade 3. This is a general problem for many schools, in part because of limitations on space in relation to student numbers, but also because sport is typically a priority activity for older students. Structured sport (e.g. basketball) tends to be unavailable for younger children and often limits participation to students who qualify for, and play on, team sports. Those students, who do not make the team, are unable to participate. We urge schools to become more inclusive about school-planned physical activity; for example, promote activities with age appropriate skill requirements. Again, a trained physical education specialist would be well positioned to design these activities. Interestingly we found no difference in student's perception of physical activity participation between BSD and TSD schools. When the BSD was first implemented in schools, its proponents argued that there would be an increase in physical activity participation because schools could run activities like basketball practice in two separate nutrition breaks, instead of just having one practice at lunch break. However, there is a difference between a sched-

uling framework that *theoretically offers* more opportunities for students to participate in PE, and a system that has a greater number of children *participating in these PE opportunities*. Our findings are in line with those of Gauthier et al. (2012), who concluded that the BSD schedule did not result in greater physical activity for students.

While our findings for unstructured physical activity participation during recess supported the findings in the literature, surprisingly, we found a significant difference in reported rates of participation in physical education class between schools using the BSD and TSD schedule. Because physical education classes are structured, one would not expect differences in participation rates, irrespective of scheduling. As McKenzie, Sallis, Kolody, & Faucette (1997) demonstrate: the presence of highly trained physical activity teachers in schools improves the quantity and quality of students' participation in physical education class. Perhaps, differences in teacher training amongst the schools create the effect of greater participation in physical education classes at the BSD schools.

We advocate for a physical education specialist at every school to ensure that adequate activity is achieved during scheduled physical education classes for all children, irrespective of school schedule.

Student Perceptions of Eating Environment

It is well documented that student hunger impacts student success (Gunter & Daly, 2013; Taras, 2005) although until recently little research has examined the impacts of school scheduling on the eating environment and diet (Dorman et al., 2013a,b). Two findings of importance were noted in this study with respect to eating environment and food.

First, we were happy to find that most children (reported eating breakfast. However, despite this, many third-graders reported being hungry upon arrival to school. We hypothesize that younger students may not be capable of accurately predicting and managing their food needs, in comparison to older children (Atance & Meltzoff, 2005). Due to this, students may not be eating enough for breakfast. This is an important consideration, given the implementation of the full-day kindergarten program in Ontario, where children as young as three must now adapt to a school-day schedule. We speculate that if children eight years of age have difficulty regulating their food consumption, it is likely that younger counterparts are also arriving at school hungry (i.e. kindergarten - grade 2). This hypothesis is supported by the fact that significantly more grade 3 students than grade 6 students felt as though they did not have enough time to eat during nutrition breaks. This again suggests that younger students have a reduced ability to regulate their eating, per scheduled requirements. School administrators should therefore consider allowing younger children, regardless of schedule, to access their packed lunches in the morning. In addition, a healthy snack program, or the implementation of a healthy breakfast program could address the hunger concerns for this cohort of students.

Second, it is important to note that many students (70%), regardless of grade, gender, or school schedule, reported feeling hungry at the end of the school day. Parents/guardians need to be reminded of this so that they can plan and provide healthy snacks upon arrival at home or at an after-school program.

Student Perceptions About Learning Engagement

The last component of this study examined *when* during the school day children felt they were most capable of focusing and *when* they were the most and least tired, as a reflection of learning engagement. Many students identified 14:00 as the most difficult time of the day to focus. This was also the time when students perceived themselves to be the 'most tired'. This information likely comes as no surprise to educators, and we therefore recommend they continue to plan their end of day classwork noting the appreciable student fatigue and lack of ability to focus at this time. The differences between when students on each schedule were most tired is interesting, and perhaps attributed to the timing of eating and recess breaks.

3.6 CONCLUSION

Throughout this study we have asked ourselves: How do students use their opportunities for physical activity? When are students most engaged in learning? When do students naturally need breaks for activity and eating? Are students getting those opportunities to be active and to eat when they most need it?

