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The Effects of a Universal Income Transfer on Food Insecurity within Households

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THE EFFECTS OF A UNIVERSAL INCOME TRANSFER ON FOOD INSECURITY WITHIN HOUSEHOLDS

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Food insecurity is a persistent public health problem, and it adversely affects multiple dimensions of health and well-being across various stages of life. Socio-economic characteristics is one of the key predictors of food insecurity and there exists a strong association between income and food insecurity. Since food insecurity is closely linked to deprivation of financial resources, research has been continued to examine the potential of government income support policies in mitigating food insecurity. Several studies have already demonstrated that income interventions alleviate household-level food insecurity. However, little is known about how these public policies affect adults and children, within the households, respectively. Using the Universal Child Care Benefit as an exogenous income shock, we estimate the relationship between income and food insecurity separately for adults and children.

In Chapter 1, we use data from the public-use microdata files of the Canadian Community Health Survey (2005-2012) and employ a standard difference-in-differences methodology to assess the impact of a universal income transfer on food insecurity at the adult, child, and household levels. In 2006, the Canadian federal government introduced the Universal Child Care Benefit as an income support for families with children below the age of six years. This policy

provided families with a monthly taxable benefit of $100 for each child, regardless of socio-economic conditions. We quantify the effects of this income transfer using two measures of self-reported food insecurity: a four-level categorical measurement (i.e., food-secure, marginally food-insecure, moderately food-insecure and severely food-insecure) and a continuous food insecurity scale. Our results based on both measures suggest that the transfer reduced the prevalence and severity of food insecurity at the child-level. The policy change increased the probability of being food secure and reduced the likelihood of experiencing any form of food insecurity for children from eligible households.

In Chapter 2, we address the heterogeneity in the impact of the income transfer on food insecurity across households. Using the same dataset from the Canadian Community Health Survey (2005-2012) and again utilizing a difference-in-differences method, we estimate the policy effects across subpopulations differentiated based on living arrangements, highest educational attainment in the household and household income. Our findings from subgroup analyses reveal disparities in the policy impact and indicate statistically significant reductions in child-level food insecurity among two-parent households, those with secondary education and those with household income at or above the median. These heterogeneous estimates suggest that the universal income transfer likely could not lead to substantial improvements in food security for vulnerable subpopulations.

Both chapter findings illustrate the need for disaggregating the food insecurity effects of income supplement and similar public policy interventions by different levels within and across households to help policymakers design better informed and targeted interventions.

DEDICATION

To my parents and sisters.

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CHAPTER 1

UNIVERSAL INCOME TRANSFER AND FOOD INSECURITY WITHIN HOUSEHOLDS

1.1. Introduction

Food insecurity exists when there is a lack of regular access to enough safe and nutritious food for normal growth and development and an active and healthy life (Food and Agricultural Organization of the United Nations, 2021a). In the year 2020, one-third of the world's population, equating nearly 2.37 billion people were food-insecure, with the prevalence varying significantly across geographic regions (e.g., 59.6% in Africa, 25.8% in Asia, 40.9% in the Latin America and the Caribbean and 8.8% in North America and Europe) (Food and Agricultural Organization, International Fund for Agricultural Development, United Nations International Children's Emergency Fund, World Food Program and World Health Organization, 2021). The rate of food insecurity is also unexpectedly high in some developed countries, especially those dealing with more socioeconomic inequalities (Pollard & Booth, 2019). In the United States, 10.5% of the population experienced some level of food insecurity in the year 2020 (Coleman-Jensen et al., 2021). In Canada, food insecurity affects more than 12% of households — around 4.4 million people including more than 1.2 million children (Tarasuk & Mitchell, 2020).

Food insecurity is associated with an array of negative consequences across all stages of life (Gundersen & Ziliak, 2015). Among adults, food insecurity has been found to be correlated with poor physical and mental health, chronic health conditions, additional health care costs and premature mortality (Gregory & Coleman-Jensen, 2017; Gundersen & Ziliak, 2015; Gundersen et al., 2018; Martin et al., 2016; Men et al., 2020; Muldoon et al., 2013). For children, exposure to food insecurity adversely affects physical health, mental growth and development, cognitive and

non-cognitive abilities (Cook el., 2004; Cook et al., 2006; Gundersen & Ziliak, 2015; Johnson & Markowitz, 2018; Kirkpatrick et al., 2010; Melchior et al., 2012). Food insecurity during early ages also causes long-term harmful effects like suicidal ideation in adolescence or early adulthood (McIntyre et al., 2013).

Since socio-economic status is a dominant predictor of food insecurity (Che & Chen, 2001; Tarasuk, Fafard St-Germain et al., 2019), several studies have examined the role of income supplementation programs or social policy interventions in reducing food insecurity. In fact, past studies have shown improvements in food security resulting from targeted interventions that improve household financial conditions (Brown & Tarasuk, 2019; Ionescu-Ittu et al., 2015; McIntyre et al., 2016). However, most of these studies have focused on household-level food insecurity. Given evidence that adults and children within a household do not necessarily experience food insecurity in a similar manner (Nord & Bickel, 2002; Nord & Hopwood, 2007) and that child food insecurity is a more severe manifestation of the problem (Drennen et al., 2019) with distinct implications (Skalicky et al., 2006), it is important to disaggregate the household-level effects of such policies and examine them separately for adults and children.

In our study, we examine the impact of a universal income transfer on food insecurity, assessing the effects separately for adults and children within the households. We do so by using the Universal Child Care Benefit (UCCB), which was an income supplementation policy implemented by the Canadian federal government from 2006-2016. The UCCB provided families with a monthly transfer of $100 for each child below the age of six years, regardless of socio-economic or other conditions. Using this policy change as an exogenous income shock, we explore how income affects food insecurity at the adult, child, and household levels, respectively.

1.2. Literature Review

1.2.1. The Concept of Food Insecurity

Food insecurity has been defined in many different ways in various contexts around the world. The widely used and broad definition of food insecurity by the Food and Agricultural Organization of the United Nations (mentioned in section 1.1.) is based on four dimensions (i.e., availability, accessibility, utilization, and stability) and encompasses insecurity due to unavailability of food and/or lack of resources to obtain food. In the United States, food insecurity is defined as limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways (United States Department of Agriculture, 2021). In Canada, food insecurity — the inadequate or insecure access to food due to financial constraints — is recognized as a serious public health problem and a key determinant of health (Health Canada, 2007; PROOF, 2021) (PROOF is an interdisciplinary research group investigating household food insecurity in Canada).

Since 2005, Statistics Canada has been monitoring income-related household-level food insecurity using the Household Food Security Survey Module of the Canadian Community Health Survey (CCHS). The module captures self-reported food insecurity experiences of households over the past twelve months arising from lack of financial resources. This module was initially developed by the United States Department of Agriculture in 1995 and is based on Rasch-modeling (Bickel et al., 2000). It contains a total of eighteen questions that incorporate a range of experiences, such as, worrying about running out of food, compromising on a balanced diet, skipping meals and, in extreme cases going without food for a whole day due to a lack of money (Health Canada, 2007; PROOF, 2018)[1]. Out of the eighteen questions, ten are specific to the

[1] Refer to Appendix A for the eighteen questions of the Household Food Security Survey Module.

experiences of adults and eight are specific to the experiences of children within the household. Based on the number of affirmative responses, the food insecurity situation of adults, children (if present) and households are determined.

1.2.2. Prevalence of Food Insecurity

The global prevalence of food insecurity has been following a gradual upward trend since 2014. The percentage of the world's population facing moderate or severe food insecurity increased from 22.6% to 30.4% between 2014 and 2020 (Food and Agricultural Organization of the United Nations, 2021b). The food insecurity rate has been usually the highest in low-income economies, however, it has also been unexpectedly high in some developed countries, ranging from 8% to 20% (Pollard & Booth, 2019; Smith et al., 2017) [2]. Though there has been remarkable reduction in global poverty over the years (i.e., the global poverty rate decreased from 36% to 9% between 1990 to 2017), factors such as conflict and violence in many parts of the world along with climate change have slowed global efforts towards achieving the goal of ending hunger and achieving food security by 2030 (Food and Agricultural Organization, International Fund for Agricultural Development, United Nations International Children's Emergency Fund, World Food Programme and World Health Organization, 2021; World Bank 2020).

In Canada, one in every eight households experience some level of food insecurity (PROOF, 2021). The number of people living in food-insecure households has been increasing over time: 3.4 million in 2007-2008, 3.9 million in 2011-2012 and 4.4 million in 2017-2018 (PROOF, 2021). There are also disparities in prevalence, and some population subgroups are more vulnerable to food insecurity than others including households living in the Northern part of the

[2] Low-income economies are defined by the World Bank as those with a Gross National Income per capita of $1,046 or less.

country, those with children, those in the lowest income decile, those with lower educational attainment and Indigenous Peoples (Dietitians of Canada, 2016; PROOF, 2021; Tarasuk & Mitchell, 2020).

