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Food Insecurity and Educational Outcomes: A Focus on TDSB Students

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Table of Contents

List of Tables

List of Figures

Executive Summary

In this report, we examine early deprivation in the form of food insecurity (inadequate quantity and quality of food) and its influence on the educational opportunities experienced by youth. Deprivation often creates unequal playing conditions at the primary school level and this educational disadvantage is accentuated when youth experiencing food insecurity transition into secondary school. A substantial body of literature shows that hungry children experience more behavioural, emotional and academic problems than non-hungry children. Food insecurity has been linked to lower test scores, trouble interacting with peers, poor health and higher prevalence of illness. The majority of research studies have been conducted in the United States and contain limitations that raise questions regarding the generalizability of findings to Canadian students. Thus, many studies employ a medical/nutritional focus and exclude social and cultural factors that are of proven importance in understanding student academic success at the secondary level and subsequent transitions to postsecondary education (PSE). While food insecurity, often employed by researchers as a proxy for poverty, is key in explaining unequal education outcomes, research employing life course and intersectionality perspectives suggest that other demographic and social structural factors need to be considered as well. In addition, many of the studies are cross-sectional rather than longitudinal in nature, making it difficult to assess the long-term educational outcomes of food insecurity. Our scan also revealed a primary focus on young children rather than adolescents, and a reliance on adults who tend to under-report hunger among children.

Our use of the Toronto District School Board (TDSB) 2011 Student Census addresses many of these limitations. The Student Census is longitudinal so we were able to examine short-term indicators of school success (Grade 11/12 marks) and longer-term educational outcomes (transition to PSE). The 2011 Student Census was completed by Grade 7–12 TDSB students in fall 2011. Of specific interest here was the data on 15,133 TDSB students who were 17 years of age as these students were age-appropriate for Grade 12 Year 4, the age at which most Ontario students start their transition to PSE. Information on missing meals was supplied directly by students; this limited the issue of under-reporting by adults. It should also be noted that the Student Census does not contain items that measure the nutritional quality of food consumed by students. Two measures of food insecurity were employed in our analysis:

1. Frequency with which students missed meals during the school week
2. A food security index based on the frequency with which students missed meals during the school week

There were also three measures of economic resources available to a student's family that were available in the data set: parental occupation status, parental attainment of PSE and neighborhood income. This index was developed based upon our reading of the research literature on food security, and provides greater conceptual validity of the very nature of food security than breakfast alone. In other words, it is not just about what students eat; social position, access to food and family economic resources also influence the educational outcomes of students.

Two research questions guided the multi-level regression analysis employed in this report:

1. What is the impact of food security on students' academic success (average marks in Grades 11/12 and confirmation of university/college)?
2. How does ethnoracial identity interact with food security to shape students' academic success (average marks in Grades 11/12 and confirmation of university/college)?

The key findings of our analysis include the following:

1. Food security, regardless of how it was measured, had significant effects on average Grade 11/12 marks and PSE confirmations. However, racial differences were more pronounced and subtle when the food security index was employed.
2. The interactions between race and food security indicate whether the measures of food security employed have differential impacts by race on the Grade 11/12 marks and PSE confirmation, and our analysis reveals that they do. A list of differential impacts of food security by race on educational outcomes follows:

Average Grade 11/12 Marks

- The effect of breakfast eating is different for Black and Southeast Asian students when compared to White students. Among White students, eating breakfast results in a strong and noticeable increase in average marks. However, for Black and Southeast Asian students, the impact of eating breakfast is more modest. While Black and White students start off about the same at the lowest end of the breakfast eating scale, average marks are relatively unaffected by breakfast eating for Black compared to White students. In the case of Southeast Asian students, they start higher on the lowest end of the breakfast eating scale, but again the impact of breakfast consumption is quite modest with respect to these students.

- The association between the food security index and marks was significantly different between White students and Black, East Asian, South Asian and Southeast Asian students. The impact of food security on average marks is strongest for White students. As we found in the case of breakfast consumption, the impact of food security on average marks for Black students is more modest than for White students. East Asian students have higher marks at all levels of the food security index, although the relationship between food security and average marks is weaker than for White students. Southeast Asian students start higher than White students at the lowest end of the food security index but show lower average marks at the higher end of the index than either White or East Asian students.

Confirming PSE

- The frequency of eating breakfast is positively associated with university (relative to not confirming PSE) but not college.

- In terms of university confirmations, only one interaction between race and eating breakfast was significantly different when compared with White students (i.e., South Asian students). South Asian students demonstrated a strong association between the frequency of eating breakfast and university confirmation. None of the interactions were significant for college when the eating breakfast measure was employed.

- In contrast, we found that the food security index was positively associated with university confirmations and negatively associated with college confirmations.

- When the interactions between race and the food security index were analyzed, we obtained very different results than those revealed by the breakfast consumption measure. For university confirmations, the interactions are significant for East Asian students and mixed-background students. For college confirmations, the interactions are significant for Black, Asian, mixed-background and Southeast Asian students. Specifically, mixed-background students start out at the lowest likelihood of university confirmation at the lowest end of the food security index, but surpass White students at the higher end. East Asian students start much higher than White students at the lowest end of the index, but their trajectory flattens out in the middle and the likelihood of university confirmation is the same as it is for White students at the highest end of the index.

- In general, the relationship between the food security index and the probability of college confirmation is negative, suggesting that the better-resourced students demonstrate a university preference. This negative relationship is true for all groups except Southeast Asian students, where the relationship between the index and college confirmation is weakly positive.

- At the lowest ends of the index, the different racial groups are somewhat similar, with probabilities of attending college ranging from 0.25–0.35. However, at the highest values of the index, the likelihood of East Asian students confirming college is virtually nil. For White students, the probability at the highest end of the index is under 0.10, or very close to the value for mixed-background students. The trajectory for Black students, however, is flatter. At the highest end of the index, the likelihood of confirming college is just under 0.20.

Future Research

Our study underscores the negative impact of food insecurity on the academic success and PSE transitions of 17-year-old students, and the extent to which negative educational outcomes vary across self-identified racial groups. However, the generalizability of our findings is limited by the scope of the study; additional research will be required if we wish to extend our understanding of the impact of food insecurity beyond the TDSB to other school boards in Ontario and to students in lower grades. By extending the research we will also be in a position to answer additional research questions such as:

- What is the duration of food insecurity among youth at different ages?
- Does the duration of food insecurity vary by self-identified ethnoracial group?
- Does the duration of food insecurity have an impact on our educational outcomes of interest?

Conducting longer-range cohort research could provide useful information as to whether or how the provision of school meals in elementary or the early secondary grades affects students' future school success and access to PSE. By extending the geographical scope of research in this area we will then be in a position to analyze the impact of food insecurity among Aboriginal students. Because our data source contained too few students (less than 100) who self-identified as Aboriginal, our findings neglect to address a particularly marginalized Canadian demographic.

Introduction

Postsecondary education (PSE) participation rates in Ontario have risen significantly over the past several decades. Over 80% of high school graduates now enrol in some form of PSE, with more than half going to university and the remainder to community colleges, apprenticeships or private training programs (Norrie & Zhao, 2011). Despite this substantial increase, however, many underrepresented groups encounter barriers when translating their postsecondary aspirations into postsecondary choices. These barriers, whether linked to familial socioeconomic status, special needs, gender or race, often serve to perpetuate inequalities of educational opportunity.

Eliminating these barriers requires a clear understanding of how these sociological factors affect postsecondary access and participation. Postsecondary access can be thought of in two distinct ways (Anisef, Bertrand, Hortian & James, 1985). The first refers to how many people participate in PSE while the second looks at who participates, focusing on the composition of participants in PSE and how their participation compares to the participation of the overall population. This second type provides a clear indicator of equity within a country (Finnie & Pavlic, 2013) making it an ideal measure for determining what sociological factors impact PSE access and participation. Over the past several decades, many important financial and non-financial factors that affect the second type of access mentioned above have been identified (EPI, 1998), which has provided clarity about the barriers that young people face when transitioning to PSE. By using advanced statistical techniques, researchers can now consider how multiple factors, such as gender, income and race, play a combined role in determining PSE access. For example, while income may affect the likelihood of attending university, its impact may not be the same for all students. By studying the interplay among the fixed characteristics of people who participate in our research projects, we will then be in a better position to develop a fuller understanding of their educational outcomes, such as success in school and transition to PSE. This mode of reasoning and analysis is also useful in developing policies and practices that are relevant to very specific underrepresented groups.

The examination of the second type of access has been enhanced in recent decades by the introduction and use of longitudinal data sets (e.g., Statistics Canada Youth in Transition Survey), showing that the interplay of fixed characteristics often varies along the life course (Norrie & Zhao, 2011; Robson, Anisef, Brown & Parekh, 2014). Through the use of these data sets, researchers have identified various risk factors associated with poor school readiness and poor educational outcomes (e.g., being raised in a low-income or lone-parent household), early deprivations that make it even more likely that a child will struggle, and perhaps continue to struggle, in school (Robson, 2013, p. 223). One risk factor that has received scant attention in Canada with respect to its negative impact on school readiness, grade performance and PSE transitions is food insecurity. The few studies that have been conducted in Canada (discussed in the literature review) provide valuable insights regarding the demographics, social characteristics and educational outcomes of students that are food insecure, but they lack the explanatory power that is provided by a multivariate analysis. This analysis will be implemented in this report.

A number of American and Canadian organizations, such as the USDA, the Food Research and Action Centre (FRAC), Statistics Canada, and Food Secure Canada, have recognized a relationship between race and food insecurity. US data shows that households headed by Black or Hispanic people are more than twice as likely

as White households to be food insecure, a figure which increases when looking at households with very low food security or when looking at households with children (Child Trends, 2016; No Kid Hungry, n.d.). While Canada has a more comprehensive safety net than the United States and does not have the same history of segregation, racial trends are still present in Canadian data on food insecurity. Aboriginal or Black Households are more likely to be food insecure (Tarasuk, Mitchell & Dachner, 2016), and recent immigrant households have also been identified as being particularly vulnerable (Matern and Iman, 2016). Based on current research discussed in the literature review, we know that food insecurity hinders academic success in a variety of ways. It is perhaps unsurprising then that our analyses using the TDSB data show a complex relationship between race, food insecurity and academic outcomes and postsecondary transitions, which became the focus of this report.

Objectives, Research Questions and Perspectives

Our objective in this report is to employ TDSB 2011 Student Census data to conduct an analysis of the following research questions:[1]

1. What is the impact of food security on students' academic success (average marks in Grades 11/12 and confirmation of university/college)?

2. How does ethnoracial identity interact with food security to shape students' academic success (average marks in Grades 11/12 and confirmation of university/college)?

The 2011 Student Census was completed by Grade 7–12 TDSB students in the fall of 2011 (Brown, Parekh & Presley, 2012; Yau, O'Reilly, Rosolen, Kozovski & Archer, 2014) and reports on 15,133 students who were 17 years of age and enrolled in the TDSB in the fall of 2011. These students were age-appropriate for Grade 12 Year 4, the age at which most Ontario students start their transition to PSE. In order to track the PSE transitions of the 17 year olds who participated in the census, data on postsecondary applications to Ontario institutions from the Ontario University Applications Centre (OUAC) and the Ontario College Applications Service (OCAS) were matched to individuals in the data set.

The theoretical underpinnings of the analysis presented in this report are grounded in both life-course and intersectionality orientations. Berger and Motte (2007) emphasize the utility of the life-course perspective in capturing the complexities of pathways to PSE and in better identifying and understanding the access, persistence and completion barriers that many individuals and groups encounter. Specifically, they emphasize two points:

1. Factors that determine PSE access and completion lie in the individual's life circumstances and are already present in early childhood.

1 Our explorations of the interactions between the food security measures and sex failed to reveal any statistically significant results, and therefore we will not address them in this report.

2. Factors such as socioeconomic status interact with individual (demographic) characteristics and do so in different ways throughout the life course.

Therefore, this conceptual framework recognizes the importance of three essential ingredients in examining life-course transitions and trajectories — time, social structures (e.g., gender, social class, ethnicity and race, school level factors) and personal agency (e.g., educational choices, student engagement/readiness). In relation to the educational sequence, the time element suggests three phases: planning for PSE, participating in PSE and transitioning from PSE to the workforce (Robson, Anisef & Brown, 2016). Included within the element of time — an essential theme in life-course research — is the notion of stability and change, which acknowledges the constraints on and opportunities for individuals to alter their values, beliefs and self-evaluations as they move through their life course.

Through the introduction of the intersectionality approach, we recognize that individuals occupy multiple categories in their identities that include their race(s), ethnicities, gender and immigrant status (McCall, 2005). More importantly, these combinations of characteristics operate together to influence various experiences in life, including educational attainment and other forms of social mobility (Collins, 1990). Rather than conceptualizing social identities as functioning independently before subsequently being "added together to form experience," those that employ the intersectionality notion agree that identity cannot be reduced to a summary of the social groups to which a person belongs. In fact, social groups interact with each other and, as a consequence, create specific manifestations that cannot be explained by each alone (Warner, 2008, p. 1). The use of an intersectionality framework will be useful in uncovering a causal link between food security and student educational outcomes, particularly with respect to the role played by ethnoracial identity. In our previous analyses of TDSB Student Census data we have consistently shown that race, along with gender and social class, are very strong predictors of future PSE participation (Robson et. al., 2016). Given its proven impact in the research we have conducted, the interaction of race and food security will be employed in our analysis of student success outcomes.

Literature Review

Introduction

The impact of food security is an important — though under-researched — factor in understanding the human development, school success and transitions to PSE of Canadian children and youth, particularly among those residing in low-income households. A lack of food security can affect the health and well-being of children in a myriad of ways and is often viewed as a significant constraint to their growth, health and cognitive and behavioural potential, especially among those children who live in poverty (Cook & Frank, 2008). Studies conducted in the United States validate that most behavioural, emotional and academic problems are more prevalent among hungry children than non-hungry children. However, we must exercise caution in applying American research to the Canadian context, as the settings are not interchangeable. In this review, we draw on Canadian studies where possible, but the lack of research on food insecurity in this country both forces us to look elsewhere for relevant literature and was one of the primary motivations for our study.

In this section, we review research on food security, first through a brief look at prominent definitions and measures. Food security in the Canadian context is then explored. Following this, we review research literature on the effects of food security and insecurity on children, particularly in terms of academic success. Given the importance of the relationship established by this literature, we examine school policy and programs designed to combat student hunger. Finally, we explore the sparse research on food security and transitions to PSE.