In the absence of a board-wide or provincial policy on scheduling at school, school decision-makers should consider offering schedule modifications to accommodate some of the needs highlighted in this study. From a practical perspective, we propose the following, five recommendations for implementation.

1. That children in kindergarten to grade 3 be allowed to access their packed lunches throughout the day, as needed.

2. That classroom activities for the end-of-day period are planned with children's fatigue, hunger, and focus difficulties in mind.

3. That school schedules include daily, structured physical activity for all children, regardless of access to the actual gym facility.

4. That the review of all schedule changes includes student considerations for both physical activity and eating needs in addition to academic needs.

5. That students be included in constructing opportunities to positively impact their eating, physical activity, and learning environment during the school day.

Examining the school environment through the lens of the Bronfenbrenner model, positions the school as a microsystem that intimately impacts the growth and development of children. By extension then, improving a student's ability to be physically active, properly satiated, and engaged is not merely a choice for today, but a choice that ensures our children will develop into healthy adults. However, this future health is dependent on an overarching need to increase food security for children. For example, the recommendations of having students access their lunches 'as needed,' might work in schools where students have ample food available in their packed lunches, with nutritious choices. In families that struggle to pack lunches for children, accessing a meagre lunch with empty calories early in the day will not improve a student's overall satiation. The impact of food security is amplified in northern Ontario regions that struggle to bring in fresh food, regardless of the family's ability to pay. From a federal perspective, we recommend that Canada follow the example of other G8 countries and initiate a national, in-school lunch program that models balanced nutrition, and ensures students are receiving necessary nutrient intake while at school.

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CHAPTER 4

GENERAL DISCUSSION

4.1 SUMMARY

In applying Bronfenbrenner's Ecological Model: the school day schedule is part of a child's microsystem; that is, it is one of the systems that has the closest interactions with the child, and directly impacts the child's development. This study calls attention to the school-day as a significant influencer in children's development and questions how it might better be organized to maximally benefit all children. The advantage of targeting the school day, as a way to positively influence children's health is, that it may equalize social, economic, and education inequities that exist in other contexts, such as the home.

To our knowledge, asking students to qualify their designated times for physical activity, eating, and learning while at school, has never been examined in the context of two distinct types of school schedules. For this reason, and because understanding children's physical activity, eating behaviors and learning engagement at school is necessary in planning a health-promoting school environment, the aim of this thesis was to:

i) Give students a voice to express their perceptions about their school environment as it relates to their opportunities for physical activity, eating behavior, and learning engagement.
ii) Collect and analyze student reflections on their physical activity, eating behavior and learning engagement, to better understand student needs.
iii) Suggest ways to optimize current school day scheduling to best meet student needs.

Our study revealed that student perceptions related to physical activity, eating, and learning engagement were different between grade three and six students, between the BSD and TSD schedule, and between boys and girls. This is consistent with previous research that shows: younger students are more active that older students at recess; that boys are more active at recess than girls; but also adds to the research literature around age-specific needs: i.e. that younger students are consistently more hungry than older students (Nielsen, Pfister, & Andersen, 2011; Pawlowski, Tjørnhøj-Thomsen, Schipperijn, & Troelsen, 2014). Specifically, we found that grade three students reported greater hunger at the beginning of their school day and felt they did not having enough time to eat during the school day compared to grade 6 students. Grade 6 students were less physically active during recess and physical education class than their grade 3 counterparts; but, grade 6 students reported higher levels of physical activity during physical education class than during recess. Importantly, but in accordance with the literature, male and female students in our study used their physical activity time differently: females self-reported being more physically active during physical education class than during recess, regardless of age. Our data does not indicate that either schedule is better for optimizing PA behaviors, eating behaviors, or academic engagement. It does confirm that both schedules could be adjusted to better meet student needs.