The prevalence of food insecurity among households with children has been reportedly higher compared to households without children. For example, during 2017-2018, Canadian households with children under the age of 18 were more likely to report food insecurity (16.2%) compared to those without any children (11.4%) (Tarasuk & Mitchell, 2020). According to this estimate, one in every six Canadian children had experienced some level of food insecurity. Even within the households with children, the prevalence of food insecurity differs markedly based on household composition and geographic location. For example, during 2011-2012, lone-mother households with children experienced food insecurity at a rate more than twice as high when compared to lone-father households (34.3% versus 14.7%) and two-parent households (34.3% versus 11.7%) (Tarasuk et al., 2014). During the same period, the prevalence among households with children varied geographically from 62.2% in Nunavut to 15.1% in Newfoundland and Labrador (Tarasuk et al., 2014).

Among food-insecure households with children, the extent of food insecurity experienced by all household members is not necessarily the same. In fact, research indicates that the experiences of adults and children within a household vary noticeably (Nord & Bickel, 2002). According to Health Canada (2007), among 412,300 food-insecure Canadian households with children in 2004, around 49.8% reported that only adult members were food insecure, 44.4% reported that both adults and children were food insecure and 5.6% reported that only children were food insecure.[3]

[3] This report, which was based on the CCHS (Cycle 2.2), was the first to present income-related food insecurity among Canadian adults, children, and households separately.

1.2.3. Determinants of Food Insecurity

While the pervasiveness of food insecurity is closely related to economic circumstances, there are many other geographic and socio-demographic factors that intensify the occurrence of this complex phenomenon. Past studies have attempted to identify the determinants of food insecurity to better advocate for targeted policies to alleviate the problem. For example, Smith et al. (2017), examine the common determinants of food insecurity across 134 countries. Using multilevel linear probability models, this study identified five characteristics that were largely associated with increased risk of food insecurity around the world: low educational attainment, weak social networks, low social capital, low household income and unemployment.

In Canada, multiple studies have examined the risk factors that contribute to household food insecurity using different data sources (Che & Chen, 2001; Rainville & Brick, 2001, Tarasuk, Fafard St. Germain et al., 2019; Vozoris & Tarasuk 2003). After adjusting for potential confounders, these studies commonly reported that the odds of experiencing food insecurity were higher for households if they were: single-parent families, had children under age 18, had lower household income, relied on social assistance as their main source of income, had lower educational attainment, lived in rented houses, lived in certain provinces/territories and self-identified as Indigenous.

1.2.4. Health Consequences of Food Insecurity

There is an extensive body of literature on the consequences of food insecurity, especially adverse health outcomes. In general, most of the studies have reported a negative relationship between food insecurity and health. In this section, I briefly summarize some key threads of this literature, separately for adults and children.

1.2.4.1. Physical and Mental Health Consequences for Adults

Among adults, food insecurity is correlated with poor/fair self-reported physical health, chronic health conditions, poor chronic disease management, increased health care utilization, additional health care costs and premature mortality. Besides, food insecurity increases the risk of experiencing a variety of detrimental mental health outcomes such as anxiety, mood disorders, depressive symptoms, and suicidal ideation. Appendix B (Table B.1.) contains a summary of research findings from the literature on the association between food insecurity and health outcomes for adults, which are discussed in detail below.

The association between food insecurity and nutrient deficiencies is indeed well-established in the literature (Rose & Oliveira, 1997; Tarasuk & Beaton, 1999; Tarasuk, 2001). For example, using a nationally representative sample from Canada, Kirkpatrick and Tarasuk (2008) found that food-insecure adolescents and adults had poorer diet quality and lower consumption of milk, fruits and vegetables compared to their food-secure counterparts.

The connection between food insecurity and obesity has been somewhat paradoxical in the empirical literature. For example, a study in the United States found that food insecurity was related to the prevalence of overweight status among women, but not among men (Towsend et al., 2001). Similarly, a study based on the 1998-1999 Canadian National Population Health Survey reported that individuals from food-insecure households were 1.5 times more likely to be obese than those from food-secure households (Rainville & Brink, 2001). On the contrary, Jones and Frongillo (2007), found no significant association between food insecurity and subsequent weight gain among women in the United States. Likewise, Vozoris and Tarasuk (2003), found no significant association between food insecurity (measured as food insufficiency) and body mass index in Canada but, after adjusting for potential confounders, reported that men in food-insecure households were less likely to be overweight. Recently published research has also explored this

relationship for some subpopulations. For instance, Domingo and co-authors focused on First Nations communities in Canada, finding that the odds of obesity were highest among the marginally food-insecure households, but the odds of obesity were lowest among severely food-insecure households for males (Domingo et al., 2020).

Several studies have demonstrated that exposure to food insecurity is strongly associated with the probability of experiencing several chronic diseases. For example, based on 2011-2015 data from the National Health Interview Survey in the United States, Gregory and Coleman-Jensen (2017) found that food insecurity is correlated with a higher probability of ten chronic conditions: hypertension, coronary heart disease, hepatitis, stroke, cancer, asthma, diabetes, arthritis, chronic obstructive pulmonary disease, and kidney disease. A review of fifty recent studies (including original research, systematic reviews, and meta-analyses) on the topic of food insecurity and cardiometabolic risk revealed that there is a robust association between food insecurity and cardiometabolic risk factors such as obesity, hypertension, diabetes, coronary heart disease, congestive heart failure, stroke and kidney disease among adults, but no significant association for children (Te Vazquez et al., 2021). In Canada, Tait et al. (2018) investigated the relationship between food insecurity and the probability of developing type-2 diabetes. Using data from the 2004 CCHS they found that adults in food-insecure households in Ontario had more than twice the risk of developing type-2 diabetes compared to those living in food-secure households. Another study showed that household food insecurity among Canadians with diabetes increased the likelihood of unhealthy behaviors among this population (Gucciardi et al., 2009). In addition, food insecurity is associated with the difficulty of managing these chronic conditions (Chan et al., 2015). Recent research has also shown that food insecurity is associated with premature mortality.

For example, food-insecure adults in Canada are more likely to die prematurely than their food-secure counterparts (Gundersen et al., 2018, Men et al., 2020).

Consistent with the physical health consequences, food insecurity also increases out-of-pocket health care costs. For example, a study of adults aged 18-64 years in Ontario showed that annual health care costs were higher by 16%, 32% and 76% for marginally, moderately, and severely food-insecure households, respectively, when compared with the health care costs of food-secure households (Tarasuk et al., 2015).

Muldoon et al. (2013) showed that Canadian adults experiencing food insecurity (measured as food insufficiency) had higher relative risks (1.69 adjusted odds) of a mental health diagnosis. Martin et al. (2016) found that adult women and men from food-insecure households had respectively 18.4% and 13.5% higher prevalence of mental illness relative to those from food-secure households. Likewise, food insecurity is associated with mood and mania disorders (Davison & Kaplan, 2015) and suicidal ideation in adults (Davison et al., 2015). In addition, food insecurity has a potentially graded effect on a variety of mental health consequences such as major depressive episodes, depressive thoughts, anxiety disorders, mood disorders and suicidal thoughts (Jessiman-Perreault & McIntyre, 2017). There is also evidence that odds of mental health service utilization are higher for food-insecure individuals compared to their secured counterparts (Tarasuk et al., 2018).

Moreover, there are gender differences in the association between food insecurity and mental health, with evidence that females suffering from food insecurity are more vulnerable to developing mental health problems. For example, Siefert et al. (2001) and Seifert et al. (2004) found that food insecurity (measured as food insufficiency) was associated with diagnostic screening criteria for recent major depression among low-income women. In Canada, recent

research found increased risk of poor or fair mental health from food insecurity particularly among females, especially among middle-aged respondents (Pound & Chen, 2021).

1.2.4.2. Consequences for Children's Health, Development and Well-Being

This section discusses some key findings from the literature on the association between food insecurity and health outcomes for children. Appendix B (Table B.2.) contains a summary of this discussion.

Past research has linked food insecurity among children with overall poorer health (Cook et al., 2004; Cook et al., 2006; Gundersen & Kreider, 2009; Kirkpatrick et al., 2010), lower nutrient intake (Cook et al., 2006), poorer diet quality (Fram et al., 2015), iron deficiency anemia (Metallinos-Katsaras et al.,2016; Eicher-Miller et al., 2009; Skalicky et al., 2006), increased risk of chronic diseases like asthma (Kirkpatrick et al., 2010, Mangini et al., 2015), high blood pressure (South et al., 2019), obesity (Dubois et al., 2011), increased cardiometabolic risk factors (Robson et al., 2017) and poor dental health (Chi et al., 2014). Also, food insecurity heightens the risk of increased hospitalizations and additional health care costs for children (Cook et al., 2013, Cuba et al., 2018). Presence of food insecurity during the prenatal period has also been found to be associated with lower birth weight and birth defects among infants (Borders et al., 2007; Carmichael et al., 2007).