Food Security: Definitions and Measures

Food security is a multidimensional concept, with over 200 definitions appearing in published literature (FAO, 2003, p. 25). Initial definitions developed by the United Nations Food and Agricultural Organization (FAO) in the 1970s focused on the volume and stability of food supplies using data such as national food balance sheets and per capita availability or consumption of staple foods (Bickel, Nord, Price, Hamilton & Cook, 2000; FAO, IFAD & WFP, 2014; FAO, 2003, p. 26). However, these big picture indicators provided only general national overviews of food quantities and did not reflect variability among regions and households in terms of food distribution, availability, quality, barriers to access and coping strategies. The FAO's definition was therefore revised and expanded more recently in order to capture a greater range of food and hunger related experiences (FRAC, 2015a; FAO et al., 2014; FAO, 2003). Its current definitions of food security and food insecurity are as follows:

> **Food security** exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life. Household food security is the application of this concept to the family level, with individuals within households as the focus of concern.
>
> **Food insecurity** exists when people do not have adequate physical, social or economic access to food as defined above.
> (FAO, 2003, p. 29)

The above definitions demonstrate the complexity of food security as a concept, highlighting a variety of associated dimensions (access, quantity, quality) and factors (physical, social, economic, cultural) that affect access, quantity and quality. They also incorporate an idea of human flourishing, rather than mere survival. This is the broadest definition of food security and it serves as an international standard for which to strive. The scope of this definition, however, makes it unwieldy and difficult to operationalize due a lack of data and/or resources and measuring difficulties.

In the North American context, the United States Department of Agriculture (USDA) has been the leader in developing a measure for household food security, which it defines as follows:

> **Food security**: access by all people at all times to enough food for an active, healthy life. Food security includes at a minimum: (1) the ready availability of nutritionally adequate and safe foods, and (2) an assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies).

> **Food insecurity**: limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways
> (Bickel et al., 2000, p. 6)

Based on these definitions, the USDA has developed a measure which is part of the nutrition monitoring system included in the Census Population Survey (CPS), conducted monthly by the United States Census Bureau. It includes:

> [questions] about the following kinds of household conditions, events, behaviours, and subjective reactions: anxiety that the household food budget or food supply may be insufficient to meet basic needs; the experience of running out of food, without money to obtain more; perceptions by the respondent that the food eaten by household members was inadequate in quality or quantity; adjustments to normal food use, substituting fewer and cheaper foods than usual; instances of reduced food intake by adults in the household, or consequences of reduced intake such as the physical sensation of hunger or loss of weight; and instances of reduced food intake, or consequences of reduced intake, for children in the household.
> (Bickel et al., 2000, p. 8)

The set of 18 questions, ten of which relate to adult food security within the household and eight of which relate to child food security (if there are children under 18 in the household), forms the "core module" for food security. Respondents' answers are viewed together to form the Food Security Scale (FSS). These responses are coded and combined through a statistical formula into a single number from zero to ten which reflects the household's level of food insecurity (i.e., the difficulty the household confronts in securing sufficient quality and quantities of food and the frequency of reducing food intake). The higher the number, the greater the level of food insecurity (Bickel et al., 2000, p. 10).[2]

The FSS is perhaps the most widely used food security measure. A number of prominent organizations, such as the Food Research and Action Centre (FRAC) (FRAC 2015a) and Children's HealthWatch (formerly Sentinel Nutrition Assessment Program or C-SNAP), an American network of pediatricians and children's health advocates (Cook & Frank, 2008), employ it in their research and advocacy work around food security. Research conducted for academic purposes also often makes use of the FSS, either by accessing the data collected by the Census Bureau or administering the FSS to study participants, sometimes even when the research is being conducted in another country, such as Ramsey, Giskes, Turrell and Gallegos' 2011 study of food insecurity among Australian children.

However, not all research uses the FSS or follows the FAO's definition. Indeed, our literature review reveals that there is no single measure that serves to capture all aspects of food insecurity (FAO, 2002, p. 35). Even though definitions and measures of food security thus often vary, most include at least one of the dimensions referred to by the FAO definition — quantity, quality and access — via common indicators such

2 For full details and the complete questionnaire, see *Guide to Measuring Household Food Insecurity, Revised 2000* (Bickel et al., 2000), available on the USDA's website [https://fns-prod.azureedge.net/sites/default/files/FSGuide_0.pdf]. The guide encourages local groups to use it in their own research and provides guidance on how to deploy it, along with links to reports already prepared by the USDA using the data.

as the experience of hunger, dietary diversity and coping mechanisms for dealing with insufficient quantities and quality of food, respectively (Kirkland, Kemp, Hunter & Twine, 2013). Depending on the focus of the authors, the particular research questions and the data/resources available, certain dimensions or factors associated with food security may become more prominent in defining and measuring the concept. The particular definition and measure of food security used in this study, based on the TDSB data, will be discussed in the methods section.

Food Insecurity in Canada

Canada began collecting data regarding household food security about ten years after the US first developed the FSS and is now one of over 20 nations who regularly monitors this issue on a national level. Since 2004, the Household Food Security Survey Module (HFSSM), which is included in Statistics Canada's Canadian Community Health Survey (CCHS), has used the USDA's core module with some minor language adaptations to allow for more accurate understanding in French and Aboriginal contexts (Health Canada, 2006; Health Canada, 2012). PROOF (Food Insecurity Policy Research) published a report based on the most recent round of this survey entitled *Household Food Insecurity in Canada 2014*, documenting the extent of Canadian food insecurity. The report included data provided by Alberta, Saskatchewan, Ontario, Quebec, New Brunswick, Prince Edward Island, the Northwest Territories and Nunavut (Tarasuk et al., 2016). They designate three levels of food insecurity based on the survey data:[3] marginal (household members are concerned that they may run out of food or limit food selection for financial reasons), moderate (household members actively compromise quality and quantity of food for financial reasons) and severe (household members miss meals or reduce food intake, going for a day or more without eating in the most extreme cases) (Tarasuk et al., 2016, pp. 2, 4).

The report indicates that food insecurity is a significant and persistent problem in Canada. The trend over the past decade is an upward climb, with a particularly sharp increase from 2008–2011. Overall, about 12% of Canadian households experienced food insecurity in 2014, which equates to 1.3 million households or 3.2 million individuals, including nearly 1 million children. While the data indicates that certain areas are at greater risk, such as the northern territories and the Maritimes, no province (of those who provided data) was exempt; in all provinces, over 10% of households experienced some level of food insecurity, whether marginal, moderate or severe.

The report identifies a number of household characteristics correlated with food insecurity (Tarasuk et al., 2016, pp. 11–13). The strongest predictor is, unsurprisingly, household income — as income rises, the likelihood of food insecurity declines. Instances of food insecurity become more common as household income decreases and spike once income drops below $30,000. It is worth noting, however, that income is not necessarily a guarantor of food security, nor is low income a sure sign of food insecurity (Fram, Bernal & Frongillo, 2015; Bickel et al., 2000; Cook & Frank, 2008). Households with income in the $30,000–$50,000

3 Households were designated as marginally food insecure if they, "affirmed no more than 1 item" on the adult or child food security scale, moderately food insecure if they had two to five positive responses on the adult scale or two to four positive responses on the child scale and severely food insecure if they had six or more positive responses on the adult scale or five or more positive responses on the child scale. If no items on either scale were affirmed, the household was categorized as food secure (Appendix B in Tarasuk et al., 2016).

range have rates between 5% and 10%, and even households with income over $50,000 still report food insecurity. Data from the US shows that over 50% of households below the Federal Poverty Line report themselves as food secure, while almost 6% of households whose income was 185% of the poverty threshold or above are food insecure (USDA, 2016a). This suggests that food insecurity is not simply a problem for those who are — by definition — living in poverty.

The source of household income is also correlated with food insecurity (Tarasuk et al., 2016, p. 13). The most vulnerable group is those households whose main source of income was social assistance, over 60% of which experienced food insecurity. *Who's Hungry*, a report on food bank usage in Toronto, shows that 65% of Toronto food bank users rely on some form of social assistance as their main source of income (Matern & Iman, 2016). However, the vast majority of food insecure households Canada-wide rely on wages and salaries (Tarasuk et al., 2016). In other words, most food insecure households derive their income from jobs, not social assistance. However, households who *are* on social assistance have a much greater likelihood of being food insecure than households who rely on jobs. Other household characteristics associated with a higher likelihood of food insecurity in Canada include being Aboriginal (25.7%), being Black (29.4%) and renting rather than owning one's home (24.5%).

Who's Hungry (Matern & Iman, 2016) also indicates that, whether relying on some form of social assistance or wages, those making use of Toronto's food banks see the majority of their income — over 70% — go toward other expenses, such as rent. Food, then, becomes an element of their budget, which, despite its importance, survey respondents reported foregoing in order to accommodate rent, phone, transportation or utilities (Matern & Iman, 2016, p. 18). The report identifies recent immigrant households, which, according to the report, are more likely to include children, as particularly vulnerable in Toronto. With housing being notoriously expensive in Toronto and with limited social networks, many newcomers are particularly at risk for food insecurity (Matern & Iman, 2016, p. 25).

Food Insecurity, Children and Academic Success

Food insecurity affects the growth and development of human beings in a number of ways. Young children are particularly vulnerable to risks associated with a lack of access to sufficient quality and quantities of food because their physical and cognitive development are incomplete, and because they rely on others to provide food for them (Cook & Frank, 2008; Vozoris & Tarasuk, 2003; Ke & Ford-Jones 2015; Ramsey et al., 2011). Food managers in insecure households, usually parents, will often sacrifice quality of food for quantity in order to avoid feeling hungry or to avoid their children feeling hungry, resulting in a diet of "energy dense and nutrient sparse" foods that are cheaper. As Cook and Frank (2008) report, however, feeling satisfied, or rather, not feeling hungry, does not index adequate nutritional intake. Diets consisting of these cheap, nutritionally deficient foods, may leave children or adults feeling full, but can stunt growth and lead to a number of other health problems (e.g., diabetes, anemia, cardiovascular diseases, obesity and asthma) in the short and long term (Ke & Ford-Jones, 2015; Cook & Frank, 2008; Ramsey et al., 2011; Vozoris & Tarasuk, 2003; Tarasuk, 2016; Kirkpatrick, McIntyre & Potestio, 2010). Children in food insecure households are therefore disproportionately likely to experience physical developmental delays (Ettinger de Cuba et al., 2008; FRAC/Children's HealthWatch, 2015; Hickson, Ettinger de Cuba, Weiss, Donofrio & Cook, 2013; Scholl & Johnson, 2000; King, 2003).

The developmental damage caused by food insecurity can extend into psychological, cognitive, behavioural and social realms, as well (Ettinger de Cuba et al., 2008; FRAC/Children's HealthWatch 2015; Hickson et al., 2013). Cognitive development, such as language comprehension and memory, has been shown to be negatively affected by nutrient deficiencies and high sugar and low iron foods that characterize food insecure diets (Ke & Ford-Jones, 2015). A study of Australian children found that those from food insecure households are significantly more likely to exhibit psychological problems such as antisocial behaviour, lack of self-control, hyperactivity and inattention (Ramsey et al., 2011, p. 409; Whitaker, Phillips & Orzol, 2006). Mental health is also put at risk by food insecurity; American studies reviewed by Cook and Frank (2008) have shown that food insecure adolescents are more likely than their food secure peers to have seen a psychologist and/or experienced chronic depression and suicidal thoughts and actions. In some instances, parents sacrifice their own food intake in order to prevent their children going hungry (Tarasuk et al., 2016, p. 15), but current research suggests that this strategy can still negatively impact children, particularly through depression in mothers (Casey et al., 2004; Whitaker et al., 2006). While the mechanism is not direct, parental depression and lack of energy due to a poor/inadequate diet can result in caregiving deficiencies that are negatively associated with normal cognitive development (Ke & Ford-Jones, 2015, p. 90).

Given the negative effects of food insecurity on development and cognitive functions, it is unsurprising that there is a significant and growing body of research literature which examines the impact of hunger, poor nutrition and, more recently, food insecurity on academic success. Evidence from research conducted around the world, in countries such as the US (Holben, 2010), Canada (MacLellan, Taylor & Wood, 2008), China (Hannum, Liu & Frongillo, 2014), Ethiopia (Belachew et al., 2011) and Australia (Ramsey et al., 2011), among others, overwhelmingly indicates that food insecurity has a negative impact on academic performance. Jyoti, Frongillo and Jones' (2005) touchstone study used data from the Early Childhood Longitudinal Study-Kindergarten Cohort in which over 20,000 American children were assessed for literacy, numeracy, height, weight and social skills over a period of four years. Food insecurity was tracked via the children's parents, and teachers reported on the social skills of their students. The study found that early childhood food insecurity was associated with poorer reading and mathematics performance (pp. 2835–2836). The authors hypothesize that the underlying mechanisms for these cognitive deficiencies are both nutritional (i.e., poor diet interferes with children's cognitive development), and psychological (i.e., food insecurity is a stressor that affects behaviour and ability to concentrate (pp. 2837–2838). Those on the front lines of education — namely teachers — support these findings. A national survey of American teachers in 2012 and again in 2015 by No Kid Hungry, a charity dedicated to ending child hunger, showed that the vast majority of teachers, kindergarten to grade 8, believed that hunger, particularly skipping breakfast, had serious and observable negative consequences for their students (No Kid Hungry, 2012; 2015).

Other research has extended this line of work by examining how children's social behaviours are influenced by food insecurity, corroborating the findings of Jyoti, Frongillo and Jones (Florence, Asbridge & Veugelers, 2008; Winicki and Jemison, 2003; Ashiabi, 2005; Roustit, Hamelin, Grillo, Martin & Chauvin, 2010). For example, Howard (2011) used the Early Childhood Longitudinal Study-Kindergarten data to explore the connection between food insecurity and social skills in children aged 6–13. The findings indicate that food insecure children are not only more likely to experience poor health, they are also more likely to have compromised social skills and be late or absent from school (Cook & Frank, 2008; Ramsey et al., 2011; Belachew et al., 2011). A survey of Canadian teachers conducted by Kellogg in 2016 reports that hunger

results in students losing significant amounts of learning time each day (Kellogg Canada Inc., 2016). These studies emphasize the multifaceted effect food insecurity has on the educational experiences of young people. Various mechanisms — cognitive, psychological, social and temporal — associated with food insecurity can put students at an academic disadvantage.