4.2 Relevance of Study

This research began as an attempt to investigate the BSD and the multitude of health claims that surrounded its inception and adoption, through the voices of the schedule's chief stakeholders—

children. In addition to discovering that children adhering to the BSD schedule did not perceive themselves as getting more physical activity, or better nutrition compared to the TSD, we also discovered some key points about scheduling in general, that are often overlooked. Young children are hungrier throughout the day. Older children and girls need something more than just free play in a grassy field to insight them to be physically active in a meaningful way. Effectively, we began to understand, what we know intuitively but do not demonstrate through school organization: that children's developmental and gender differences likely result in different scheduling needs. To its credit, the Early Learning Kindergarten Program acknowledged this and organized the program, including the daily schedule specifically to accommodate the needs of a target 3-5 year old age group. However, it would be fascinating to see a schedule that more directly attempts to meet the needs of specific demographics across the grades in elementary school. While no clear evidence suggests that Michael Walmsley, principal and originator of the Balanced School Day, began this schedule with children's health in mind, ultimately, the widespread acceptance of Walmsley's "BSD" has demonstrated the potential for wide-spread school-day organizational change. If the 300 minutes allotted to education during the school day can be flexibly arranged with the intent of maximizing learning time, and supervision for teachers, administrators and policy makers should also examine the reorganization of the 300 minutes as they can positively impact children's health and learning engagement.

4. 3 Reflections on Physical Activity

The responses of our student participants reinforced findings from similar studies in the literature: older children are less active than younger children and girls are

less active than boys (Gauthier et al., 2012; Nettlefold et al., 2011). Our study found that this difference was only significant during recess-time; there were no significant differences in reported activity levels for gender or age when students were engaged in physical activity during physical education class. We suggest that this finding is due to the teacher-led, structured nature of physical education class, which encourages children to specifically engage in activity, as opposed to recess, where children direct their own activities.

Recent data indicates that 45% of Canadian schools have a physical education specialist, or someone who has training in physical activity, teaching physical education (Active Healthy Kids Canada, 2014). While the solution to increasing, physical activity should be to not remove recess/play time for students, trained physical activity teachers could help teachers integrate curriculum with physical activities. One example of this would be a social studies community scavenger hunt, which also incorporates vigorous movement. As mentioned previously, investing in training teachers specifically for the purposes of improving physical education, could have positive influences on academics as well.

Additionally, schools could use trained physical education specialists to develop creative school opportunities for primary students (e.g. dance, team play). Although space, is generally a problem, harnessing the school's outdoor space can provide physical education opportunities and provide ideas for students to engage in during recess.

Anecdotally, some schools allowed grade 1 and 2 students to participate in a "dance class" during second nutrition break, once a week. This initiative, led by an experienced teacher, gives primary students, typically overlooked for competitive school team sports, a chance to be active, and learn skills they can practice at other recess breaks. More, and varied, structured opportunities for students that start at a young age, will not only optimize physical activity for the duration of the opportunity; but, also teach physical activity skills.

In addition, there should be room for students to create personal physical activity goals in the curriculum. Achieving quality physical activity can be measured by heart-rate and duration of activity. Encouraging children to achieve quality physical activity during school hours, and providing physical education, are ironically not often considered at the same time. We suggest that physical education classes extend beyond structuring activities and teaching healthy behaviors, to a curriculum where students are encouraged to reflect on their physical activity. Creating S.M.A.R.T (i.e. Specific, Measurable, Attainable, Relevant and Timely) goals surrounding their own physical activity may allow students to achieve their own successes in this area.

4.4 Reflections on Student Eating Behaviors

We found it concerning that a little under half of grade three students reported being hungry at the beginning of the school day, despite having eaten breakfast. The higher prevalence of Grade 3 children being hungry upon arrival to school and throughout the day, when compared to grade 6 students, suggests that younger students have a reduced ability to regulate their eating. In addition, it sheds light on the benefits of food programs at school. While, students may feel more satiated if they had ongoing access to their lunches, those students are coming from homes with food scarcity issues may not benefit from increased access to a small or nutritionally hollow lunch. There is still a need for healthy snacks to be provided at school.

A reliable breakfast or snack program could augment student's packed food, ensuring that the necessary nutrients for learning were provided, regardless of what food items students eat in their packed lunches (Nelson &Breda, 2013). Currently, schools rely on community funding, volunteers and grass-roots entrepreneurs, to provide in-school food for students. According to a Conference Board of Canada publication, Canada is the only G-8 country not providing a school meal program for our children (Howard & Edge, 2013). Perhaps some federal government commitment to an ongoing nutritious morning snack or breakfast program would be a step in the right direction (Poppendieck, 2010).