Food insecurity among children not only affects their physical health and growth, but it adversely influences their mental health and well-being. Evidence suggests that food-insecure children are more likely to have depressive symptoms, anxiety and behavioral issues like inattention, hyperactivity, and aggression (Huang et al., 2010; Johnson & Markowitz, 2018; Melchior et al., 2012; Whitaker et al., 2006). Likewise, experiencing food insecurity during childhood also increases the risk for suicidal ideation and suicidal attempts in adolescence and

early adulthood (McIntyre et al., 2013; McLaughlin et al., 2012). Food insecurity also impedes cognitive and non-cognitive development among children and is negatively correlated with academic performance (Faught et al., 2017; Howard, 2011). Several studies also indicate that food insecurity in households with children leads to adverse mental health outcomes (i.e., depressive symptoms) for mothers, which affects children's growth and development in a latent manner. For example, some studies found that food-insecure mothers are more likely to have mental health problems, lifetime post-traumatic stress (Weinreb et al., 2002; Whitaker et al., 2006), while other studies found that maternal depression is associated with lower child health status (Casey et al., 2004). In addition, exposure to food insecurity during infancy weakens child-parent attachments, which might affect children's mental growth in later life (Zaslow et al., 2009).

1.2.5. Public Policy Responses to Address Food Insecurity

There is substantial evidence, especially in the context of high-income countries, that public policy interventions (e.g., cash transfers, food assistance programs) have the potential to impact household-level food insecurity (Loopstra, 2018). In the United States, research has focused on the evaluation of food-assistance programs (such as the Supplemental Nutrition Assistance Program) in relation to food insecurity, with relatively recent research exploring food insecurity implications of other policies such as the minimum wage and the Affordable Care Act (Gundersen and Ziliak, 2018).

In Canada, considerable attention has been given to federal and provincial social policy changes (e.g., social assistance, child benefits, senior pensions) to understand how they impact food insecurity. For example, Loopstra et al. (2015) undertook an exploratory analysis to examine the effects of the poverty reduction strategy in Newfoundland and Labrador, emphasizing the association between social assistance and food insecurity. The study found a dramatic reduction

in food insecurity among social assistance recipients, from 59.9% in 2007 to 33.5% in 2012. Another study investigated the effect of a one-time increase in social assistance and the introduction of a rental assistance program on food insecurity among target groups in British Columbia (Li et al., 2016). Using data from the 2005-2012 CCHS, this study found that the increase in social assistance reduced food insecurity among households on social assistance, but the rental assistance program did not impact food insecurity among renter households. Research has also shown that guaranteed annual income, such as public pensions, are effective in reducing food insecurity among low-income adults (McIntyre et al., 2016). This study examined changes in food insecurity among low-income seniors aged 55-74 years, before and after they became eligible for the seniors' benefit (at the age of 65). Findings suggest that prevalence of food insecurity decreased by around 50% among those who were age-eligible for the program versus those who were not.

Given the heightened prevalence and negative consequences of food insecurity among households with children, a number of studies have assessed the impact of child benefit policies on food insecurity. For instance, Ionescu-Ittu et al. (2015) examined the effect of the UCCB on food insecurity using a difference-in-differences strategy. They found a 2.4 percentage points reduction in the likelihood of household food insecurity. Further, they argued that the effect was stronger for vulnerable subgroups: 4.3 percentage points reduction among households with annual income below the population median and 5.4 percentage points reduction among single-parent families. Another provincial child benefit policy, the Ontario Child Benefit, has been found to reduce the odds of experiencing food insecurity by 34% among eligible households (Tarasuk, Li et al., 2019). Likewise, Brown and Tarasuk (2019) examined the association between the Canada Child Benefit (an income-tested federal income supplementation program for families with

children under the age of 18) and food insecurity. They found that, although the policy did not improve the overall food security situation among low-income households, it reduced their likelihood of experiencing severe food insecurity by 4.7 percentage points.

1.3. Policy Context

The UCCB, which was introduced by the federal government in July 2006, was a monthly income transfer for Canadian families with young children. The policy provided families with a monthly payment of $100 for each child under the age of six years. The primary goal of the policy was to assist families with childcare, and to help them cover some costs of raising children (Lebihan & Takongmo, 2019). The payment was a sizeable benefit, especially for low-income households (Daley, 2017; Schirle, 2015). The benefit amount was approximately 12-18% of the total annual cost of raising children (Schirle, 2015) and 17% of the average annual household food expenditure in 2006 Canadian dollars.[4] The policy was not income-tested, nor was it impacted by receipt of other benefits such as the Canada Child Tax Benefit or provincial social assistance.

Eligible families that previously received the Canada Child Tax Benefit were automatically enrolled in the UCCB program, otherwise parents had to apply to the Canada Revenue Agency. Upon applying they could receive benefits within 80 calendar days, and payments were retroactive up to 11 months (Daley, 2017; Lebihan & Takongmo, 2019). According to Schirle (2015), there was almost zero cost of applying for the UCCB, and it was rare for eligible families not to receive the transfer; 99% of eligible families received it (Daley, 2017; Lebihan & Takongmo, 2019; Schirle, 2015). In two-parent households, benefits were usually paid to mothers, while in single-

[4] According to Statistics Canada, the average annual expenditure on food per household was $7,046 in 2006 Canadian dollars (Statistics Canada, 2008a).

parent households, they were paid to the primary caregiver of the child. However, from 2011, benefits could be shared by parents involved in a shared-custody arrangement (Schirle, 2015).

The UCCB was a taxable benefit. The payments were subject to both federal and provincial/territorial income taxes. In two-parent households, the spouse/partner with the lower net income had to report the UCCB on their income tax, regardless of who actually received the transfer (Government of Canada, n.d.). After 2010, single parents were able to claim the transfer as part of their own income or as income of the child for whom they received the benefit (Daley, 2017).

In 2015, there were major changes in the eligibility criteria and in the amount of the UCCB. As of July 2015, families received a monthly amount of $160 for each child under the age of six and $60 for each child aged 6-17. However, this change is not relevant to our analysis, as it came into effect after our study period. The UCCB was replaced by a new means-tested policy in July 2016, the Canada Child Benefit.

1.4. Data and Methodology

1.4.1. Data

Our study utilizes the public-use microdata files of the CCHS. The CCHS is an ongoing nationally representative cross-sectional survey of the Canadian population aged 12 years and older, excluding full-time members of the Canadian forces, institutionalized population, people living on reserves and residents of certain remote regions. These exclusions altogether represent less than 3% of the Canadian population aged 12 years and older (Statistics Canada, 2008b). One of the main objectives of the CCHS is to gather health related data at the sub-provincial levels (i.e., health region) and provide timely and reliable estimates of health determinants, health status and health care utilization across Canada (Statistics Canada, 2008b).

The CCHS was initiated in 2001 and repeated every two years until 2007, at which point the survey became annual. The CCHS uses three sampling frames to select households: the majority come from an area frame and list frame of telephone numbers, and only 1% come from a random digit dialing (Statistics Canada, 2008b).

In the CCHS, data are collected directly from survey respondents using either computer-assisted personal interviewing or telephone interviewing. The interviewee is selected using a two-stage procedure: first a representative (i.e., the person most knowledgeable) of the household provides basic demographic information, and then one household member is selected for an in-depth interview. Although response rates vary across survey cycles, most cycles have a combined response rate (i.e., household-level and person-level) of approximately 80%. To ensure that any estimates produced from the survey data are representative of the population, the CCHS assigns a final sampling weight to each person in the sample (Statistics Canada, 2008b).

1.4.2. Sample

For our study we pool seven cycles of the CCHS: 3.1(2005), 2007-2008, 2009-2010 and 2011-2012. [5] The UCCB was implemented on July 1, 2006 and was in-effect until June 30, 2016. Beginning in 2005, the 18-item food security module was incorporated in the CCHS to monitor food security at the adult, child, and household levels. So, our data include observations from one pre-UCCB period (2005) and three post-UCCB periods (2007-2008, 2009-2010 and 2011-2012). However, the food security module was not selected by every province/territory during the study period. Specifically, the module was part of the "optional content" (modules that health regions

[5] In 2015, there was a major redesign in the CCHS, and Statistics Canada does not recommend making comparisons using data before and after 2015 (Statistics Canada, 2016).

have to opt into) in 2005 and 2009-2010, and it was part of the "core content" (modules that are requested by all health regions) in 2007-2008 and 2011-2012.

We focus on households from the provinces that participated in the food security module during all cycles of the study period (i.e., Nova Scotia, Ontario, Quebec, Alberta and British Columbia).[6] Since questions in the food security module are asked to individuals who are most knowledgeable about the household, we restrict our sample to individuals who identify themselves as "parent". We include households with children under the age of 12. Further, following Schirle (2015) and Lebihan and Takongmo (2019), we restrict our sample to parents aged 25-49 as they are most likely to have children in this age group. Based on the UCCB eligibility criteria, we define our "treatment group" as households with the youngest child aged 0-5 years and "control group" as households with the youngest child aged 6-11 years, similar to some past studies (Daley 2017; Ionescu-Ittu et al., 2015; Lebihan & Takongmo 2019).

After dropping observations that were missing data related to any of our key variables, our estimating sample consists of 46,233 respondents of which 29,971 respondents belong to the "treatment group" and 16,262 respondents belong to the "control group".