A significant portion of the research literature dealing with food insecurity and academic achievement focuses specifically on the effects of eating or skipping breakfast. Nutrition and medical studies indicate that eating breakfast provides a significant portion of daily caloric and nutrient intake that is especially important for children (Deshmukh-Taskar et al., 2010). However, research also shows that as children age, they become less likely to eat breakfast, with girls missing breakfast more frequently than boys (Sweeney & Horishita, 2005; Hearst, Shanafelt, Want, Leduc & Nanney, 2016). A TDSB study of students in Grades 7–12 found that in addition to girls, students from lower socioeconomic backgrounds, students from some ethnoracial backgrounds (Aboriginal, Black, Southeast Asian and Middle Eastern), and students from single-parent households were also more likely to skip breakfast (O'Reilly, Rosolen and Archer, 2015). Several reasons are commonly reported by adolescents and high school students for skipping breakfast: attempted weight loss, not being hungry in the morning, lack of time, cost, quality, and, in terms of reduced-price school breakfasts, stigma (Hearst et al., 2016, p. 192).

Does eating breakfast help students succeed academically? Two systematic reviews of research on the relationship between eating breakfast and academic performance establish a generally positive association. The first, conducted by Hoyland, Dye and Lawton (2009), reviews 45 studies published between 1950 and 2008 that looked at the relationship between breakfast and cognitive performance. Two-thirds of the studies examined short-term effects of breakfast versus no breakfast or type of breakfast, and found some, though by no means universal, positive results in later testing for those participants who ate breakfast, but no compelling differences between participants who ate different types of breakfasts. Thirteen studies examined the long-term effects of breakfast programs, and found improvements in math scores, memory, concentration and attendance among participants. The authors speculate that the improvements in test scores could be due, at least in part, to the increased attendance the breakfast program encouraged, rather than solely to the breakfast itself, again pointing to the multiple mechanisms at work. Finally, four studies looked at habitual breakfast intake, with positive effects in terms of scholastic performance shown. The authors advise caution in interpreting these results, however, because of the generally poor quality of many of the studies examined. Lack of specification and rigour in research design and measurement is a main concern for the authors, in that many of the studies were inconsistent or unclear about study conditions, operational definitions of terms and measures, and characteristics of participants. Intervention effects were often difficult to disentangle; for example, were improvements due to breakfast consumption or to the increased attendance breakfast programs encouraged? Cognitive testing was often limited and potentially inappropriate for the participants, as well as being incomparable across multiple studies. In addition, less than a quarter of the studies included participants over 13 years of age, leaving a significant shortcoming in generalizability to youth who are approaching the transition point into PSE.

The second review (Adolphus, Lawton & Dye, 2013) examined 36 studies published between 1950 and 2013 and focused on the academic performance and behaviours of children as they related to breakfast consumption (p. 426). In general, the studies showed positive effects from breakfast consumption on on-

task behaviour, particularly in undernourished and low socioeconomic status (SES) children and students who ate breakfast habitually. However, one of the more rigorous studies reviewed (a longitudinal study examining the frequency of family breakfasts and dinners and their relationship to academic and behavioural outcomes and involving a ten-year follow up) found no association between breakfast consumption patterns and behaviour, which the authors speculate was due to an unusually rich data set that allowed them to rigorously account for a host of potentially confounding factors. (Miller, Waldfogel & Han, 2012) Of the 22 studies that used marks or standardized test scores as an outcome, 21 found that habitual breakfast consumption had a positive effect, which was particularly clear for mathematics scores. Though some studies were well designed, the reviewers noted the subjective nature of these studies and the absence of systematic, validated and reliable coding systems to measure classroom behaviour (Adolphus et al., p. 22). In the studies that focused on academic performance as an outcome, there was also a lack of accounting for confounding variables in the analysis, such as SES.

In the Canadian context, a study of TDSB students in middle and secondary schools where a free breakfast was offered before or during first period, revealed that 78% of high school students who ate breakfast at least three days per week were on track for graduation, compared with 61% of students who ate it only on a few days or not at all. In addition, the use of basic cross tabulations showed that students, irrespective of gender, socioeconomic status, or cultural background, tended to benefit from the program (Muthuswamy, 2011). Based on the research described in this section, there is some evidence to suggest a positive relationship between breakfast consumption and academic success, but the lack of support from longitudinal studies makes it clear that more robust and rigorous research is needed in order to further unpack the effects of breakfast in combination with other factors, such as participant characteristics and school environment.

Combatting Food Insecurity in Schools

Alongside the research literature that establishes the relationship between academic success and food insecurity is an evaluative body of research that looks at programs designed to combat hunger in schools. Advocacy groups and educators have noted the role that proper nutrition plays in students' educational experiences and believe schools can help close achievement gaps for food insecure students (No Kid Hungry, 2012; Fram, Frongillo, Fishbein & Burke, 2014; Augustine-Thottungal, Kern, Key & Sherman, 2013). Education around nutrition and physical fitness is widely promoted, but mitigating food insecurity requires more direct interventions. In Canada and the US, this has been done most commonly through school-provided lunch or breakfast programs. The US has had the National School Lunch Program since 1946, which offers healthy, low-cost meals to children daily (USDA, 2016b). A School Breakfast Program (SBP) targeted at poorer areas was piloted in 1966 and became permanent in 1975 (USDA, 2013).

Despite agreement in the research literature about the positive impacts of adequate nutrition on student performance, consensus with respect to the impact of school-provided meal programs has not yet been reached. The American national school food program has been in place since the end of World War II, but it has not been without its critics or controversies. Reviews of the NSLP in the early 1990s showed that school lunches often contained levels of fats, saturated fats and sodium that exceeded the recommended guidelines, while at the same time failed to provide sufficient caloric intake (Fox, Crepinsek, Connor &

Battaglia, 2001). The most recent review reports that school lunches have improved significantly in some areas, such as recommended fat and saturated fat levels and target nutrient levels, though these are still a challenge. Other problems remain in terms of minimum calorie levels, fibre and sodium (Fox & Condon, 2012). The research reviewed in the previous section indicates that insufficient quantity and quality of food has a negative effect on young people. As such, interventions that fail to provide the necessary nutritional and caloric intake may be ineffective.

Participation appears to be another key obstacle to making the lunch program effective at combatting food insecurity, rather than any debate regarding the positive effects on academic achievement. While the USDA and schools are doing their best to offer nutritionally balanced meals, these are not always the options children and teenagers will choose. The NSLP reviews mentioned above make a distinction between lunches/breakfasts *offered* (the options available to students) and lunches/breakfasts *served* (the items the students actually choose) and note that the meals offered often meet all the required nutritional standards, but the meals the students are choosing do not. In addition, "competitive foods," which are any foods sold in schools outside the NSLP and SBP, are under no nutrient guidelines and are available in most schools. These tend to decrease student participation in school meal programs, especially by those students who must pay full price for school lunches because they do not qualify for free or reduced-price meals (FRAC, 2015c).

The SBP has also been criticized for low rates of participation. One of the more recent innovations in school-provided meal programs involves providing breakfast in the classroom, to be eaten during the first part of class, instead of cafeteria-based breakfasts before school (Imberman & Kugler, 2014). This was introduced in response to studies and surveys that found that one of the barriers to students taking advantage of school breakfasts was that it was served too early (Imberman & Kugler, 2014; Hearst et al., 2016; Sweeney and Horishita, 2005). However, Schanzenbach and Zaki's 2014 review of American school breakfast programs found that, while expansion of the programs significantly increased participation, they largely represented a simple change in the location of where the student ate breakfast (i.e., at school rather than home) and were not correlated with any improvement in attendance or test scores (p. 15). Waehrer (2008) found that students who took advantage of school breakfast programs ate less on weekdays than on weekends. Imberman and Kugler's 2014 study showed an improvement in math and reading scores in state accountability exams among some students, but no improvement in overall marks.

Another criticism of the SBP concerns its lack of availability. There has been some call for this program, like the lunch program, to be made universal, rather than targeted at impoverished areas (Schanzenbach & Zaki, 2014). There is also concern over students' food intake during the periods they are not in school, a problem the more recent Summer Food Service Program is attempting to address, though so-far with limited success (USDA, 2016c; Hayes, Rosso, Anderson and FitzSimons, 2016). Given the benefits of breakfast and food security on health and learning discussed above, these mixed results suggest the need for more textured research on the underlying relationships and mechanisms in order to design more effective school food programs and policies.

Unlike the US and many other industrialized nations, Canada does not have a national school food program (Food Secure Canada, n.d.) and a number of organizations have called for the establishment of such a

program in order to address student food insecurity, rising obesity, nutritional illiteracy and the inconsistency that sometimes characterizes local programs (The Coalition for Healthy School Food, n.d.). In instances where food programs are available, they are locally or provincially funded and operated (Brown, 1993; Muthuswamy, 2012; Alberta Education, 2017). For example, the Toronto District School Board launched a school food nutrition pilot program in the early 1990s that provided subsidized meals and nutrition education to 15 schools (Brown, 1993). Funding was provided by the TDSB and City of Toronto, but also relied on parents, staff and the school community to help cover the costs and take responsibility for planning and administering these programs. An evaluation of the pilot through analysis of questionnaires, attendance records and focus group proceedings showed that snack programs had the highest participation rates, tardiness on school days decreased, and female students and younger students were less likely to skip meals than male students and older students. The TDSB has continued to rely on partnerships with schools, parents and community organizations, along with provincial and municipal funding, in order to provide meal programs in schools that are primarily located in lower income neighborhoods (TDSB, 2014). In April 2017, the Alberta government announced the expansion of a school meal pilot program in elementary schools into a province-wide initiative for the 2017/18 academic year (Graney, 2017).

While there are calls for the American School Breakfast Program to be made universally available and for a national lunch program to be put in place in Canada, some researchers caution against implementing blanket programs. Carter, Dubois, Tremblay and Taljaard (2012) argue that intervention programs must take account of local physical and social environmental factors in their design and execution. Research on Canadian food insecurity discussed above indicates that this problem cuts across almost all demographics, but there are certain subpopulations that tend to be more vulnerable, such as households that are low income or on social assistance, racial minorities, recent immigrants and single-parent households. In addition, certain areas, sometimes known as "food deserts,"[4] may have fewer healthy food resources available or there may be low social cohesion, making it more difficult to access help or collectively organize intervention strategies (Carter et al., 2012, p. 1039). Programs that are tailored based on school or community demographics may yield better results. For example, Travers et al. (1997) found that Nova Scotians living in rural areas of the province may experience more barriers than those residing in urban areas with respect to accessing a nutritionally recommended diet. A study of a school snack program in Fort Albany, Ontario, also supports a locally focused approach. The results show that the program has been successful in improving the dietary intake of participants by offering foods that the largely Cree students in the remote community often lacked, such as milk, fruits and vegetables. These foods must be shipped in and are often too expensive for local residents to purchase on a regular basis. The program also occasionally offers traditional foods, such as bannock, acknowledging the First Nations heritage of the students, and integrates community involvement as key to its functioning. The community element appears to be critical to the program's success and longevity. Rather than a short-term "pilot intervention," the program was institutionalized in the community and has improved over time. The study does not contain data on

4 The use of this term is somewhat controversial, particularly outside the United States. Beaulac, Kristjansson, and Cummins' (2009) review of research on food deserts showed that most studies, "assess[ed] the differential accessibility to healthy and affordable food between socioeconomically advantaged and disadvantaged areas," such as proximity to and quantity of supermarkets versus convenience stores, food prices, and availability of fresh produce (p. 1). They conclude that evidence of food deserts is robust for the United States, but that more research is needed for other developed nations, including Canada.

academic performance, but the students report feeling less hungry at school, eating more fruit and being motivated to make better dietary choices (Skinner, Hanning, Metatawabin, Martin & Tsuji, 2012).

Food Insecurity and Postsecondary Education Transitions

Postsecondary education drives individual and national success. Across all Organization for Economic Co-operation and Development (OECD) nations, PSE increases the likelihood of participation in the labour market; is associated with higher earnings, national economic competitiveness and smaller gender gaps in earnings; and acts as an indicator of equity within a country (Finnie & Pavlic, 2013; OECD, 2013). Despite these widely acknowledged benefits, certain groups continue to be underrepresented in PSE: students with special needs, certain ethnic and racial minorities, recent immigrants and lower socioeconomic status groups (Robson et al., 2014; Finnie, Childs & Wismer, 2011). Access and transitions to PSE, therefore, become significant individual and national issues.

While the negative relationship between food insecurity and academic success is reasonably well established, there has been very little research with a focus beyond elementary education. Research on food insecurity as a whole tends to focus on general patterns in the adult population in relation to geography, income, ethnic identity, etc. and on the negative effects suffered by children, especially very young children. While research suggests that food insecurity in children could potentially lead to problems later in life, the amount of research on specific effects, such as related health and mental problems, behavioural problems, cognitive functioning and social integration, decreases as age increases. There are far fewer food insecurity studies on older adolescents (defined in the article as those 14–18 year olds), than on young children (Hoyland, Dye & Lawton, 2009; FRAC/Children's HealthWatch 2014), and very few studies on university and college students (Cady, 2014). As a result, it is unclear how food insecurity might affect the transition from secondary to postsecondary education, and persistence at the postsecondary level since this transition usually coincides with students moving from adolescence into adulthood.

The research that does focus on food insecurity and adolescents (defined by the World Health Organization as those 10–19 years of age), suggests that food insecurity is related to behavioural and psychological problems, including suspensions and poor peer relations (FRAC/Children's HealthWatch, 2014, p. 2; Alaimo, Olson & Frongillo, 2001); depression, acting out, "suicidal ideation" (Slopen, Fitzmaurice, Williams & Gilman, 2010; McIntyre, Williams, Lavorato & Patten, 2013); and physical effects, such as decreased bone mineral content (Eicher-Miller, Mason, Weaver, McCabe & Boushey, 2011). These psychological, behavioural and physical effects are worrying, particularly in light of their potential future impact, such as the ability to enter PSE, but this is not specifically addressed in the literature. The relationship between food insecurity and academic achievement at the secondary level and in the transition to PSE remains under-researched. Despite this gap in the literature, it is important to understand how food insecurity in early years affects the postsecondary transition since this could provide critical feedback on the effectiveness of intervention programs designed to combat food insecurity.

Research on food insecurity among PSE students is also sparse. Cady's review of research on food insecure American college students suggests that, while no student is immune to food insecurity, there are some groups who are particularly vulnerable, just as there are in the general population — racial minorities,

students with disabilities and single mothers, for example (Cady, 2014, p. 268). In a report for Meal Exchange, a Canadian charity that advocates for community-based, socially-just food systems via youth organizations, Silverthorn (2016) states that many Canadian campuses now have food banks, the use of which has increased over the past decade, and that almost 40% of PSE students surveyed reported experiencing moderate to severe food insecurity. Establishing the extent of food insecurity in the postsecondary environment is difficult, however, particularly at the national level, due to a lack of data. In Canada and the US, some small-scale studies like those reviewed by Cady (2014) are available (Chaparro, Zaghloul, Holck & Dobbs, 2009; Gaines, Robb, Knol & Sickler, 2014; Meldrum & Willows 2006), but these are largely limited to single campuses and so cannot yet be considered nationally representative. Moreover, food insecurity at the postsecondary level has not yet been linked in the research to food insecurity at the secondary level or during the transition to PSE, so little is known about the long-term continuity and effects of food insecurity in relation to academic performance.