Also notable is the number of students, across grade, gender, and schedule that reported feeling hungry at the end of the school day. Timing healthy snacks, for children, upon arrival at home or at an after-school program is important. In addition,

this finding suggests that parents and guardians could once again consider the content of the packed lunches they are sending to school. Anecdotally, we have heard school lunch monitors suggest students eat the "healthy" portion of their lunch first, and save the sweet things or dessert items for the second break. However, sugary snacks will not sustain a child for an afternoon, as well as a snack that is high in protein and or fats (Weight, 1995). Eat Right Ontario has provided great materials suggesting balanced food options for student nutrition breaks (Eat Right Ontario, 2015), to ensure parents and guardians pack lunches and snacks that nutritionally satisfy student hunger throughout the school day.

4.5 Reflections on Learning Engagement

As the final component to this study we wanted to understand when children felt they were ready for learning, and when they felt too tired to learn. Our study indicated that students are best able to engage in learning during the first part of the day, and in the early afternoon. When considering the connection between glucose levels, hunger and cognition, perhaps the grade 3 students' lack of learning engagement at 14:00 can be partially connected with their hunger levels at this time. Though many factors affect learning engagement, such as subject matter, individual learning styles, classroom setup, etc., as previously stated, the literature suggests that well-fed, physically-active students, will perform better during learning times. Learning engagement is thus an integral measure of a schedule's success, and is an important variable that can be maximized through health initiatives. This suggests

that longer instruction times may be more appropriate for older students and that younger students be provided a different schedule that includes more frequent breaks.

4.6 THE SPAEBLES SURVEY

The creation of the SPAEBLES survey was an attempt to better understand students' physical activity, eating, and engagement behaviors during the school day; from the students' perspective. To our knowledge, this has never been attempted before, and therefore no previously validated instrument existed. While the PAQ-C provided formatting and wording for our physical activity inquiries, the length of the PAQ-C prohibited us from merely adding the entirety of the PAQ-C survey to the eating and engagement questions on our survey.

In addition, the questions about food consumption on the SPAEBLES survey were unique. Although other surveys have attempted to capture the nutrition environments at school, they often use researcher or school administrator based observations (Nathan, Wolfenden, Morgan, Bell, Barker, & Wiggers, 2013; Manske, 2008). Furthermore, SPAEBLES questions were carefully chosen to avoid instilling feelings of shame or embarrassment in students, about the contents of their lunch; we were not as concerned with *what* students were eating as we were with *if* students were satiated.

The survey was not pilot-tested before this study. As the BSD was increasing in popularity, most Sudbury schools were phasing out the TSD schedule in 2011-12. This study, administered in 2012, attempted to capture and compare data from two different schedules to determine if one schedule would better support student physical activity, eating behavior and engagement. Thus, the time-sensitive nature of the schedule comparison did not allow for a pilot test.

4.7 LIMITATIONS

Our study, in keeping with all research, has some identifiable limitations. To begin, our response rate was relatively low (54%), resulting in a lower than anticipated sample size (n=173). In the future, completing the study when students are less likely to be involved in extra-curricular events, yet still able to consistently go outside for recess (late fall or spring) would be the ideal time to perhaps increase the participation rates.

Additionally, while we attempted to control for external variables, it is still possible that some of the differences we noticed between BSD and TSD schedules, between boys and girls, or between grades, were influenced by external variables. For example, to more accurately examine how hunger, physical activity, and fatigue are affected by age we could survey students in grade three and then survey the very same students in grade six, to minimize individual differences within this group.

Additionally, pilot testing for the SPAEBLES survey would have helped us better establish the validity of our survey for future studies. Using the SPAEBLES survey on the same group of students, along with research observation, would also provide valuable insight into the student responses. However the cost of this type of observational research is expensive and impractical for most research teams.

It would also be interesting to combine a student-survey, with some of the photographic lunch methods. Understanding if students are hungry because the quality of food in their lunch did not sustain them, would be an important information that could to support requests for a federal augmentation of the school snack program, or perhaps even a nutritious lunch program.