1.4.3. Outcome Variables

We use two measures of self-reported food insecurity as our main dependent variables: (i) a four-level categorical measure (ii) a continuous food insecurity scale. Both of these measures are based on the food security module of the CCHS, and we estimate them at the adult, child, and household levels, respectively.

[6]Northern Territories (i.e., Northwest Territories, Nunavut, and Yukon) did not participate in the food security module during all cycles of the study period. Since, we do not have any respondents from the Northern Territories in our sample, we use the term province instead of province/territory for the rest of the paper.

In the food security module, the person most knowledgeable about the household is asked ten questions to assess food insecurity among adults and eight questions to assess food insecurity among children within the household. On the adult scale, respondents are classified as "food secure", "marginally food insecure", "moderately food insecure" and "severely food insecure" if the number of affirmative responses is zero, one, two to five and six or more, respectively. On the child scale, respondents are categorized into the same four categories if the number of affirmative responses is zero, one, two to four and five or more, respectively. The household food insecurity status is then determined based on the adult and child scales. In cases where adult and child scales are discordant, the more severe of the two determines food insecurity at the household level. Table 1.1 shows the four-level classification of food insecurity status at the adult, child and household levels based on the food security module questions.[7]

Table 1.1: Classification of food insecurity status at the adult, child, and household levels based on the food security module

Food Insecurity Status	10-Item Adult Scale	8-Item Child Scale	18-Item Household Scale
Food Secure	No affirmative responses	No affirmative responses	Both adults and children are food secure
Marginally Food Insecure	No more than 1 affirmative response	No more than 1 affirmative response	Adults and/or children are marginally food insecure
Moderately Food Insecure	2 to 5 affirmative responses	2 to 4 affirmative responses	Adults and/or children are moderately food insecure
Severely Food Insecure	6 or more affirmative responses	5 or more affirmative responses	Adults and/or children are severely food insecure

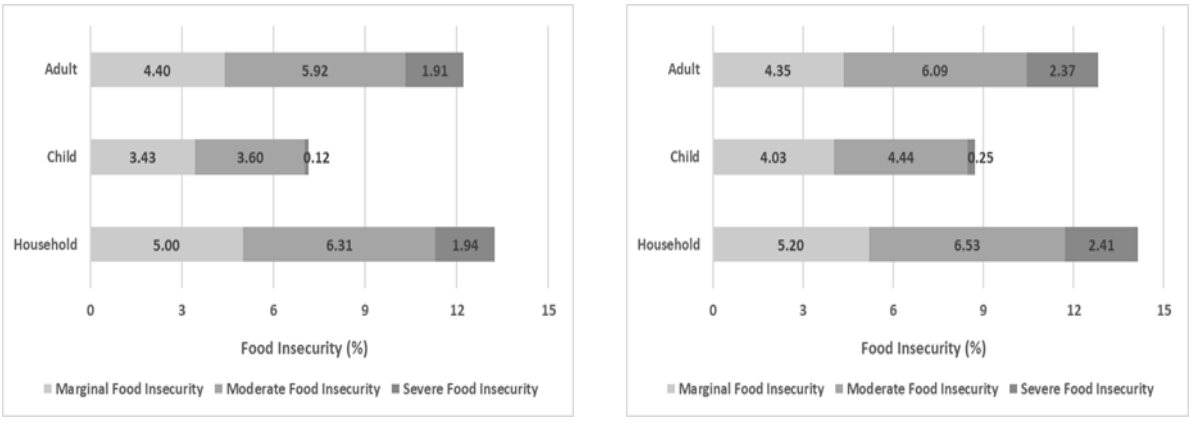
(Source: PROOF, 2018; Statistics Canada, 2020)

[7] This classification scheme is consistent with studies in the current food insecurity literature in Canada (Brown & Tarasuk, 2018; Jessiman-Perreault & McIntyre, 2017; Loopstra et al., 2015; Men et al., 2020; Men et al., 2021).

Figures 1.1 (a) and (b) show the prevalence and severity of food insecurity at the adult, child, and household levels using the categorical measure during 2005-2012, separately for treatment and control groups. During our study period, the prevalence of adult, child, and household food insecurity among the treatment group was 12.23%, 7.15%, and 13.24%, respectively. Among the control group, the prevalence was 12.81%, 8.72%, and 14.14% for adults, children, and households, respectively. Overall, the prevalence of food insecurity was higher among the control group compared to the treatment group. These figures also show that moderate food insecurity was more common relative to marginal or severe food insecurity, for both treatment and control groups.

Figure 1.1: Prevalence and severity of adult, child, and household food insecurity among treatment and control groups, 2005-2012

(a) Treatment Group (n=29,971) (b) Control Group (n=16,262)



In addition to the categorical measure of food insecurity, we use the continuous measure to further capture marginal changes across the food insecurity spectrum. We develop our continuous food insecurity scale for adults, children, and households based on Coates et al. (2007). Depending on the nature of a question (i.e., whether it asks about the occurrence or frequency of food insecurity) we assign values of "0", "1" and "2". For example, if the question asks about the

occurrence of skipping meals, we assign a value of "0" if the response is "negative" and a value of "1" if the response is "affirmative". If the question asks about the frequency of skipping meals, we assign "0" if the response is "never true", "1" if "sometimes true" and "2" if "often true". Our continuous adult, child, and household food insecurity scales range from 0-15, 0-12 and 0-27, respectively. Higher scores on each of these continuous scales indicate increased severity of food insecurity. Table 1.2 presents key summary statistics for these continuous food insecurity scales.

Table 1.2: Summary statistics of continuous adult, child, and household food insecurity scales based on the food security module

Food Insecurity Scales	Range	Mean Score (Standard Deviation)	Obs.
Adult	0-15	0.42 (1.50)	46,233
Child	0-12	0.16 (0.69)	46,233
Household	0-27	0.58 (2.07)	46,233

1.4.4. Control Variables

We include a set of individual-level and household-level socio-demographic characteristics as covariates, which have been identified as potential confounders in the literature (Brown & Tarasuk, 2019; Che & Chen, 2001; Ionescu-Ittu et al., 2015; Tarasuk, Fafard St-Germain et al., 2019). At the individual-level, we control for respondent's age (a set of categories versus 25-29 years), gender (female versus male), immigration status (immigrant versus non-immigrant), and visible minority status (visible minority versus white). At the household-level, we control for living arrangements (single-parent versus two-parent family), highest education (less than secondary or post-secondary versus secondary), main source of income (other sources such as unemployment benefit/welfare benefits versus employment), homeownership (own home versus rental),

household size, and the natural logarithm of real equivalent household income in 2006 Canadian dollars. In the public-use microdata files of the CCHS, household income is reported as a categorical variable. From this, we construct a quasi-continuous income variable by taking the midpoint of each category, a method similar to Daley and Phipps (2021). Further, we adjust this income for inflation and household size. In particular, we divide income by the square root of the household size and convert it to the real 2006 dollars using the all-items Consumer Price Index by province (Daley, 2017; Daley & Phipps, 2021). We also incorporate province-level economic variables that might modify the relationship between income and food insecurity. Specifically, we adjust for the provincial unemployment rate (Statistics Canada n.d.a). and the annual average all-items Consumer Price Index by province (Statistics Canada n.d.b). Finally, we also include a control for province, with the base as Ontario.

1.4.5. Empirical Strategy

We use a difference-in-differences methodology to estimate the effect of the income transfer on food insecurity at the adult, child, and household levels. This is based on an "intent-to-treat" approach, and is comparable to Schirle (2015), Daley (2017) and Lebihan and Takongmo (2019).

For our categorical dependent variables, we estimate an ordered probit model (represented by equation (1)) using the maximum likelihood estimation method. For the continuous food insecurity outcomes, we estimate a linear model (represented by equation (2)) using the ordinary least-squares approach.

$$Prob\left(Y_{ipt}\middle|Treat_i, Post_t, X_{it}, Z_{pt}\right) = \phi(\beta_0 + \beta_1 Treat_i + \beta_2 Post_t + \beta_3 (Treat_i * Post_t) + \alpha X_{it} + \gamma Z_{pt} + Province_p + \epsilon_{ipt}) \quad (1)$$

$$E\left(Y_{ipt}\middle|Treat_i, Post_t, X_{it}, Z_{pt}\right) = \beta_0 + \beta_1 Treat_i + \beta_2 Post_t + \beta_3 (Treat_i * Post_t) + \alpha X_{it} + \gamma Z_{pt} + Province_p + \epsilon_{ipt} \quad (2)$$

In equations (1) and (2), Y_{ipt} denotes the dependent variable for respondent i from province p and time period t. $Treat_i$ is a dummy variable to indicate eligibility for the UCCB. It takes a value of 1 if a household has a child under age six and 0 otherwise. $Post_t$ is a dummy variable that takes a value of 1 if a household is observed in the post-UCCB period and 0 otherwise. In addition, X_{it} is a vector of time-varying individual and household-level covariates and Z_{pt} is a vector of time-varying province-level economic controls. β_1 captures the effect of having a child below six years on food insecurity, β_2 indicates the effect of the post-policy period on the outcome and β_3 is our key parameter of interest, which reflects the effect of the UCCB on food insecurity. $Province_p$ stands for the province fixed effects and ϵ_{ipt} indicates the error term.