Conclusion/Observations

Food insecurity is a key concept in current studies of poverty, mental and physical health, academic achievement and social inequality. The research reviewed above paints a complex and concerning picture in which hunger acts as a barrier to development and success in multiple aspects of life. This is a widespread problem in Canada, according to the most recent data, with 12% of households (including 1 million children) experiencing some level of food insecurity. It is important to note that, while food insecurity is correlated with income, it is not a problem exclusive to households below the low-income measure (LIM). The complex relationship between food insecurity and poverty/low income makes the use of food insecurity, rather than socioeconomic status (SES) or low-income cut-offs (LICOs) alone, a compelling choice in education research. Using measures of food insecurity includes both those below and above the poverty line who experience this barrier to academic success. It points to the complex interaction of factors that limit (or enhance) young people's chances, such as race, income and immigration status, highlighting vulnerable groups, but still accounting for all those who are not part of those groups.

The effects of this condition are well documented, particularly in children. Physical, cognitive, psychological, behavioural, social and academic development are all negatively impacted by food insecurity. Research suggests that a good breakfast in particular can help alleviate some of these problems, and schools are attempting to combat student hunger through breakfast and lunch programs. The National School Lunch Program and School Breakfast Program in the US have met with some success, though there is still work to be done in terms of nutrition content, student choice and participation, and hunger outside the school day. Some organizations have called for a similar national school food program to be instated in Canada, though, to date, this has not been realized.

There remain, however, grey areas in the literature. Fram, Bernal and Frongillo (2015) argue that when it comes to children's experiences of food insecurity, many of the large-scale surveys from which data is available must be treated with caution because of the tendency of adult respondents to under-report issues around child hunger. In order to capture the phenomenon accurately, the data must be rooted in children's experiences. The lack of young people's experience of food insecurity as reported by young people themselves represents a significant gap in the food insecurity research literature. Much of the research

discussed here, particularly in those studies examining households as a unit, relies on data reported by adult respondents. One of the key advantages of this study, as will be discussed in the following section, is the use of the TDSB 2011 Student Census data set, which taps directly into the experiences of young people.

Cook and Frank indicate that poor nutrition, and by extension food insecurity, continue to operate throughout the life course, impacting on the health and well-being of people well into their senior years (2008, p. 5). This influence has been closely researched in the early stages of life, from pregnancy to childhood, but the relationship becomes less thoroughly examined through adolescence and into adulthood. In terms of the relationship between academic achievement and food insecurity, there are far fewer studies of adolescents and PSE students than of younger children, leaving something of a blind spot in the research. The negative relationship in studies of younger children suggests that food insecurity would have continued effects as people age. There are the more obvious consequences of acute and chronic health problems, such as obesity, diabetes and cardiac disease, in addition to developmental consequences that can affect brain functions, such as cognition and memory, with consequences for everything from building functional relationships to educational attainment. Food insecurity has scarring psychological and social dimensions to consider, as well. Lifelong eating habits, susceptibility to stress and depression, perceptions of self-worth and the perpetuation of the poverty cycle can all be influenced by exposure to food insecurity.

However, these patterns seem rather assumed than extensively investigated at this point. For example, Cady's review of food insecurity research at the postsecondary level uses a "pipeline" approach:

> A pipeline approach … assumes that issues that occur in elementary school will move forward along the pipeline into secondary schools, which in turn will move forward into college. Given that food insecurity has negative impacts in elementary, and then in high school, one could make the assumption that the same impacts would be present for college students experiencing food insecurity. Further research is needed in order to determine whether or not this assumption is true. (2014, p. 268)

Given the existing research on academic achievement and food insecurity for younger children, it is not unreasonable to suspect a negative relationship between the two, as well, at the secondary level and in the transition to PSE.

Methodology

Data

We use the 2011 TDSB Student Census data in responding to the general research question posed in this report. The 2011 Student Census was completed by Grade 7–12 TDSB students in the fall of 2011 (Brown et al., 2012; Yau et al., 2013) and reports on 15,133 students who were 17 years of age and enrolled in the TDSB in the fall of 2011. These students were age-appropriate for Grade 12 Year 4, the age at which most Ontario students start their transition to PSE. There were two versions of the survey used in the census, and our analysis is limited to those students who answered questions on Form B about their eating habits, with a resulting sample size of 7,208 students. The 2011 Student Census data was merged with TDSB administrative data, as well as household income from the 2006 Canadian Federal Census. In order to track the PSE transitions of the 17 year olds who participated in the census, data on postsecondary applications to Ontario institutions from the Ontario University Applications Centre (OUAC) and the Ontario College Applications Centre (OCAS) were matched to individuals in the data set. Because students apply to PSE over multiple years (Sweet et al., 2010), OUAC and OCAS information from the 2012, 2013 and 2014 application cycles was merged with the data set to determine if students had applied and confirmed acceptance at a university or college in any of these years (N=7,058).

Variables

Dependent Variables

Our choice of dependent variables reflects aspects of student success and includes students' academic performance in high school and their acceptance of an offer from an Ontario PSE institution.

> *High school grades* were measured from the average marks that students had achieved in their Grade 11 and 12 courses, which were obtained from the Toronto District School Board administrative database.
>
> *Acceptance of an offer from an Ontario PSE institution.* We examined three possible pathways:
>
> 1. Confirmed an offer of admission to an Ontario university
> 2. Confirmed an offer of admission to an Ontario college
> 3. Neither of these two options (i.e., did not apply or applied but was not accepted)

The term "confirmed acceptance" applies to the condition where a student has applied to a college or university, been accepted and accepted the offer. It is more substantial than a simple acceptance at a university or college, because it implies the additional intentionality of the student to actually attend.

Independent Variables

Our choice of independent variables reflects both our general research question as well as the factors that previous literature has identified as critical in understanding the PSE pathways of youth in Canada. We have three groups of independent variables: food security, intersectionality and controls.

Food security is our major concept of interest. As discussed in the literature review, there is no standard way of measuring food insecurity. Often the concept is measured using data on meal skipping. However, as the literature review indicated, food insecurity is more complex than simply meal skipping. To attain conceptual validity, in other words, to ensure that a variable is measuring the concept that it is intended to measure as closely as possible, an accurate measure of food insecurity must contain information about both eating habits and financial resources. It is the combination of these elements (i.e., what students eat and the wider set of economic resources available) that determines their level of food security. While not strictly limited to children in poverty, it is clear from the above review that food insecurity contains an economic element. To address this limitation in previous work, we used a combination of several different measures to capture both dimensions of food security, consumption and economic resources. Because this analysis is exploratory, we employ an exploratory approach to examine how these concepts will group together.

In order to operationalize the consumption dimension of food insecurity, we used a *frequency of meal consumption* measure. More specifically, we employed item 30 of the 2011 Student Census, which asked students to respond to the following question: "During the school week, how often do you": a) eat breakfast before coming to school; b) eat lunch; c) eat dinner. Response categories for each meal were "Everyday (5 days)," "3–4 days," "1–2 days," and "Never." The items were reverse coded so that "Never" had a value of 1 and "Everyday (5 days)" had a value of 4. We include these three items as measures of meal consumption in one set of estimations. Because the literature focused on breakfast consumption/skipping, we emphasize breakfast as the main meal of interest, although we control for the effects of other meals that were reported by the respondent. It should be noted that the Student Census does not contain self-report items that permit the measurement of the quality of food eaten by students.

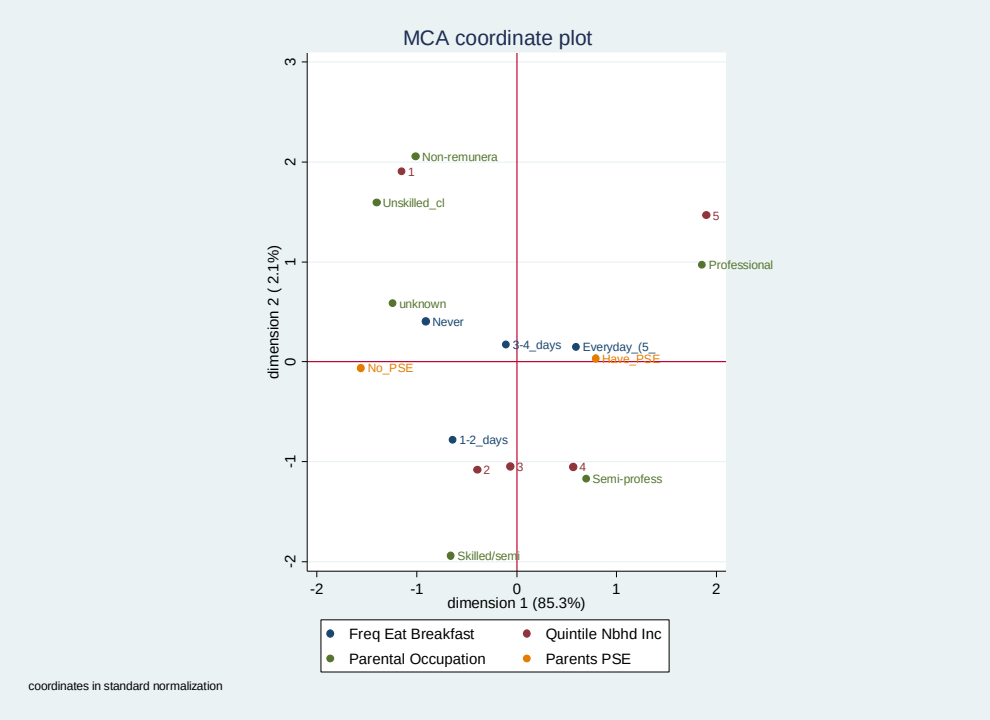
We used three measures of economic resources available to a student's family that are present in the data set: parental occupation status, parental attainment of PSE and neighborhood income. For *parental occupation status*, students in the 2011 TDSB student census were asked "If your parents work, what are their jobs/occupations? (Write WHAT they do such as cashier, teacher, truck driver, computer technician, restaurant owner, accountant, book keeper, nurse, office manager, auto mechanic, lawyer, etc.)" The data from these open-ended questions was categorized and coded into five groups: non-remunerative, unskilled clerical and trades, skilled/semi-skilled clerical and trades, semi-professional and middle management, and professional and senior management. If two parents' occupations were listed, then the one with the higher of the two would be used to represent family occupational status. Parents who were retired, unemployed, or stay-at-home were coded as non-remunerative, even if an occupation was provided (Yau, O'Reilly, Rosolen, Kozovski & Archer, 2014). Because this variable contained around 17% missing cases, we retained a category for "unknown" after initial exploration revealed that cases where the parental occupation was missing tended to be overrepresented among students who were low income and had no parental PSE. We judged that retention of this category, despite its "fuzziness," was preferential to losing a fifth of cases.

To measure *parental attainment of PSE*, students were asked "What level(s) of education have your parents completed (in Canada or in any other country)?" Possible response categories were "Secondary School," "College," "University" and "I don't know." It was possible for students to complete answers for their mother, father or other caregiver. If the response indicated "college" or "university," the parent was considered to have attended PSE. In the case of two-parent families, if either parent had PSE, the parental PSE was coded 1. If no parent or caregiver had PSE, the variable was coded 0.

To measure average *neighbourhood income*, we use household income from the 2006 Canadian Federal Census, matched by postal code to the Census Dissemination Area or DA, usually with several hundred households per DA. We divide this distribution into fives quintiles so that the lowest quintile, 1, represents the poorest 20% and the highest quintile, 5, represents the richest 20%.

Next, to create a single measure of food security that incorporates meal consumption and the three economic factors described above, we employed multiple correspondence analysis (MCA) to help us reveal patterns of relationships among breakfast skipping, quintile of neighbourhood income, parental PSE and parental occupation. We employed MCA techniques on the same data set that we utilized later in the analysis, focusing on a subset of indicators to be included in the index. MCA is similar to techniques like cluster analysis and factor analysis insofar as they are all concerned with data reduction. Unlike cluster analysis or factor analysis, MCA is particularly useful for geometrically mapping variable patterns (Costa, Santos, Cunha, Cotter & Sousa, 2013). Since visual mappings of the associations between variables is possible in MCA, it was deemed by the authors to be a more appropriate method for our exploratory analysis in developing the food security index. The analysis was estimated using command MCA in Stata 14. Figure 1 illustrates the MCA coordinate plot. The figures produced in MCA are graphical illustrations of contingency tables between row-column pairs that would not be revealed through simple pairwise analysis. Based upon the proximity of the variables to each other on the graph, an index of food security is derived. In MCA, the dots in the coordinate plot represent people with similar profiles in their answers to questions. The distances between the dots represent associations between variable categories.

Figure 1: MCA Plot for Food Security Index



The first dimension explained 85.3% of the variation. Because this analysis is exploratory and not confirmatory (i.e., testing a hypothesis), we can interpret this dimension to be representative of economic resources and its association with eating. The plot illustrates the pattern that breakfast eating makes with the three measures of SES. In the top right quadrant there are individuals who are from the highest SES groups and eat breakfast daily and whose parents have PSE. The top left quadrant contains students who never eat breakfast and are from the lowest SES groups (as well as the "unknown" SES group). Students who eat breakfast 3–4 times per week are also represented here. The bottom left is characterized by lower middle-SES students who eat breakfast 1–2 days per week and whose parents have no PSE, while the bottom right quadrant contains middle SES students but no breakfast behaviours. Following Greenacre (2007), we retain a one-factor solution in order to maximize the meaningful interpretation that can be given to the dimension. In this case, the single factor solution accounted for the vast majority of variance.[5]

5 It should be noted that multiple correspondence analysis is ostensibly identical to principal component analysis, except that useful visualizations are produced when using MCA which can lead to a more fulsome understanding of how the components of a factor are related to one another. In this particular instance, when the factor was created using PCA, it correlated with the MCA solution at 0.98.

Next we turn to variables that operationalize concepts associated with *intersectionality*. Race, sex and class are key to an intersectionality framework, which understands that these combinations of traits interact with each other to shape the social mobility opportunities of individuals.
Ethnoracial group was measured by asking the students, "Which of the following best describes your racial background? (Pick one only.)"