Future directions to increase the understanding of how the school environment can better support student physical activity, eating behavior, and learning engagement, would include a mix-methods study approach which would be administered pre- and post-strategic physical activity, eating behavior, and engagement intervention.

Finally, some preliminary research indicates that when completing health surveys, the presence of a researcher, or interviewer can affect the responses of the participants (Davis, et. al, 2010). In our case the effect of the researchers, if any, is not known.

4.8 STRENGTHS

To our knowledge, this study is the first study to use student self-report to assess the hunger, physical activity, and fatigue levels of students throughout the day, and examine school-day scheduling, using these assessments.

Our findings confirmed research from larger-scale studies, demonstrating previously acknowledged PA trends for girls and boys, grade 3 and six students, and followed up on recommendations in the body of BSD literature, which suggested future studies give greater weight to the student voice.

The demographics of the participating schools were matched, using the School Information Finder through the Ontario Ministry of Education website. The schools used in this study had similar geographic proximity: all within a 20km radius of each other.

4.9 Conclusion

In general, we support the idea of a school schedule, like the BSD, for students. The BSD streamlines recess and lunch, and provides clear routine for students, and gives more opportunities for structured physical activity and number of times to eat.

Based on findings from this study we suggest that the school environment, while a natural setting for research and academic creativity, needs to also be considered for innovation and funding regarding eating behavior and physical activity. In agreement with recent assertions by Wu, Macaskill, Salvadori, & Dworatzek, (2015), we agree that a thorough health

impact assessment should be part of any school day decision that affects student opportunity to eat and be active. These health impact assessments should ideally precede any mass implementation of schedule change. Our study is the first to demonstrate that students of similar ages show trends in hunger and physical activity throughout the day. This suggests the necessity of age-based schedules to better meet student needs, or perhaps, more frequent breaks to eat throughout the day. Additionally, our student's assertions that they were more physically active during physical education classes reinforce the need for structured, or professionally facilitated physical activity opportunities that strive to meet the Moderate to Vigorous Physical Activity (MVPA) guidelines.

We conclude that while the BSD may provide scheduling and academic benefits for schools, modifications are needed to properly address the articulated needs of students. Given that differences probably also exist in other sub-cohorts within the school populations, a comprehensive strategy for schedule modification should be considered. It is incumbent upon the Ministry of Education, based on responsibilities articulated though the Healthy Schools Act and other policies to ensure the school environment provides and encourages opportunities for students to feel nourished and engaged throughout the day, and improve physical activity duration and intensity. This investment is surely worth government funding and time. When physical activity, healthy eating behaviors, and engaged learners are part of a school experience, academic success is sure to exist as well.

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APPENDIX 1

APPROVAL FOR CONDUCTING RESEARCH INVOLVING HUMAN SUBJECTS
Research Ethics Board – Laurentian University

This letter confirms that the research project identified below has successfully passed the ethics review by the Laurentian University Research Ethics Board (REB). Your ethics approval date, other milestone dates, and any special conditions for your project are indicated below.

TYPE OF APPROVAL	New	X	Modifications to project		Time extension	

Name of Principal Investigator and school/department	Dr. Sandra Dorman; Dr. Alain Gauthier (Human Kinetics – Laurentian University)
Title of Project	*A Survey Study on School Scheduling: Implications for Student Nutrition, Physical Activity and Attention*
REB file number	2012-01-13
Date of original approval of project	March 2nd 2012
Date of approval of project modifications or extension *(if applicable)*	
Final/Interim report due on	March 2nd 2013
Conditions placed on project	Final or interim report on March 2nd 2013

During the course of your research, no deviations or changes to the protocol, recruitment or consent forms may be initiated without prior written approval from the REB. If you wish to modify your research project, please complete the appropriate REB form.

All projects must submit a report to REB at least once per year. If involvement with human participants continues for longer than one year (e.g. you have not completed the objectives of the study and have not yet terminated contact with the participants, except for feedback of final results to participants), you must request an extension using the appropriate REB FORM.