Finally, in each of our regression models, we use the sampling weights (normalized) provided in the CCHS to ensure that our estimates are representative of the population and to account for the varying number of observations during different survey cycles of the CCHS.

1.5. Results

1.5.1. Descriptive Statistics

Figures 1.2-1.4 depict changes in the prevalence of adult, child, and household food insecurity before and after the UCCB, separately for treatment and control groups. Here, food insecurity refers to experiencing any level of food insecurity: marginal, moderate, or severe. As shown in Figure 1.2, after the UCCB, the prevalence of adult food insecurity slightly decreased from 12.35% to 12.19% among the treatment group, however, the rate increased among the control group from 12.00% to 13.16%. Figure 1.3 indicates that although the prevalence of child food insecurity was lower among the treatment group compared to the control group (7.38% versus 7.84%) before the UCCB, after the policy change, the rate decreased among the treatment group as opposed to the increase among the control group (7.07% versus 9.11%). In line with the adult and child food insecurity, at the household level, we find that the prevalence decreased among the treatment group (from 13.51% to 13.16%), whereas it increased among the control group (from 13.38% to 14.47%), in the post-UCCB period (Figure 1.4).

Figure 1.2: Prevalence of adult food insecurity (marginal, moderate, or severe) among treatment and control groups, before and after the UCCB

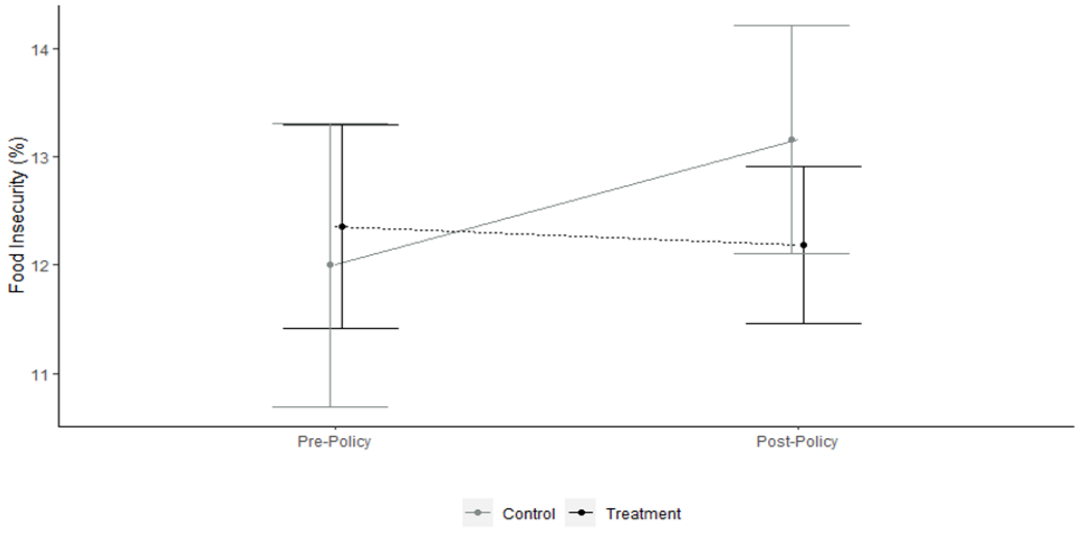


Figure 1.3: Prevalence of child food insecurity (marginal, moderate, or severe) among treatment and control groups, before and after the UCCB

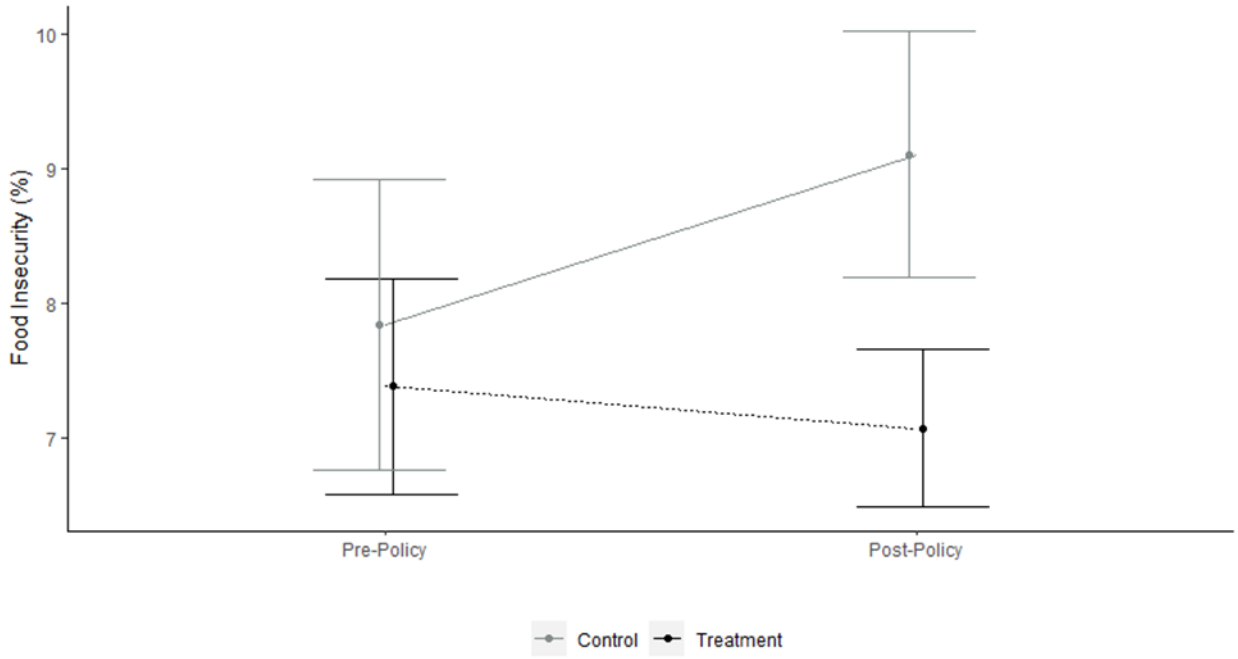


Figure 1.4: Prevalence of household food insecurity (marginal, moderate, or severe) among treatment and control groups, before and after the UCCB

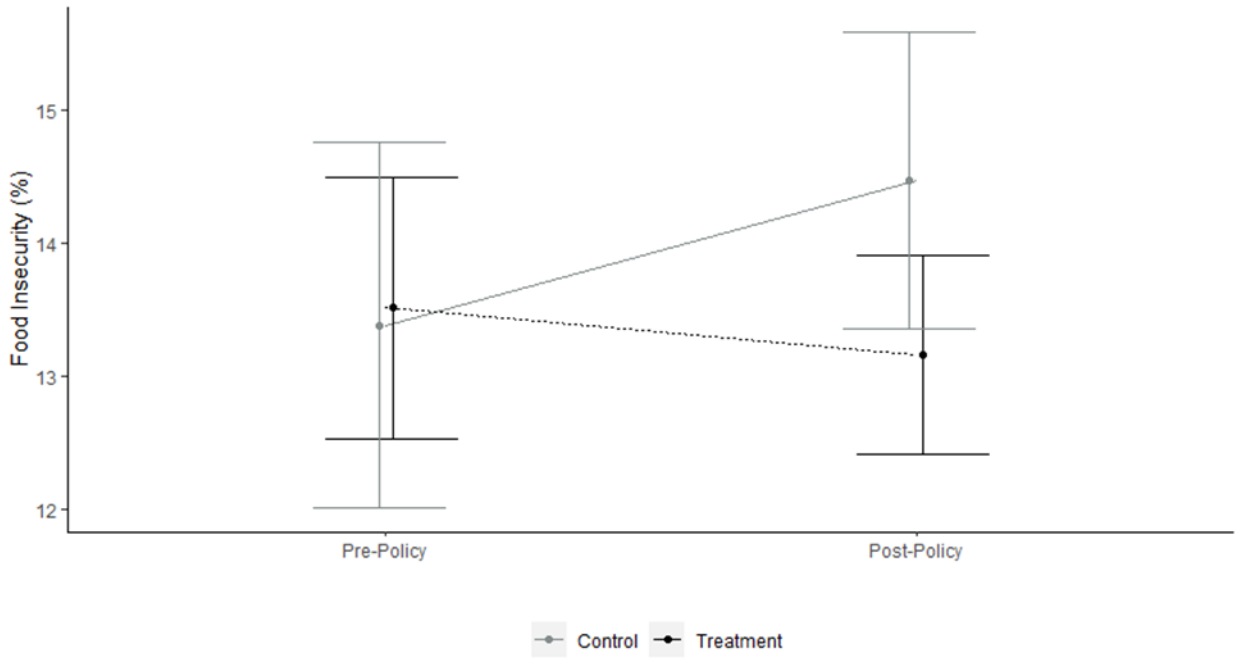


Table 1.3 presents a comparison of means/proportions of key covariates for the treatment and control groups, respectively. This pre-policy comparison facilitates the assessment of the appropriate selection of the control group. As presented in Table 1.3, we observe an expected difference between treatment and control groups due to the UCCB eligibility criteria (i.e., the presence of children aged 0 to 5): respondents from the treatment group are comparatively younger. There are some other socio-demographic differences as well. For example, the treatment group has a slightly higher proportion of visible minority representation, a lower proportion of single-parent households, higher levels of educational attainment, a lower proportion of homeownership and smaller household size. Looking at these differences, it seems rational to observe more single-parent households among families with older children compared to younger children. Similarly, it is also more likely for families with older children to have their own homes and have bigger household sizes, relative to families with younger children and younger parents. The observed differences in terms of visible minority identity and educational attainment although statistically significant, do not appear to be economically very significant. Moreover, it is important to note that, the difference-in-differences methodology does not require the treatment and control groups to necessarily have the same characteristics in the pre-policy period — but the trends in the outcome should be parallel (Gertler et al. 2011). However, we lack the ability to test for the parallel trends assumption in our study, as we do not have data from multiple pre-policy periods.