1. Aboriginal
2. Asian - East (e.g., China, Japan, Korea)
3. Asian - South (e.g., India, Pakistan, Sri Lanka)
4. Asian - Southeast (e.g., Malaysia, Philippines, Vietnam)
5. Black - Africa (e.g., Ghana, Kenya, Somalia)
6. Black - Canada Black - Caribbean Region (e.g., Jamaica, Barbados)
7. Latin American (e.g., Argentina, Chile, El Salvador)
8. Indian-Caribbean (e.g., Guyana with origins in India)
9. Middle Eastern (e.g., Egypt, Iran, Lebanon)
10. Mixed background (please specify)
11. White - Canada White - Europe (e.g., England, Italy, Portugal, Russia)
12. Other(s) (please specify)

To ensure sample sizes that made it possible to do quantitative analysis, the responses were recoded into White, Black, East Asian, South Asian, Southeast Asian, Latin American, Middle Eastern, mixed background, Aboriginal and Other. Aboriginal and Other accounted for only a handful of cases and were not retained in either data set.

Sex of student was measured using a variable in which males were coded 1 and females were coded 0.

Class was measured using the three items mentioned above as part of the food security index: parents' occupation, parental PSE and median neighbourhood income in quintiles. Where the food security index is used in estimations, the social class measures are not included in the models, as this would result in autocorrelation errors.

To operationalize the core notion of intersectionality, i.e., that different combinations of traits result in different outcomes, we use statistical interactions, also known as moderators. Interactions allow characteristics to vary in relation to their impact on a dependent variable of interest, contingent on the value of another variable. For example, we can examine if the impact of food security on educational outcomes varies by sex or race. We focus in the analysis on the interactions between the food security measures and self-identified race.[6]

6 Our explorations of the interactions between the food security measures and sex failed to reveal any statistically significant results, therefore we do not address them here.

Control Variables

In order to not overstate the relationship between food security and educational outcomes, we include a number of important control variables. These control variables are previously established predicators of educational outcomes that are important in describing the variation in our dependent variables, but are not the focus of our analysis.

Special Education Needs (SEN) was measured in this report through the use of the Education Quality and Accountability Office (EQAO) definition, that is, students who have been formally identified by an Identification, Placement and Review Committee (IPRC), as well as students who have an Individual Education Plan (IEP). Students who were identified as gifted are not included. Students with such needs were coded 1 and students who had no special education needs or were identified with a Gifted exceptionality were coded 0.[7]

Immigrant generational status of the student was derived from information on students' region of birth and where their parents were born. First-generation students were those who were born outside of Canada (as were their parents), second-generation students were born in Canada but had one parent born outside Canada, and third-generation students had both parents born in Canada (Anisef, Brown, Phythian, Sweet, & Walters, 2010).

Enjoyment of school was measured with a single Likert-type item stating "I enjoy school" with the response categories of "All of the time," "Often," "Sometimes," "Rarely" and "Never" and was reverse coded so that higher numbers were associated with greater enjoyment of school.

Academic stream of students in Grade 9 was derived from the administrative data and is coded so that 1 equates to being in the applied or locally-developed stream and 0 equates to the academic stream (the majority). We refer to the students coded 1 as "non-academic."

School size was measured through a series of categories: less than or equal to 100 students, 101–200, 201–500, 501–1000, 1001–1200, 1201–1400 and greater than 1400.

Analysis

Our analytic strategy has three parts. We first provide descriptive statistics in order to familiarize the reader with characteristics of our estimation sample. We then move on to bivariate analyses between race and our

7 Special education is intended to address the academic needs of students deemed as exceptional or who have been identified by educators as having "special needs that require supports beyond those ordinarily received in the school setting" (Ontario Ministry of Education, 2017). School principals are required to ensure that an Individual Education Plan (IEP) is developed for each student who has been identified as exceptional by an Identification, Placement and Review Committee (IPRC), within 30 school days of the student's placement in a special education program, where their needs can be met through accommodations and/or program modifications. In Ontario, there are two main categories of SEN: 1) students who have an Individual Education Plan (IEP) without undergoing a formal identification process, and 2) those who have one of twelve exceptionalities, designated through an Identification, Placement, and Review Committee procedure involving diagnostic assessments, and usually administered by a school or external psychologist.

independent and dependent variables of interest.[8] We examine how race is unequally distributed across our key independent and dependent variables.

We then move on to multivariate analyses where we can simultaneously control for the effects of different variables by including them in the model, while at the same time examining how food security and race impact educational outcomes.

Our analysis focuses on how race interacts with food security to shape the educational outcomes of young people. We argued above that food security is a concept that incorporates many aspects of social class. Here we examine how race and this understanding of access to resources (food security) have differential impacts on educational outcomes depending upon the race of the student. We add these statistical interactions, often called moderators, to our model in the second step of the multivariate analysis. Such an operationalization allows us to examine the intersectionalities of students so as to understand how different combinations of fixed characteristics can impact upon their life chances (McCall, 2005).

Results

Descriptive Statistics

Table 1 reports the descriptive statistics of the variables used in the analysis. In terms of the food security measures, the index was normalized so that it had a mean of zero and a standard deviation of 1.[9] The Likert-style items measuring frequency of eating breakfast, lunch and dinner (with 1 being "Never" and 4 being "5 days per week") indicated that breakfast was the meal that students were most likely to skip (mean=2.98) while dinner was the least likely to be missed (mean=3.80).

In terms of educational outcomes, the average grade 11/12 mark for this sample was around 71%.

Of the sample, 54% confirmed university, 18% confirmed college and 27% did not confirm PSE.

Turning to self-identified race, the largest group of students was White (27.5%), followed by South Asian (21%) and East Asian (20.5%). Black students comprised just over 12% of the sample, while the remaining groups were relatively much smaller. Those identifying as mixed background were 6.5% of the sample, while Middle Eastern students represented 6%. Southeast Asian students were just under 5% of the sample, while Latin Americans made up just 2% of the students.

8 The Pearson correlation between the food security index and marks was -0.06. The correlation between the frequency of eating breakfast and marks was 0.26. Because the other pathway variables are nominal, their correlations are less meaningful. We explore the relationship between the independent and dependent variables more thoroughly in the multivariate analysis. The purpose of the bivariate analyses here are to flesh out less obvious relationships between the independent variables of interest to this study.

9 Because Multiple Correspondence Analysis is a variant of Principle Component Analysis, the composite variables had to be normalized (made comparable) in order to understand the variance among the clusters of variables.

Social class was measured by parental occupational status, parental PSE and quintile of neighbourhood income. In terms of occupation, the largest group was semi-professional (nearly 23%), followed by professional (21%). Skilled and semi-skilled followed at 19%, while unskilled clerical was just under 6% of the sample. Non-remunerative comprised over 12% of the students' parents, while the occupational status was unknown for 19% of students. Around 66% of students said at least one of their parents had PSE. Neighbourhood income quintile should be represented by five groups of 20%, however in matters of income distribution and where the original income values are banded, which is the case here, values at the tails tend to be extreme and not readily sliced into 20% groupings. As a result, we report unequal quintiles, particularly in the case of the fourth quintile, which only had around 6% of the sample.

Just under half of the sample identified as female (49%), while 11.5% had a special education need. In terms of immigrant generation, the largest group was second-generation immigrants (46%), followed by first-generation immigrants (36%). Just over 18% of students were third-generation (or higher) Canadians. Just under 26% of students were in majority applied courses, while the average enjoyment of school was 3.6 on a 5 point scale, where 5 was "enjoyed school very much." School size is an ordinal variable, however, we use it as a control and treat it as an interval variable in our model.

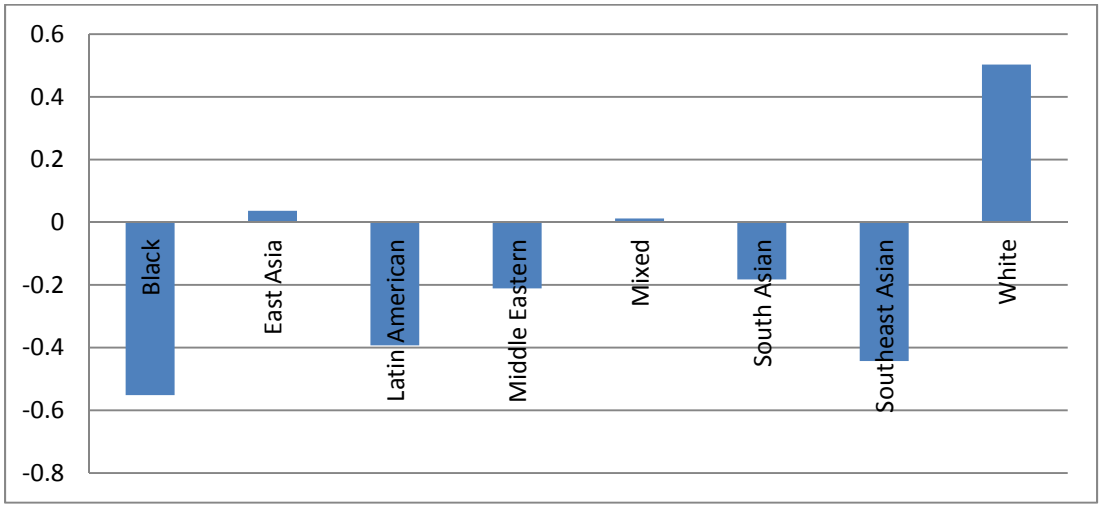
Table 1: Descriptive Statistics of Estimation Sample (N=7058)

Variable	Mean	S.D.	Min	Max
Food security index	0.002	0.999	-1.956	2.005
Frequency of eating breakfast	2.982	1.113	1	4
Frequency of eating lunch	3.472	0.797	1	4
Frequency of eating dinner	3.797	0.533	1	4
Educational Outcomes				
Average marks in grade 11/12	70.802	14.315	0	99
Confirmed university	0.543		0	1
Confirmed college	0.184		0	1
Did not confirm PSE	0.273		0	1
Self-identified Race				
Black	0.122		0	1
East Asian	0.205		0	1
Latin American	0.020		0	1
Middle Eastern	0.060		0	1
Mixed Background	0.065		0	1
South Asian	0.210		0	1
Southeast Asian	0.046		0	1
White	0.275		0	1
Social Class Indicators				
Parental occupational status				
Non-remunerative	0.124		0	1

Variable	Mean	S.D.	Min	Max
Unskilled clerical and trades	0.056		0	1
Skilled/semi-skilled clerical and trades	0.191		0	1
Semi-professional and mid-management	0.228		0	1
Professional and senior management	0.211		0	1
Unknown	0.190		0	1
If parents have PSE (1=yes)	0.663		0	1
Quintiles of Neighbourhood Household Income				
Lowest quintile of neighbourhood income	0.212		0	1
Second quintile of neighbourhood income	0.233		0	1
Third quintile of neighbourhood income	0.195		0	1
Fourth quintile of neighbourhood income	0.056		0	1
Highest quintile of neighbourhood income	0.122		0	1
Female (1=yes)	0.488		0	1
Control Variables				
Have special education needs (1=yes)	0.115		0	1
First-generation immigrant (1=yes)	0.363		0	1
Second-generation immigrant (1=yes)	0.456		0	1
Third-generation or higher (1=yes)	0.182		0	1
If majority courses non-academic (1=yes)	0.255		0	1
Level of school enjoyment	3.557	0.897	1	5
School size	5.307	1.226	1	7

Bivariate Analyses

Figure 2: Food Security Index Averages by Race



We now turn to bivariate analyses. Figure 2 displays the average food security index values by self-identified race. It should be noted that the food security index was normalized so that it had a mean value of zero, making the average across the sample zero. Deviations from either side of the value of zero represent deviations from the sample average. As can be clearly identified in the figure, White students were well above the sample average. Only East Asian and mixed-background students were also on the positive side of the horizontal axis, while the remaining groups all had average food security index values below the sample average. Black and Southeast Asian students had the lowest values on the food security index. Using ANOVA to examine mean differences between race categories on the food security index revealed statistical significance (F=150.21, p<0.000). Sidak post-hoc analyses revealed significant mean differences between White students and all other groups.

Figure 3: Self-reported Breakfast Eating Frequency Averages by Race

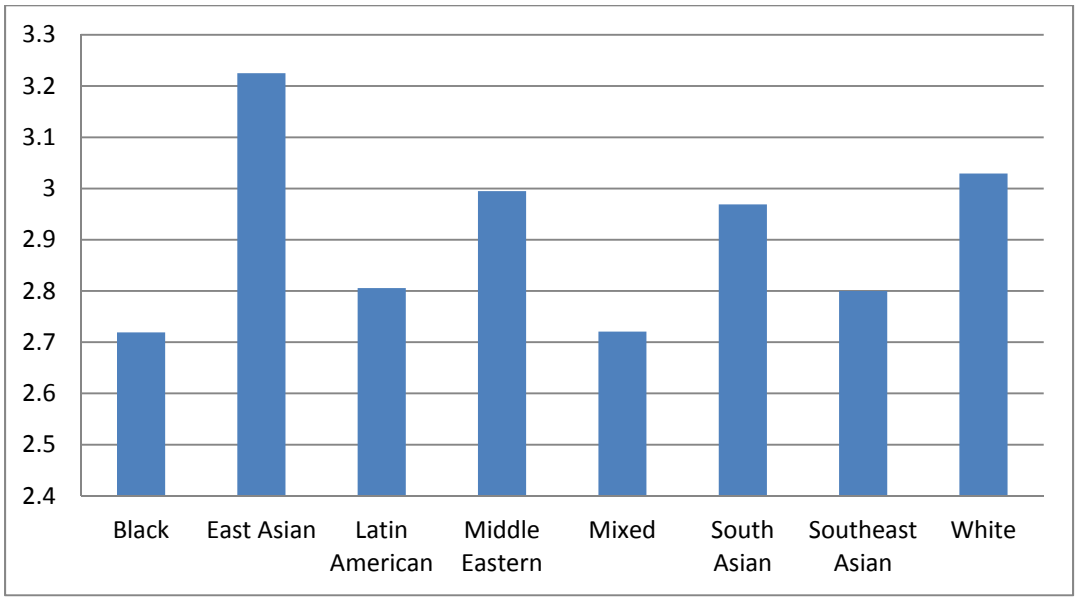


Figure 3 displays the two-way plot of the average self-reported breakfast frequencies by race. To review, self-reported breakfast eating frequency was measured through a Likert scale with the following values: "never"=1, "1–2 days per week"=2, "3–4 days per week"=3, and "5 days per week=4. East Asian and White students reported the most frequent breakfast-eating habits, while Black and mixed-background students reported eating breakfast least often. Anova analyses (F=22.71, p<0.000) with post-hoc Sidak tests revealed that East Asian students had significantly higher mean scores that all other groups.