In all cases, please ensure that your research complies with the Tri-Council Policy Statement (TCPS). Also please quote your REB file number on all future correspondence with the REB office.

Congratulations, and best of luck in conducting your research.

Jean Dragon Ph.D. (Ethics officer LU) for Susan James Ph.D.
Acting Chair of the *Laurentian University Research Ethics Board*
Laurentian University

APPENDIX 2

Student Questionnaire

THIS IS NOT A TEST!
We want to learn how kids your age feel during the school day and about some of the things you do at school.

You will need to use **your memory** and think about your school day **yesterday**

No one will ever know what your answers are unless you tell them. So, please be as honest as you can.

You will receive a password on a sticker. Please paste the sticker on the dotted line.

How old are you?

I am _____ years old

You were born in the month of
(eg: May)

_____

Are you a boy or girl?

☐ Boy

☐ Girl

PART 1: PHYSICAL ACTIVITY

Please CIRCLE the number that *best* answers the question.

YESTERDAY….

1. Were you active during recess time? (playing hard, running, jumping, throwing)?

I'm not at all active	Hardly Ever Active	Sometimes Active	Often Active	Always Active
1	2	3	4	5

2. Were you active during gym class? (playing hard, running, jumping, throwing)?

I'm not at all active	Hardly Ever Active	Sometimes Active	Often Active	Always Active
1	2	3	4	5

3. Are you involved in a school-organized sport of physical activity during recess (e.g.: basketball, running, or yoga)?

   □YES □No

4. Are you involved in a school-organized sport of physical activity after school (e.g.: basketball, running, or yoga)?

   □YES □No

5. Do you think you get enough physical activity time during the school day?

   □YES □No

PART 2: EATING BEHAVIOUR

Did you have breakfast?

□YES □No

When you got to school, were you hungry?

□YES □No

How many separate times do you eat at school?

□1 □2 □3 □4

When it is time to eat your lunch, do you have enough time to eat your food?

□YES □No

How many drinks are packed in your lunch box?

□0 □1 □2 □3

Please CIRCLE the number that describes how you felt at each time:

YESTERDAY….

1.

At 10:00, I felt:

Hungry	Just Right: not too hungry or too full	Full
1	2	3

2.

At 11:30, I felt:

Hungry	Just Right: not too hungry or too full	Full
1	2	3

3.

At 2:00, I felt:

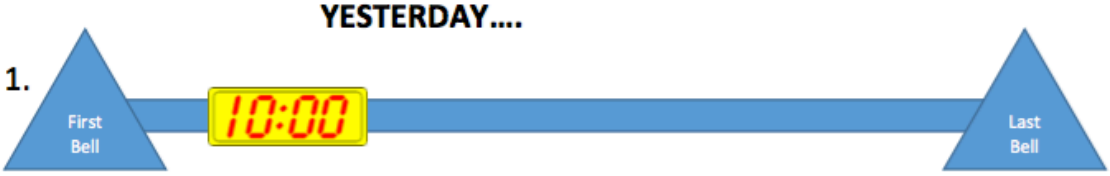
Hungry	Just Right: not too hungry or too full	Full
1	2	3

PART 3: LEARNING ENGAGEMENT

Please CIRCLE the number that describes how you felt at each time.

YESTERDAY….

1.



At 10:00, it was:

Easy for me to Focus in Class	Sometimes hard for me to focus in class	Very hard for me to focus in class
1	2	3

2.

At the 11:30, it was:

Easy for me to Focus in Class	Sometimes hard for me to focus in class	Very hard for me to focus in class
1	2	3

3.

At 2:00, it was:

Easy for me to Focus in Class	Sometimes hard for me to focus in class	Very hard for me to focus in class
1	2	3

4. What helps you to focus in class? Check the boxes....

- □ Going outside to play before class
- □ Eating a snack before class
- □ Doodling quietly during class
- □ Quiet time before class
- □ Your suggestions: _____

Please CIRCLE the clock time that best answers the question.

YESTERDAY....

5. During the school day, when did you feel the most tired?

6. During the School day, when did you feel the least tired?

Are there any changes that you would like to make to your school schedule? If so, what would you like to do and why?

_____

_____

_____