Table 1.3: Means/proportions of key covariates for treatment and control groups, before the UCCB

Covariates	Treatment Group	Control Group	Difference
Age (%)			
25 to 29 Years	18.63	2.27	16.35***
	(0.54)	(0.21)	(0.58)
30 to 34 Years	32.82	10.57	22.26***
	(0.66)	(0.51)	(0.83)
35 to 39 Years	29.77	27.72	2.05**
	(0.67)	(0.89)	(1.11)
40 to 44 Years	14.89	39.58	-24.69***
	(0.56)	(1.04)	(1.18)
45 to 49 Years	3.89	19.86	-15.97***
	(0.43)	(1.02)	(1.11)
Female (%)	50.25	52.19	1.95
	(0.73)	(1.07)	(1.30)
Immigrant (%)	23.56	23.26	0.31
	(0.69)	(0.98)	(1.20)
Visible Minority (%)	20.19	17.84	2.35**
	(0.66)	(0.89)	(1.10)
Single-Parent (%)	4.97	11.95	-6.97***
	(0.26)	(0.58)	(0.64)
Education (%)			
Less than Secondary	2.19	3.15	-0.95**
	(0.20)	(0.38)	(0.43)
Secondary	11.31	13.43	-2.12**
	(0.46)	(0.70)	(0.84)
Post-Secondary	86.50	83.42	3.08***
	(0.49)	(0.78)	(0.92)
Other as Main Source of Income (%)	4.39	4.40	-0.01
	(0.30)	(0.40)	(0.49)
Homeownership (%)	77.71	82.81	-5.11***
	(0.62)	(0.74)	(0.96)
Household Size (%)			
Two-Persons	1.74	4.48	-2.73***
	(0.12)	(0.24)	(0.27)
Three-Persons	36.77	23.57	13.19***
	(0.70)	(0.78)	(1.05)

Table 1.3 (Continued)

Four-Persons	41.95	48.31	-6.36***
	(0.71)	(1.06)	(1.28)
Five or More Persons	19.53	23.64	-4.11***
	(0.66)	(1.06)	(1.25)
Real Equivalent Household Income ($2006)	32678.57	32501.71	176.86
	(165.11)	(208.58)	(266.03))
Observations	8,051	4,798	12,849

Note: Normalized sampling weights are used in all analyses. Standard errors are reported in parentheses. Statistical significance is given by: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 1.4 contains the means/proportions of key covariates for the treatment and control groups, before and after the UCCB. This pre-post comparison allows us to assess changes in the composition of the treatment and control groups, before and after the policy change. We find that after the UCCB, the proportion of immigrants, visible minority and single-parent households increased among both the treatment and control groups. We also observe some decrease in the proportion of households with secondary education as the highest level of educational attainment, while some increase in the percentage of households having post-secondary education, among both the groups. Both groups had small increases in the percentage reporting other (such as unemployment insurance, welfare/senior's benefits) as their main source of income. We also find that the proportion of homeownership slightly increased among the treatment group, whereas it decreased in the control group. There are also some statistically significant changes in terms of household size, among both the groups. Additionally, we find that the average real equivalent household income decreased in the post-policy period for both groups, with a larger decrease for the control group. Ideally, the groups should be similar before and after the policy intervention, that is, there should not be significant compositional changes within groups over time. In our case, though we observe few statistically significant differences, they are mostly small in magnitude.

Table 1.4: Means/proportions of key covariates for treatment and control groups, before and after the UCCB

	Treatment Group			Control Group		
Covariates	Pre-Policy	Post-Policy	Difference	Pre-Policy	Post-Policy	Difference
Age (%)						
25 to 29 Years	18.63	18.36	0.27	2.27	2.43	-0.16
	(0.54)	(0.39)	(0.66)	(0.21)	(0.18)	(0.27)
30 to 34 Years	32.82	31.46	1.37*	10.57	10.11	0.46
	(0.66)	(0.48)	(0.82)	(0.51)	(0.41)	(0.66)
35 to 39 Years	29.77	30.72	-0.95	27.72	27.10	0.62
	(0.67)	(0.48)	(0.83)	(0.89)	(0.64)	(1.10)
40 to 44 Years	14.89	15.81	-0.92	39.58	38.73	0.85
	(0.56)	(0.42)	(0.70)	(1.04)	(0.76)	(1.28)
45 to 49 Years	3.89	3.65	0.24	19.86	21.62	-1.76
	(0.43)	(0.23)	(0.48)	(1.02)	(0.70)	(1.23)
Female (%)	50.25	50.18	0.07	52.19	56.64	-4.44***
	(0.73)	(0.53)	(0.91)	(1.07)	(0.77)	(1.32)
Immigrant (%)	23.56	27.96	-4.40***	23.26	27.33	-4.07***
	(0.69)	(0.53)	(0.87)	(0.98)	(0.75)	(1.24)
Visible Minority (%)	20.19	25.87	-5.68***	17.84	23.38	-5.54***
	(0.66)	(0.52)	(0.84)	(0.89)	(0.72)	(1.14)
Single-Parent (%)	4.97	6.77	-1.80***	11.95	14.46	-2.52***
	(0.26)	(0.26)	(0.36)	(0.58)	(0.50)	(0.77)
Education (%)						
Less than Secondary	2.19	2.27	-0.07	3.15	3.10	0.05
	(0.20)	(0.15)	(0.26)	(0.38)	(0.27)	(0.47)
Secondary	11.31	10.16	1.15**	13.43	11.73	1.71**
	(0.46)	(0.33)	(0.56)	(0.70)	(0.47)	(0.85)
Post-Secondary	86.50	87.57	-1.07*	83.42	85.18	-1.75*
	(0.49)	(0.35)	(0.61)	(0.78)	(0.53)	(0.94)
Other as Main Source of Income (%)	4.39	5.93	-1.54***	4.40	6.17	-1.78***
	(0.30)	(0.26)	(0.40)	(0.40)	(0.37)	(0.54)
Homeownership (%)	77.71	74.49	-3.22***	82.81	79.41	3.40***
	(0.62)	(0.50)	(0.80)	(0.74)	(0.63)	(0.97)
Household Size (%)						
Two-Persons	1.74	2.50	-0.75***	4.48	5.61	-1.14***
	(0.12)	(0.13)	(0.18)	(0.24)	(0.23)	(0.33)
Three-Persons	36.77	34.60	2.16**	23.57	25.67	-2.10**
	(0.70)	(0.50)	(0.86)	(0.78)	(0.61)	(0.99)

Table 1.4 (Continued)

Four-Persons	41.95	42.64	-0.69	48.31	48.73	-0.42
	(0.71)	(0.52)	(0.88)	(1.06)	(0.77)	(1.31)
Five or More Persons	19.53	20.26	-0.72	23.64	19.99	3.65***
	(0.66)	(0.46)	(0.81)	(1.06)	(0.70)	(1.27)
Real Equivalent Household Income ($2006)	32678.57	31423.52	1255.05***	32501.71	31088.18	1413.53***
	(165.11)	(113.26)	(200.22)	(208.58)	(158.91)	(262.22)
Observations	8051	21920	29971	4798	11464	16262

Note: Normalized sampling weights are applied in all analyses. Standard errors are reported in parentheses. Statistical significance is given by: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

1.5.2. Regression Estimates

Table 1.5 presents the adjusted predicted probabilities of experiencing each category of food insecurity among treatment and control groups, before and after the UCCB, at the adult, child, and household levels, respectively. These probabilities are calculated from ordered probit regressions of equation (1). As shown in Table 1.5, at the adult-level, after the UCCB, the probability of being food secure increased and the probability of being in any food insecure categories (i.e., marginal, moderate, and severe) decreased for the treatment group. Among the control group, the likelihood of experiencing food security remained almost unchanged and the probability of marginal food insecurity increased with reductions in the likelihood of experiencing moderate and severe food insecurity. At the child-level, in the post-UCCB period, the probability of food security increased, and the likelihood of marginal, moderate, and severe food insecurity decreased among both treatment and control groups, with comparatively greater changes for the former group. At the household-level, after the policy change, both groups experienced higher probabilities of being food secure and lower probabilities of being in any of the food insecure categories. However, the changes in the probabilities were relatively greater among the treatment group. Overall, the treatment group experienced relatively larger increases in the probability of

food security and greater reductions in the probability of food insecurity at the adult, child, and household-levels, after the implementation of the UCCB.