Figure 4: Average Grade 11/12 Marks by Race

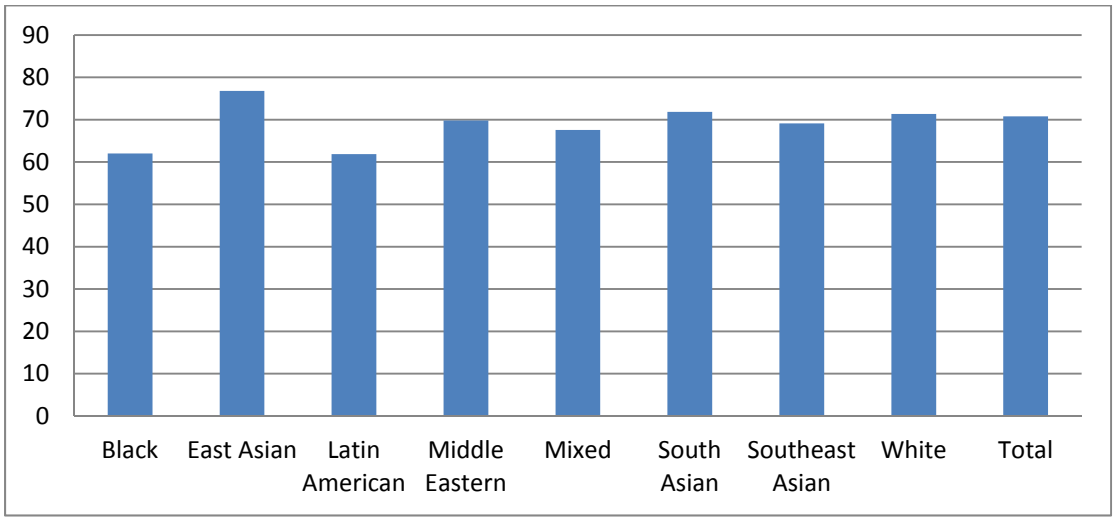


Figure 4 illustrates the average grade 11/12 marks of students by race. The average mark of the sample is around 70% (the last bar on the right). Middle Eastern, South Asian, Southeast Asian and White students all have average marks that are very similar to the sample average. Black and Latin American students have average marks that are almost 10% lower than the sample average, while the average marks of East Asian students are around 77%. One-way ANOVA analyses of means differences (F= 107.14, p<0.000) with Sidak post-hoc analyses revealed the average marks of Black students to be significantly lower than all other groups except for Latin Americans.

Figure 5: Postsecondary Pathways by Race

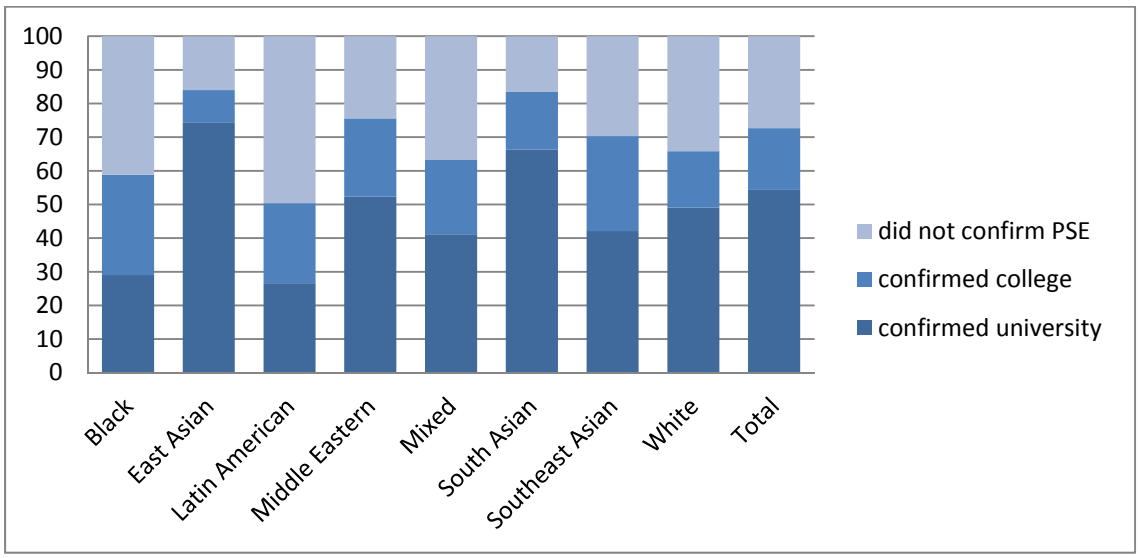


Figure 5 displays the postsecondary pathways of sample members by race. The bottom bar represents students who applied and confirmed an offer of university. The groups with the highest university confirmation percentages are East Asian and South Asian students (over 65%), while Black and Latin American students have the lowest percentage of university confirmations (less than 30%). Around 30% of Black and Southeast Asian students confirmed an offer of admission to college, while the lowest college confirmation rates were found among East Asian students, who had a rate of less than 10%. Latin American students were least likely to confirm an offer of admission to PSE (around 50%), followed by Black students (41%).

Bivariate Summary

Our bivariate analyses illustrate that there are differences by race in the distributions of the independent (breakfast eating and food security index) and dependent variables (grade 11/12 average marks and PSE confirmations) of interest. It is also worth noting, although it is beyond the scope of this report, that significant racial differences also exist in the distribution of the control variables in this model, as demonstrated in our previous work (Robson, Anisef, Brown & George, forthcoming). For example, Black students are more likely to have special education needs and be in applied streams of study. Multivariate models that we tested control and adjust for these factors, but it is worth noting that, like the independent and dependent variables of interest, the control variables in this study also exhibit similar disparities by race. We now turn to our multivariate analyses, which allow us to examine the impact of food security on educational outcomes, accounting for the effects of a host of other factors.

Multivariate Analysis

We now turn to our multivariate analyses, which allow us to simultaneously control for variables in our model while focusing on the effects of our variables of interest (i.e., food security). Our multivariate analyses are organized into four tables, each of which has two models. We first examine the dependent variable Grade 11/12 average marks. In Table 2, our independent variable of interest is frequency of breakfast eating. In Table 3, the independent variable of interest is the food security index. In the next set of estimations, we focus on postsecondary confirmations, first focusing on frequency of breakfast eating (Table 4), then shifting to our food security index (Table 5). In each table, two models are run. The first model includes all the main effects of all variables in the model. The second model adds the interactions between race (reference=White) and the food security measure from the previous model (frequency of breakfast eating or the food security index). We use multi-level modeling to allow for random intercepts by school, as initial analyses revealed significant nesting/clustering by high school. Multi-level modeling allows us to correct for this clustering, which is a violation of the assumptions of ordinary least squares regression (Robson & Pevalin, 2016).

Table 2: Multi-level Regression for Variables Predicting Grade 11/12 Average Marks on Frequency of Eating Breakfast, Race and Controls

Unstandardized Regression Coefficients

	Model 1	***Model 2***
Frequency of eating breakfast	1.772***	2.050***
Frequency of eating lunch	0.500*	0.496*
Frequency of eating dinner	1.044***	1.100***
Black	-3.449***	0.916
East Asian	4.715***	5.151***
Latin American	-5.372***	-6.566*
Middle Eastern	1.129	3.574
Mixed background	-1.329*	-2.547
South Asian	1.524**	1.437
Southeast Asian	0.865	5.132**
Professional and senior management	3.687***	3.636***
Semi-professional and middle management	1.445**	1.452**
Skilled/semi-skilled clerical and trades	1.029*	1.046*
Unskilled clerical and trades	1.677*	1.723*
Non-remunerative	0.066	0.087
Quintiles of household income	0.475***	0.465***
If parents have PSE (1=yes)	1.349***	1.372***
Female	3.333***	3.308***
Have special education needs (1=yes)	-2.059***	-2.099***
First-generation immigrant (1=yes)	0.091	0.048
Second-generation immigrant (1=yes)	0.266	0.254
If majority courses non-academic (1=yes)	-7.649***	-7.642***
Level of school enjoyment	1.864***	1.877***
School size ranges	2.144***	2.115***
Black × eat breakfast		-1.575***
East Asian × eat breakfast		-0.151
Latin American × eat breakfast		0.454
Middle Eastern × eat breakfast		-0.815
Mixed background × eat breakfast		0.474
South Asian × eat breakfast		0.031
Southeast Asian × eat breakfast		-1.499*
Constant	37.75***	36.87***
Level 1 variance	17.28***	16.65***

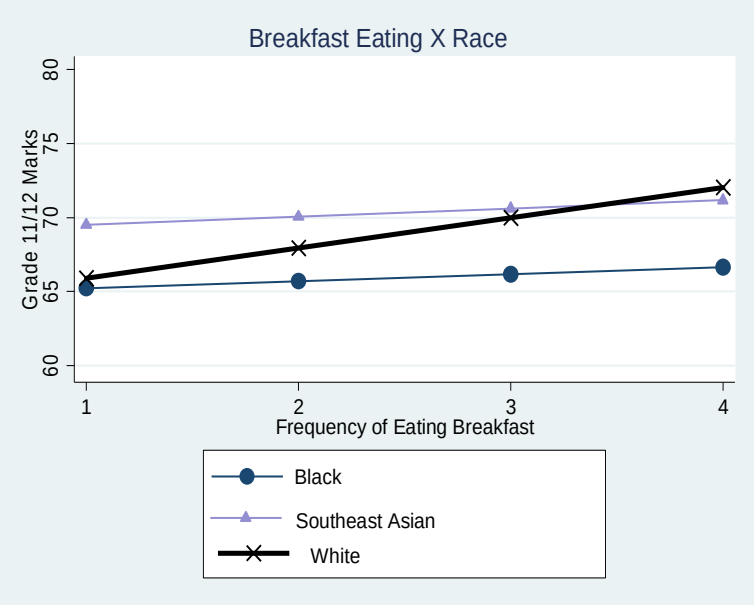
	Model 1	***Model 2***
Level 2 variance	135.1***	134.7***
Intraclass correlation	0.113	0.110
Log likelihood	-27429.20	-27417.50

* p<0.05, ** p<0.01, *** p<0.001

Every unit increase in the eating breakfast scale increased average marks by 1.7 percentage points in Model 1. Eating lunch and dinner also had statistically significant effects on marks, but not as strong. In terms of race, relative to White students (the omitted category), being Black was associated with a 3.5% decrease in average marks, being Latin American was associated with a 5.4% decrease in average marks and being mixed background was associated with a 1.3% decrease in average marks. Conversely, East Asian students had an almost 5 percentage point advantage relative to White students, while South Asian students had a 1.5 percentage point advantage. The occupational class variables were also significant (the omitted category was the "unknown" group), with children of professional and senior management having the greatest advantage with regard to average marks. In general, the remaining controls performed as expected, and because they are not the focus of this inquiry, they are not elaborated upon here.

The interactions in Model 2 examined if eating breakfast had a differential impact on average marks according to race, relative to White students. Two statistically significant results were revealed and these were for Black and Southeast Asian students. Because the meanings of main effects change when interactions are included in multivariate models, it is difficult to "eyeball" interactions in complex models. As such, we plot the significant results in Figure 6.

Figure 6: Grade 11/12 Average Marks by Frequency of Breakfast Eating and Race



The statistically significant interactions indicate that the effect of breakfast eating is different for Black and Southeast Asian students compared to White students. As demonstrated in Figure 6, the trajectory for White students is steeper — as breakfast eating increases, average marks increase. However, for Black and Southeast Asian students, the trajectories are much flatter. While Black and White students start off about the same at the lowest end of the breakfast eating scale, average marks are relatively unaffected by breakfast eating for Black students compared to White students. In the case of Southeast Asian students, they start higher on the lowest end of breakfast eating, but again the relationship is quite flat.

Table 3: Multi-level Regression of Grade 11/12 Average Marks on Food Security Index, Race and Controls

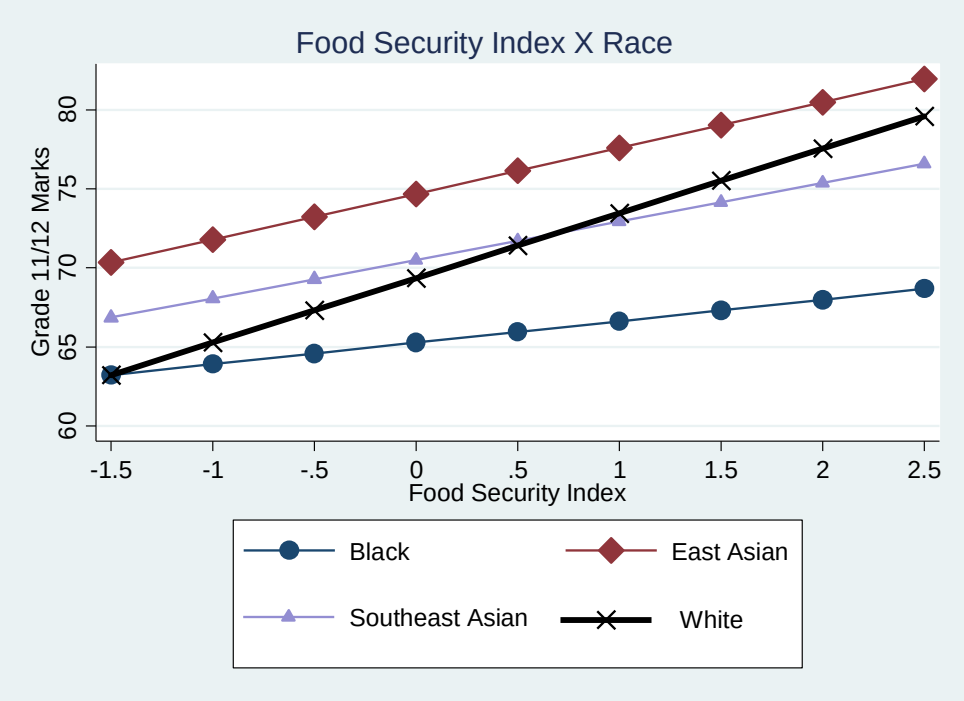
Unstandardized Regression Coefficients

Grade 11/12 Average Marks		
	Model 1	Model 2
Food security index	2.713***	3.592***
Black	-3.571***	-4.384***
East Asian	5.027***	5.386***
Latin American	-4.991***	-5.190***
Middle Eastern	1.085	1.295
Mixed background	-1.473*	-1.134
South Asian	1.642**	1.931***
Southeast Asian	1.094	1.025
First-generation immigrant (1=yes)	0.287	0.415
Second-generation immigrant (1=yes)	0.526	0.588
If majority courses non-academic (1=yes)	-8.032***	-7.986***
Level of school enjoyment	2.145***	2.138***
School size ranges	2.235***	2.184***
Black × food security index		-2.953***
East Asian × food security index		-1.283**
Latin American × food security index		-2.322
Middle Eastern × food security index		-1.072
Mixed background × food security index		0.614
South Asian × food security index		-0.893*
Southeast Asian × food security index		-1.854*
Constant	50.72***	50.57***
Level 1 variance	17.12***	15.64***
Level 2 variance	139.9***	139.2***
Observations	7208	7208
Intraclass correlation	0.109	0.101
Log likelihood	-28134.1	-28113.6

Table 3 presents the results of the multi-level regression of the food security index on grade 11/12 average marks. The index is positively associated with marks, controlling for the other variables in the model. We found that race was associated with marks in a similar pattern to what was found in Table 2. The controls also performed as expected, in general. The variables that were part of the index are not included as controls in these models.