Table 1.5: Adjusted predicted probabilities of categorical food insecurity between treatment and control groups, before and after the UCCB

	Treatment Group		Control Group	
	Pre-Policy (θ_0)	Post-Policy (θ_1)	Pre-Policy (μ_0)	Post-Policy (μ_1)
Adult (n= 46,233)				
Food Secure	86.91	88.79	86.05	86.84
	(0.67)	(0.33)	(0.81)	(0.50)
Marginally Food	4.56	4.01	4.57	4.80
Insecure	(0.23)	(0.16)	(0.21)	(0.27)
Moderately	6.19	5.30	6.60	6.22
Food Insecure	(0.35)	(0.20)	(0.41)	(0.27)
Severely Food	2.34	1.90	2.55	2.36
Insecure	(0.19)	(0.11)	(0.23)	(0.15)
Child (n= 46,233)				
Food Secure	91.43	93.36	91.05	91.56
	(0.63)	(0.27)	(0.67)	(0.41)
Marginally Food	3.97	3.18	4.12	3.92
Insecure	(0.28)	(0.14)	(0.30)	(0.21)
Moderately	4.35	3.30	4.56	4.28
Food Insecure	(0.36)	(0.18)	(0.39)	(0.25)
Severely Food	0.25	0.17	0.27	0.24
Insecure	(0.05)	(0.02)	(0.05)	(0.04)
Household (n=46,233)				
Food Secure	85.93	87.77	84.85	85.52
	(0.68)	(0.34)	(0.82)	(0.51)
Marginally Food	5.23	4.66	5.55	5.35
Insecure	(0.25)	(0.17)	(0.29)	(0.23)
Moderately	6.50	5.64	7.02	6.70
Food Insecure	(0.35)	(0.20)	(0.41)	(0.27)
Severely Food	2.33	1.93	2.59	2.43
Insecure	(0.18)	(0.11)	(0.22)	(0.15)

Note: Normalized sampling weights are used in all regressions. We include all covariates in each regression. Standard errors are reported in parentheses. Statistical significance is given by: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 1.6 shows the difference-in-differences estimates $[(\theta_1 - \theta_0) - (\mu_1 - \mu_0)]$ based on the adjusted predicted probabilities presented in Table 1.5. The estimates are calculated as the differences between the change in predicted probabilities for the treatment group $(\theta_1 - \theta_0)$, and the change in predicted probabilities for the control group $(\mu_1 - \mu_0)$, after the UCCB.

Table 1.6: Difference-in-differences in categorical food insecurity between treatment and control groups

Difference-in-Differences Estimates $(\theta_1 - \theta_0) - (\mu_1 - \mu_0)$	
Adult (n=46,233)	
Food Secure	1.08
	(0.93)
Marginally Food Insecure	-0.32
	(0.26)
Moderately Food Insecure	-0.52
	(0.44)
Severely Food Insecure	-0.24
	(0.23)
Child (n=46,233)	
Food Secure	1.42*
	(0.78)
Marginally Food Insecure	-0.59*
	(0.31)
Moderately Food Insecure	-0.77*
	(0.43)
Severely Food Insecure	-0.06*
	(0.04)
Household (n=46,233)	
Food Secure	1.16
	(0.95)
Marginally Food Insecure	-0.37
	(0.29)
Moderately Food Insecure	-0.55
	(0.45)
Severely Food Insecure	-0.25
	(0.22)

Note: Normalized sampling weights are used in all regressions. We include all covariates in each regression. Standard errors are reported in parentheses. Statistical significance is given by: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

As indicated in Table 1.6, at the child level, the UCCB increased the probability of being food secure by 1.42 percentage points and decreased the likelihood of experiencing marginal, moderate, and severe food insecurity by 0.59, 0.77, and 0.06 percentage points, respectively. Based on the pre-policy probabilities (given in Table 1.5) these estimates are equivalent to 14.86%, 17.70%, and 24% decreases in the probability of marginal, moderate, and severe child food insecurity, respectively. However, as shown in Table 1.6, we did not find any statistically significant decreases in the probability of experiencing food insecurity at the adult or household levels.

Table 1.7 presents coefficients from the ordinary least-squares regression using the model represented by equation (2). Here, we only report the key difference-in-differences estimate ($\widehat{\beta_3}$), but we include a full set of covariates in each of our regression models and present the results in Appendix C. As demonstrated in Table 1.7, we find that the UCCB reduced the average child food insecurity score by 0.04 units (a decrease of 25% relative to the mean score). In line with our results based on the categorical measurement of food insecurity, we do not observe any statistically significant effect of the income transfer on the continuous adult and household food insecurity scales.

Table 1.7: Difference-in-differences in continuous food insecurity between treatment and control groups

	Difference-in-Differences Estimates ($Treat_i * Post_t$)
Adult (n=46,233)	-0.06
	(0.04)
Child (n=46,233)	-0.04*
	(0.02)
Household (n=46,233)	-0.09
	(0.06)

Note: Normalized sampling weights are used in all regressions. We include all covariates in each regression. Standard errors are reported in parentheses. Statistical significance is given by: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

1.6. Robustness Checks

In this section, we perform several robustness checks to examine the sensitivity of our main results. Specifically, we exclude Ontario, then we exclude Quebec, we change the respondents' age to 18-59 years, we incorporate additional provinces, we exclude the Great Recession period, and we exclude the control for household income. Tables 1.8 and 1.9 present the difference-in-differences estimates using the categorical and continuous measures of food insecurity for these robustness checks.

Table 1.8: Difference-in-differences in categorical food insecurity between treatment and control groups, robustness checks

	Main Result	Exclude Ontario	Exclude Quebec	Respondents Aged to 18-59 Years	Include Additional Provinces	Exclude Great Recession	Exclude Household Income
Adult							
Food Secure	1.08	1.86	0.73	1.09	1.11	0.73	1.42
	(0.93)	(1.29)	(1.06)	(0.92)	(0.92)	(1.28)	(0.97)
Marginally Food Insecure	-0.32	-0.58	-0.21	-0.31	-0.33	-0.23	-0.41
	(0.26)	(0.38)	(0.28)	(0.26)	(0.26)	(0.36)	(0.27)
Moderately Food Insecure	-0.52	-0.87	-0.35	-0.52	-0.53	-0.35	-0.68
	(0.44)	(0.60)	(0.51)	(0.44)	(0.44)	(0.62)	(0.47)
Severely Food Insecure	-0.24	-0.42	-0.17	-0.26	-0.25	-0.15	-0.32
	(0.23)	(0.31)	(0.27)	(0.23)	(0.22)	(0.31)	(0.24)
Child							
Food Secure	1.42*	1.22	1.71*	1.40*	1.43*	0.71	1.54*
	(0.78)	(1.09)	(0.88)	(0.76)	(0.76)	(1.10)	(0.81)
Marginally Food Insecure	-0.59*	-0.52	-0.71**	-0.57*	-0.59*	-0.34	-0.64**
	(0.31)	(0.43)	(0.36)	(0.30)	(0.30)	(0.44)	(0.32)
Moderately Food Insecure	-0.77*	-0.64	-0.94*	-0.77*	-0.79*	-0.35	-0.84*
	(0.43)	(0.61)	(0.49)	(0.42)	(0.42)	(0.60)	(0.45)
Severely Food Insecure	-0.06*	-0.05	-0.06*	-0.06*	-0.06*	-0.02	-0.06*
	(0.04)	(0.06)	(0.04)	(0.04)	(0.04)	(0.07)	(0.04)

Table 1.8 (Continued)

Household							
Food Secure	1.16	1.96	0.78	1.18	1.21	0.82	1.53
	(0.95)	(1.31)	(1.08)	(0.93)	(0.93)	(1.35)	(1.00)
Marginally Food Insecure	-0.37	-0.65	-0.24	-0.36	-0.38	-0.30	-0.47
	(0.29)	(0.41)	(0.31)	(0.27)	(0.28)	(0.40)	(0.29)
Moderately Food Insecure	-0.55	-0.91	-0.37	-0.55	-0.57	-0.38	-0.73
	(0.45)	(0.61)	(0.51)	(0.44)	(0.44)	(0.63)	(0.48)
Severely Food Insecure	-0.25	-0.41	-0.17	-0.27	-0.26	-0.14	-0.33
	(0.22)	(0.30)	(0.26)	(0.22)	(0.22)	(0.32)	(0.23)
Observations	46,233	26,197	34,686	49,053	55,906	24,230	46,233