Turning to the interactions in Model 2, four were statistically significant. The association between the food security index and marks was significantly different from White students for Black, East Asian, South Asian and Southeast Asian students. Figure 7 illustrates the different relationships between food security and marks by self-identified race. Only the statistically significant interactions are plotted.

Figure 7: Grade 11/12 Average Marks by Food Security Index and Race



The line representing White students is the steepest, revealing low marks at the lowest end of the index, and rising steeply as index values increase. Black students start out at the same level as White students at the lowest end of the index, but the trajectory is much flatter, indicating that the relationship between food security and average marks is weaker. East Asian students have higher marks at all levels of food security, although the trajectory is not as steep as for White students and thus the relationship between the two factors is weaker for East Asian students. Southeast Asian students start higher than White students at the lowest end of the food security index, but the line is flatter and results in lower average marks at the higher ends of the index.

Summary of Results for Grade 11/12 Average Marks

Tables 2 and 3, and perhaps more so Figures 6 and 7, have shown that the two measures explored here reveal quite different racial differences. If we focus on breakfast eating, following a large portion of the research literature on food security, we find a few differences that suggest that breakfast eating is less important for some groups relative to White students (Figure 6). However, if we use the index, which incorporates aspects of economic resources, social position and eating habits, the results are far more complex (Figure 7). We find that elements of social position are more closely tied to average marks for some groups (White and East Asian students) than for others (Black and Southeast Asian students). Thus, it is unlikely that the lower achievement of these groups is tied strictly to issues of nutrition or poverty, but also to other social factors that are not captured in our data.

We now turn to our multivariate analyses of PSE confirmations. Because the dependent variable is nominal (confirmed university, confirmed college, did not confirm PSE), we use multinomial logistic regression. Like the above analyses, we allow for random intercepts by individual school to account for the clustering in the data. Thus, we use multi-level multinomial logistic regression for the following two sets of estimations. Results are presented as unstandardized logistic regression coefficients.

Table 4: Multi-level Multinomial Logistic Regression of PSE Confirmations (Reference= No PSE Confirmation) on Frequency of Eating Breakfast, Race and Controls

Unstandardized Logistic Regression Coefficients

	Model 1		Model 2	
	University	College	University	College
Frequency of eating breakfast	0.131***	-0.045	0.056	-0.126*
Frequency of eating lunch	0.048	0.036	0.049	0.038
Frequency of eating dinner	0.187**	0.038	0.188**	0.035
Black	-0.18	0.129	-0.493	-0.282
East Asian	1.082***	-0.088	0.787**	-0.482
Latin American	-0.581*	-0.15	-1.118	-0.229
Middle Eastern	0.925***	0.502**	0.887	0.781
Mixed background	-0.205	-0.031	-0.538	-0.352
South Asian	1.139***	0.454**	0.600*	-0.044
Southeast Asian	0.262	0.405*	0.243	0.102
Professional and senior management	0.488***	-0.158	0.489***	-0.153
Semi-professional and middle management	0.259*	0.035	0.258*	0.034
Skilled/semi-skilled clerical and trades	0.181	0.367**	0.182	0.367**
Unskilled clerical and trades	0.342*	0.445**	0.350*	0.450**
Non-remunerative	0.015	0.107	0.016	0.108
Quintiles of neighbourhood household income	0.035	-0.092**	0.036	-0.089**

	Model 1		Model 2	
Parents have PSE (1=yes)	0.460***	-0.018	0.464***	-0.016
Female (1=yes)	0.480***	0.286***	0.480***	0.284***
Have special education needs (1=yes)	-0.977***	-0.039	-0.975***	-0.037
First-generation immigrant (reference=third)	0.053	-0.088	0.055	-0.084
Second-generation immigrant (reference=third)	0.454***	0.342**	0.461***	0.349**
Majority non-academic courses (1=yes)	-1.967***	-0.005	-1.970***	-0.009
Level of school enjoyment	0.186***	0.017	0.185***	0.015
School size ranges	0.258***	0.278***	0.260***	0.280***
Black × eat breakfast			0.109	0.151
East Asian × eat breakfast			0.183	0.024
Latin American × eat breakfast			0.010	-0.100
Middle Eastern × eat breakfast			0.114	0.117
Mixed background × eat breakfast			0.098	0.135
South Asian × eat breakfast			0.188*	0.180
Southeast Asian × eat breakfast			0.003	0.109
Constant	-3.594***	-2.268***	-3.395***	-2.054***
Random intercept	0.383***		0.384***	
Intraclass correlation	0.042		0.042	
Log likelihood	-5689.8		-5684.9	
Observations	7058		7058	

* p<0.05, ** p<0.01, *** p<0.001

Table 4 presents the multi-level multinomial logistic regression output that predicts PSE confirmations. Because the dependent variable is nominal, all coefficients are interpreted relative to the omitted category (No PSE Confirmation). Results are presented as unstandardized logistic regression coefficients, which are easiest to interpret with regard to their size (across estimations) and direction (positive or negative). In Model 1, we observe that the frequency of eating breakfast is positively associated with university (relative to not confirming PSE) but not college. In terms of the coefficients for self-identified race (interpreted relative to White students), East Asian, Middle Eastern and South Asian students were more likely to confirm university (relative to not confirming PSE) than White students. Latin American students were significantly less likely to confirm university. For college, Middle Eastern, South Asian and Southeast Asian students were more likely than White students to confirm (relative to not confirming PSE). For university confirmations, the higher parental occupations were statistically significant, as was unskilled clerical and trades; for college, the mid- to lower-status occupations were statistically significant. Income was not associated with university confirmation, but was negatively associated with college confirmation. The remaining controls performed as expected and are not elaborated upon as they are not the focus of our inquiry.

Moving to the second model, we add the interactions between frequency of eating breakfast and race. In terms of university confirmations, only one interaction was significantly different than for White students — South Asian students. None were significant for college. Figure 8 illustrates this interaction, demonstrating

the slightly steeper slope for South Asian students, relative to White students, and indicates a strong association between frequency of eating breakfast and university confirmation for South Asian students.

Figure 8: Likelihood of Confirming University by Frequency of Breakfast Eating × Race

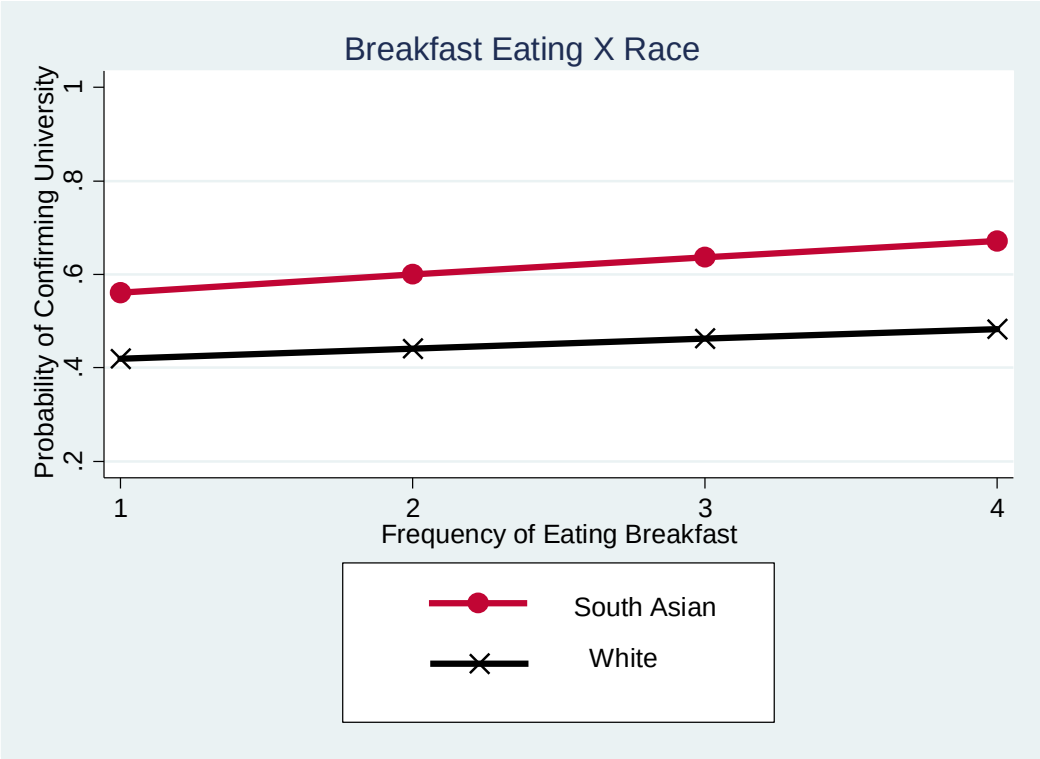


Table 5 presents the logistic regression coefficients for the multinomial multi-level models predicting PSE confirmations using the food security index. The index is positively associated with university confirmations and negatively associated with college confirmations. With regard to the main effects of race, we see essentially the same patterns as in Table 4. However, moving to the interaction terms, we have very different results than from the previous estimations using breakfast consumption. For university confirmations, the interactions are significant for East Asian students. For college confirmations, the interactions are significant for Black, Asian, mixed-background and Southeast Asian students.

Table 5: Multi-level Multinomial Logistic Regression of PSE Confirmations (Reference= No PSE Confirmation) on Food Security Index, Race and Controls

Logistic Regression Coefficients

	Model 1		Model 2	
	University	College	University	College
Food security index	0.379***	-0.175***	0.356***	-0.262***
Black	-0.122	0.154	-0.111	0.285*
East Asian	1.101***	-0.106	1.089***	-0.267
Latin American	-0.556*	-0.157	-0.607*	-0.207
Middle Eastern	0.900***	0.465*	0.919***	0.453*
Mixed background	-0.169	0.013	-0.187	0.055
South Asian	1.173***	0.463***	1.234***	0.530***
Southeast Asian	0.292	0.403*	0.315	0.629**
Female	0.464***	0.295***	0.475***	0.306***
Have special education needs	-0.970***	-0.046	-0.969***	-0.050
First-generation immigrant	0.101	-0.080	0.108	-0.081
Second-generation immigrant	0.467***	0.348**	0.460***	0.331**
If majority courses non-academic	-2.016***	-0.047	-2.013***	-0.055
Level of school enjoyment	0.217***	0.034	0.217***	0.031
School size ranges	0.271***	0.287***	0.271***	0.281***
Black × food security index			-0.016	0.284*
East Asian × food security index			-0.259*	-0.470**
Latin American × food security index			-0.207	-0.003
Middle Eastern × food security index			0.162	0.098
Mixed background × food security index			0.338*	0.305*
South Asian × food security index			0.184	0.232
SE Asian × food security index			0.038	0.539**
Constant	-1.921***	-2.422***	-1.922***	-2.371***
Random intercept	0.386***		0.384***	
Intraclass correlation	0.042		0.042	
Observations	7208		7208	
Log likelihood	-5843.3		-5819.5	

* p<0.05, ** p<0.01, *** p<0.001

Figure 9: Likelihood of Confirming University by Food Security Index × Race

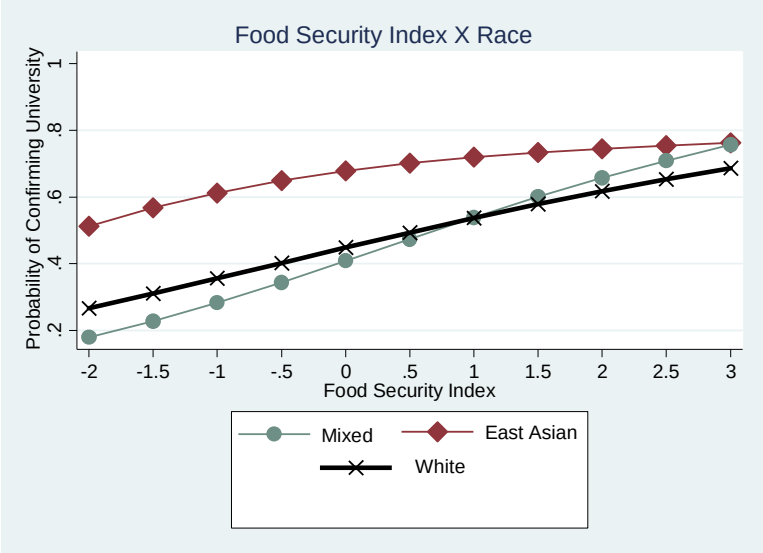


Figure 9 displays the interactions of race with the food security index. Mixed-background students start out at the lowest likelihood of university confirmation at the lowest end of the index, but surpass White students at the higher end. East Asian students start much higher than White students at the lowest end of the index, but the trajectory flattens out in the middle and the likelihood of university confirmation is the same as it is for White students at the highest values of the index.

Figure 10: Likelihood of Confirming College by Food Security Index × Race

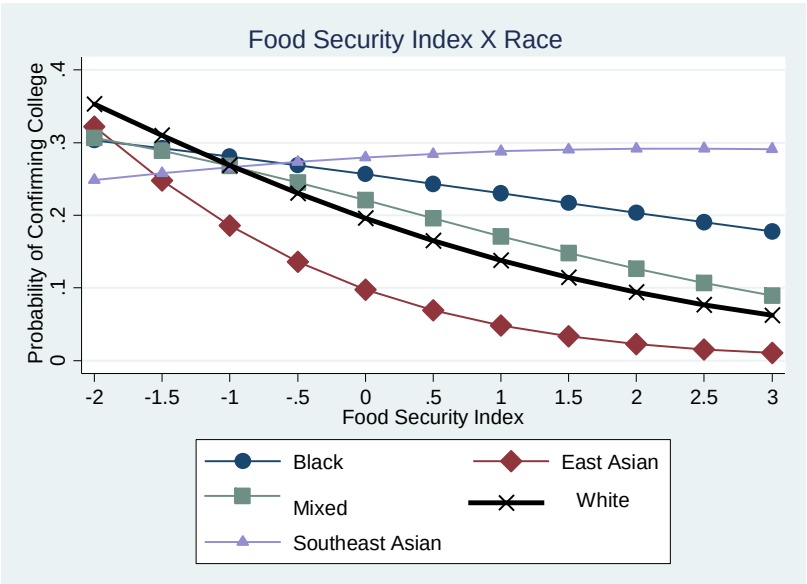


Figure 10 displays the statistical interactions that were significant in predicting college confirmations. In general, the relationship between the index and the probability of college confirmation is negative, suggesting that the better resourced have a university preference. This negative relationship is true for all groups except Southeast Asian students, whose relationship between the index and college confirmation is weakly positive. At the lowest ends of the index, the different racial groups are somewhat similar, with probabilities of attending college ranging from 0.25–0.35. However, at the highest values of the index, the likelihood of East Asian students confirming college is virtually nil. For White students, the probability at the right end of the figure is under 0.10, which is very close to the value for mixed-background students. The trajectory for Black students, however, is flatter. At the highest values of the index, the likelihood of confirming college is just under 0.20.

Summary of Results for PSE Confirmations

The estimations in Tables 4 and 5 have demonstrated that the food security index appears to provide a much more detailed set of "differences" to be explained by self-identified race.

When looking at the estimations using the frequency of breakfast-eating measure, the main effects suggested that the measure was associated with university confirmations. Even when controlling for a host of variables in the models (Table 4), frequency of eating breakfast and dinner proved to be important determinants in predicting university confirmations. However, they did not predict college confirmations. One interaction term indicated this relationship was different for South Asian students relative to White students. When plotted in Figure 8, it appeared as though compared to White students, the trajectory between frequency of breakfast eating and university confirmations was slightly steeper. No significant interactions were found in the model predicting college confirmations.

The food security index revealed a positive association with university and a negative association with college (Table 5). In the case of university confirmations, statistically significant interactions were found (relative to being White) between the index and being East Asian and mixed background. For college, the significant interactions were found (relative to being White) between the index and being Black, East Asian, mixed background and Southeast Asian.

The interactions, when visualized in Figures 9 and 10, revealed that the association of this index with PSE confirmations is not uniform by self-identified race. For university confirmations, the relationship between the index and race was somewhat curvilinear for East Asian students while the trajectory was steeper for mixed-background students relative to White students. In the case of Southeast Asian students and confirming college, the association was positive, while for Black, East Asian, mixed-background and White students, it was negative.

Discussion

This pilot study employed TDSB 2011 Student Census data to conduct an analysis of the following general research questions: What is the impact of eating breakfast on a regular basis during the school week on students' academic success? And how does ethnoracial identity interact with food security to shape students' academic success and confirmation of university/college? Student success was defined in terms of average marks in Grades 11/12 and the subsequent confirmation of acceptance to postsecondary educational institutions in Ontario. We measured food security in two ways: 1) through an item on the TDSB student census that asked students the frequency with which they ate breakfast; and 2) through an index that we developed, which incorporated the breakfast eating item along with various measures of access to economic resources. The first operationalization is a typical way of assessing food security, as informed by the previous literature. The latter is an exploratory measure that we argue is more conceptually valid, as it incorporates various dimensions of food security, which includes not only food consumption, but also access to economic resources.

The preliminary descriptive analysis revealed differences by ethnoracial groups in the distributions of both breakfast consumption and the food security index and our educational outcomes of interest (i.e., average marks in Grades 11/12 and PSE confirmations). We already knew from previous work that Black students were more likely to possess special educational needs and select applied streams of study at the secondary level (Robson et al., 2014; Robson et al, forthcoming).

The multi-level regression analysis of average marks in Grade 11/12 and PSE confirmations allowed us to control for known determinants of these educational outcomes and isolate how our food security measures performed. Our exploration of interactions also allowed us to see if these food security measures differentially impacted upon our outcomes of interest according to ethnoracial group. For example, does food security impact PSE outcomes differently for Black students than it does for White students?

Interestingly, both measures of food security employed in our pilot project revealed ethnoracial differences with respect to the impact of food security on average marks attained in Grade 11/12. However, the use of the food security index, which incorporated measures of economic resources, social position and breakfast consumption, revealed more complex differences among the various ethnoracial groups. When we employed the breakfast-eating measure alone, we found that it impacted on average marks differentially for Black and Southeast Asian students, relative to White students. We can see from Figure 6 that the trajectory for these two groups is very flat so that frequency of eating breakfast had nearly no effect on their marks, while it was a rather steep positive trajectory for White students. When the index was employed, we found that the trajectories for East Asian, Southeast Asian and Black students were significantly different than for White students. In particular, trajectories were flatter for East Asian, Black and Southeast Asian students. In other words, the relationship between their marks and the index was weaker than it was for White students. The slopes of these lines also vary considerably, and, in the case of Black students, the highest scores on the index still result in a 10% difference in average marks. The difference in results between the two measures is noteworthy because the latter measure showed that East Asian students also have flatter trajectories than White students, but, unlike Black and Southeast Asian students, they start higher (at lower ends of the index) and end higher (at the highest end of the index). Thus, whatever the food index value is for East Asian

students, they will do better than White students (and likewise, many other ethnoracial groups). These differences indicate that achievement variations by ethnoracial group are likely not restricted to issues of nutrition and poverty. Rather, they relate to social and cultural factors that are not captured by the data we employed in the analysis. Particularly in the case of Black students, we found that there were quite small differences in the average marks of students who were at the lowest end of the food security index (63%) versus the highest (68%). The corresponding averages for White students were 64% and 77%.

What is behind these differences? We can only speculate that economic deprivation is not the sole determining factor behind the underachievement of Black students in particular. Other studies, such as the recent report by James and Turner (2017) highlight that Black students in Toronto face not only an achievement gap, but an opportunity gap, as they are more likely to be placed in non-academic courses, be identified with a special education need, and be suspended from school. There is considerable evidence that the underlying causes of the differences we are observing around the underachievement of Black students are couched in structural racism.

When the two measures of food security were employed to examine ethnoracial differences with regard to PSE confirmations, more group differences were found using the index rather than the breakfast-eating item. When the single breakfast-eating item was used, differences in breakfast consumption and the likelihood of confirming university were found between South Asian and White students, with the former having a slightly steeper slope than White students. Thus, breakfast eating and university confirmations were more strongly associated for South Asian students than White students, but when plotting these relationships out (Figure 8), the results are not particularly striking. No ethnoracial differences were found for college confirmations when using the breakfast-eating measure.

The use of the food security index, however, revealed more differences with respect to university and college confirmation by self-identified race. In contrast, the food security index provided us with a somewhat different picture, revealing a main positive effect on university confirmations but a main negative effect on college confirmations. The inclusion of the ethnoracial interactions with the food security index indicated more statistically significant differences from White students than the breakfast-eating measure as well. Whereas the previous analysis only found significant differences between White and South Asian students with regard to university confirmations, the food security index interactions revealed significant differences from White students between mixed-background and East Asian students in the case of university and Black, mixed-background, Southeast Asian and Asian students in the case of college confirmations.

The use of data visualizations provided additional insights into how these trajectories varied by ethnoracial group. In the case of university, relative to White students, the trajectory for East Asian students was curvilinear, but always higher than White students regardless of the placement on the index, although this gap narrowed considerably at the highest end of the index. For mixed-background students, the association between the index and university confirmation was stronger than for White students, where they surpassed White students and achieved parity with East Asian students at the highest values of the index. The story for college confirmations, however, was quite different. Most notably, the association between the index and confirming college was positive for Southeast Asian students, while for Black, East Asian, mixed-background

and White students, the relationship was negative. In addition, the negative trajectories for these groups were far from uniform. As can be seen in Figure 10, the association between the index and college confirmation is very strongly negative for East Asian students such that at the highest end of the index, the probability of confirming college is virtually nil. For White and mixed-background students, the trajectories are more similar, although the slope is less steep for mixed-background students. For Black students the probability of going to college at the lowest and highest ends of the index differ by about .10 (or 10%). For other groups represented in Figure 10, the differences are closer to 0.20 (or 20%). In other words, the food index impacts on the probability of confirmation in a much weaker way for Black students. Again, our data alone cannot explain this, but structural barriers such as the ones highlighted by James and Turner (2017) mentioned above are strong possibilities.

The differences between East Asian and White students are explained by Canadian research that supports the strong university preference East Asian (particularly Chinese) parents have for their children (Abada, Hou & Ram, 2008; Li, 2001) .This would also translate into a negative preference for college, as observed here. This strong cultural preference for university pathways for East Asian parents and students, regardless of the economic situation of the family of origin, indicates that economic and similar resources have less influence on their PSE pathway decisions than for White students and other groups.

Unlike the other ethnoracial groups, the food index was positively associated with college confirmations for Southeast Asian students. Thus, while resources associated with this index reduce the likelihood of confirming college for most students (as evidenced by the negative main effect as well as the plotted interactions), they are positively associated with college confirmations for Southeast Asian students. Ethnic and cultural preferences for different PSE pathways will likely explain this finding, such as the overrepresentation of Filipino female students in the college allied health profession diplomas, largely driven by a family history of lower-status jobs and debt aversion (Kelly et al., 2014).

Conclusions and Policy Recommendations

Most of the studies examined in the literature review used a quantity measure (like eating or not eating a meal) or the US food security measure, which relies on self-reporting in response to food-related questions, most of which have to do with quantity. Our approach in developing a food security index that captured dimensions of quantity and access is unique in the research literature and reveals more ethnoracial differences than the food consumption measure alone. The incorporation of food consumption together with access to economic resources, we argue, provides greater conceptual validity of the very nature of food security. It is not just about what students eat: social position, access to food and economic resources also influence the educational outcomes of students. We believe our index contributes to the food security literature by offering a better way to understand how food interacts with the wider social positioning of young people.

In the introduction to this report we argued that an examination of the second type of access requires the use of an intersectionality perspective, in which we analyze the interplay of fixed factors such as sex, class and race for students succeeding in school and choosing to pursue postsecondary studies. The use of this perspective served to highlight the importance of taking into account self-identified ethnoracial identity

when analyzing the relationship between food security, success in school and subsequent PSE confirmations. Moreover, we found that variations by ethnoracial group in terms of the impact of food security on educational outcomes is very much contingent on how the concept of food security is operationalized.
It is also important to point out the limitations of our analysis, particularly with regard to the use of the self-identified racial categories that were employed. While these general categories are commonly used in quantitative social science research within Canada, there may well be ethnic subpopulation variations within these categories that would help us better understand the complex findings we have uncovered through the use of an intersectionality framework (Museus & Griffin, 2011). A recent and comprehensive study reveals there is a great deal of diversity among Black students in the TDSB (James & Turner, 2017). An analysis of the 2006–2011 TDSB high school cohort revealed Black students could be subdivided into those born in Jamaica (41%), Somalia (15%), other English Caribbean countries (13%), Canada (9%) or East Africa (7%) with the remaining 9% coming from other countries of the world. Country of origin differences may reflect social and cultural variations that relate to food consumption and the educational outcomes of interest in this study. Perhaps most notably absent from our analysis are Aboriginal students, whose numbers (in terms of self-identification) in our data were too small to analyze as a subgroup. High rates of poverty for Aboriginal people in Canada means that food security is an urgent public health issue for this group (Power, 2008). As the fastest growing population in Canada (Campion-Smith, 2013), this is no insignificant issue. Future data collected by TDSB and other boards must do more to capture this population in the self-identification process.

As documented in our review of literature, there are limited studies that focus on youth subject to different levels of food insecurity and more research needs to be conducted across different age groups, school boards and geographical areas of Ontario. We list some potential future directions that this research might take below.

1. Our analysis clearly documents a direct effect between food insecurity, academic success in Grades 11/12 and university confirmations for those adolescents in the TDSB that are 17 years of age. These findings, while underscoring the important impact of food deprivation on the educational trajectories of young people, indicate the importance of conducting additional research that would expand our knowledge by including younger age cohorts. This research effort should extend beyond the TDSB to include other school boards located in urban, suburban and rural areas in Ontario, thus permitting us to establish whether location matters in mediating the relationship between food insecurity and educational outcomes.

2. The conceptual framework adopted for this analysis involved the use of an intersectionality perspective in modeling the relationship between food security, academic success at the secondary level and PSE transitions. The interactions between food security and race revealed that food security differentially impacts on the educational outcomes of adolescents according to their self-identified ethnoracial group. While this finding clearly establishes the general importance of accounting for racial identity when examining educational outcomes, the categories we employed (e.g., Black students, East Asian students) were necessarily general in nature. While a breakdown of Black students in the TDSB by country of origin (African, Caribbean) was not feasible in terms of the numbers required for analysis purposes, there may well be cultural variations in food consumption

that are important to identify, particularly in developing effective strategies for resolving food insecurity. Having said this, our research findings demonstrate that increased breakfast consumption will not eradicate gaps in educational outcomes among ethnoracial groups.

3. Household food insecurity affects one in six Canadian children under 18 (Tarasuk et al., 2016, p. 3), yet as we indicated in our literature review, unlike the United States and many other industrialized nations, Canada does not have a national school food program (Food Secure Canada, 2016). In instances where food programs are available, they are locally or provincially funded and operated. One exception is Alberta, where there has been a $10 million expansion of an existing pilot school nutrition program to all 60 school boards in the province. Schools are required to include a nutrition education program for all students in addition to providing snacks or meals (Graney, 2017). Similar options should be explored, monitored and evaluated by the government of Ontario.

4. A limitation of this study is that information on skipping meals was based on a segment of the TDSB Student Census, that is, Grade 12 students that were approaching the end of their secondary school career. Analysis of the full TDSB Student Census shows that meal-eating habits change over time. For example, students in elementary school are less likely to skip meals than older students (O'Reilly et al., 2015). If school interventions are to have the greatest impact they must generally be implemented in the elementary or early secondary grades. As a result, we cannot employ this present study to assess the effects of meal skipping in earlier grades on average secondary marks and postsecondary access. We also cannot tell what might happen to those students who had skipped meals in earlier grades, but were no longer skipping meals by the time they entered Grade 12. Furthermore, what happens to those students who did not skip meals in earlier grades, but were frequent meal skippers by Grade 12? Conducting longer-range cohort research could provide useful information on whether/how providing school meals to students in elementary or early secondary grades impacts their future school success, and how students' changing eating habits interact with postsecondary pathways.

5. While research shows that school food supplementation is a moderating factor in the relationship of food insecurity and the scholastic difficulties encountered by adolescents (Roustit et. al. 2010), our study indicates that the impact of increased food security on academic success does vary significantly across specific ethnoracial groups. This raises a number of policy-related questions that require more evidence-based research including: (a) Will blanket policies work for all youth? Will they work more effectively if introduced at the elementary grades?; (b) Do our findings suggest that targeted programming aimed at specific ethnoracial groups is a more effective strategy for increasing their academic success in school and maximizing their chances of transitioning to PSE?

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