Note: Normalized sampling weights are used in all regressions. Standard errors are reported in parentheses. Statistical significance is given by: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 1.9: Difference-in-differences in continuous food insecurity between treatment and control groups, robustness checks

	Main Result	Exclude Ontario	Exclude Quebec	Respondents Aged to 18-59 Years	Include Additional Provinces	Exclude Great Recession	Exclude Household Income
Adult	-0.06	-0.03	-0.06	-0.05	-0.06	-0.09	-0.07*
	(0.04)	(0.05)	(0.05)	(0.04)	(0.04)	(0.06)	(0.04)
Child	-0.04*	-0.03	-0.04*	-0.03*	-0.03*	-0.03	-0.04**
	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)
Household	-0.09	-0.06	-0.10	-0.08	-0.09	-0.12	-0.12*
	(0.06)	(0.08)	(0.07)	(0.06)	(0.06)	(0.08)	(0.06)
Observations	46,233	26,197	34,686	49,053	55,906	24,230	46,233

Note: Normalized sampling weights are used in all regressions. We include all covariates in each regression. Standard errors are reported in parentheses. Statistical significance is given by: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

1.6.1. Exclude Ontario

First, we test the sensitivity of our results to changes in other child-related policies that occurred during our study period. One such policy was the introduction of the "Ontario Child Benefit" in 2007 — a non-taxable, income-tested monthly benefit for low-and moderate-income

families with children below the age of 18 years. To assure that our results do not reflect other such policies, we estimate our main models but exclude respondents from Ontario. Previous studies evaluating the impact of child benefit policies on household food insecurity have also excluded households from Ontario in their analyses (Brown and Tarasuk, 2019; Ionescu-Ittu et al., 2015). As shown in Table 1.8, the difference-in-differences estimates from this robustness check are quite similar to our main model results in terms of sign and magnitude. However, we lose statistical significance on the child food insecurity outcome. Also, Table 1.9 indicates that our result for continuous child food insecurity becomes statistically insignificant after excluding respondents from Ontario. Although, the sign and magnitude of the coefficients are similar to our main results.

1.6.2. Exclude Quebec

In 2006, the government of Quebec launched its own 'Quebec Parental Insurance Plan', which replaced the existing maternity and parental benefits paid through the federal employment insurance program with higher benefits and broader coverage. Thus, as a robustness check, we exclude respondents from Quebec, in a manner similar to Daley (2017) and Lebihan and Takongmo (2019). As indicated in Tables 1.8 and 1.9 the results for both the categorical and continuous outcomes from this robustness check are robust to our main findings.

1.6.3. Respondents Aged to 18-59 Years

For our main analysis, we restrict our sample respondents to parents aged 25-49 years, following the approach used by Schirle (2015) and Lebihan and Takongmo (2019). To test whether our results vary depending on the age of respondents in our sample, we incorporate parents aged 18-59 years (Daley, 2017). The results in Tables 1.8 and 1.9 are similar to our main model.

1.6.4. Include Additional Provinces

As mentioned in our methodology section, the food security module was a "core content" in cycles 2007-2008 and 2011-2012, whereas it was part of the "optional content" in cycles 2005 and 2009-2010. In the main analysis, we restrict our sample to the five provinces that participated in the module during all cycles of our study period. As a robustness check, we extend our sample to include respondents from provinces that participated in the food security module during any cycle within our study period. Tables 1.8 and 1.9 demonstrate, the results are robust to our main estimates in sign, size, and statistical significance.

1.6.5. Exclude Great Recession

Next, we consider whether our results are impacted by adverse economic conditions, and thus we exclude respondents interviewed during the Great Recession of 2008-2009. Since the public-use files of the CCHS do not contain months of interview information, we exclude respondents from 2007-2008 and 2009-2010 in order to remove the influence of recession. As indicated in Tables 1.8 and 1.9, the sign and magnitude of the estimates are generally similar to the main model, though the estimates are no longer statistically significant.

1.6.6. Exclude Household Income

Finally, to account for the fact that the UCCB might affect food insecurity through its impact on household income, we consider a specification that excludes the control for household income. A similar sensitivity analysis has been performed by Men et al. (2021) in their study on the impact of provincial policies and economic environments on food insecurity. As shown in Table 1.8, the results from this sensitivity analysis vary negligibly from our main estimates. In terms of the continuous outcomes, the difference-in-differences estimates become slightly larger in magnitude and remain statistically significant (Table 1.9).

1.7. Discussion

Food insecurity is an important public health issue. It is associated with a wide array of physical and mental health repercussions, and it places a substantial burden on the health care system. Food insecurity indicates a lack of financial and other resources, and it is one of the channels through which socio-economic conditions impact health (Ionescu-Ittu et al., 2015). Since a lack of financial resources has been identified as a strong predictor of food insecurity (Bhawra et al., 2021; Che & Chen, 2001; Smith et al., 2017; Tarasuk, Fafard St-Germain et al., 2019), considerable research efforts have been focused on the impact of income-based public policy interventions (e.g., cash transfers, child benefits, social assistance). However, past studies have commonly centered on household-level measures of food insecurity. Like Health Canada (2007), our descriptive analysis demonstrates that adults and children within food-insecure households may have very different experiences. While the prevalence and severity of food insecurity among adults and children are comparable in some households, there are also instances in which adults adopt a protective behavior or, in some cases, only children experience food insecurity. This suggests the need to look beyond the household-level measure when considering how public policies impact food insecurity among households with children.

Our study extends the existing literature ─ especially the study by Ionescu-Ittu et al. (2015) – in two specific ways. First, we assess the impact of an income transfer on food insecurity among adults and children within households, respectively. Second, we use two different measures of food insecurity: a four-level categorical measure (i.e., food-secure, marginally food-insecure, moderately food-insecure, severely food-insecure) and a continuous scale. Thus, our results provide better insights on the impact of the income transfer across the range of severity of food insecurity. Using the UCCB as an exogenous income shock and a standard difference-in-

differences framework, our results indicate reductions in the prevalence and severity of child food insecurity.

Our findings provide valuable insight on the role of income support policies on food insecurity within households. When we consider the effect of the policy at different levels (i.e., adult, child, and overall household), we find statistically significant reductions in food insecurity only at the child-level. We do not observe any statistically significant decline in food insecurity at the adult or household levels. Indeed, a monthly taxable benefit of $100 is less likely to provide a substantial protection against complete food insecurity. The observed reduction of food insecurity at the child level in our sample, with statistically insignificant declines at the adult and household levels, rather support the protective nature of adults within the households that have been commonly mentioned in food insecurity literature. It seems more likely that a universal income transfer like the UCCB may help food-insecure households to protect children from compromising on the quantity and/or quality of food intake, but not be able to provide sufficient financial support for the entire household. However, the reduction in child food insecurity is an important and promising outcome, especially, given that the original goal of the UCCB policy was to help families with childcare or the cost of raising children in general. As discussed in detail in section 1.2.4.2., the physical and mental health consequences associated with child food insecurity are severe and often perpetuate in later years in life as well. The reductions in child food insecurity, can be well expected to be associated with potential important health benefits among children.

Our results are in general congruence with previous studies that demonstrated decrease in household-level food insecurity due to different social policy changes (Brown and Tarasuk, 2019; Ionescu Ittu et al., 2015; Li et al., 2016; Loopstra et al., 2015; McIntyre et al., 2016; Tarasuk, Li et al., 2019). According to our estimates, in the post-policy period, the prevalence of child food

insecurity decreased by 4.20%. Past studies have commonly reported a 7% to 50% reduction in the prevalence of food insecurity. For example, Ionescu Ittu et al. (2015) showed a 25% reduction in household-level food insecurity resulting from the UCCB. Although our study is based on the same policy change, there are considerable differences in the study period, sample selection criteria and covariates. Similarly, studies reporting larger reductions in food insecurity based on other policy interventions often focused on low-income households (McIntyre et al. 2016; Loopstra et al. 2015), among whom the reduction is likely to be larger. Also, based on our estimate, we report a consistent decline across the range of severity in child food insecurity. In our sample, the UCCB reduced the probability of marginal, moderate, and severe child food insecurity by 14.86%, 17.70% and 24%, respectively. Previous research considering the effect of other policy interventions on severity yielded mixed results. For example, Brown and Tarasuk (2019) reported greater reductions in severe food insecurity, while Li et al. (2016) found reductions in marginal-moderate food insecurity, with almost no impact on severe food insecurity.

Taken together, our paper shows that a universal monthly income transfer ($100 in this case) can stimulate a small reduction across the range of food insecurity for children within the eligible households.

1.7.1. Limitations

First, we have data from only one pre-policy period (2005). Although food insecurity questions were asked in earlier survey cycles of the CCHS, the detailed 18-item food security module was introduced beginning in 2005. This affects our ability to test the parallel trends assumption.

Second, the food security survey module was "optional content" in 2005 and 2009-2010. We restricted the sample to the provinces that participated in the module in all survey cycles from 2005-2012. This left us with only five provinces (out of the ten provinces and three territories). To some extent, this weakens the generalizability of our findings. However, previous studies following the same approach showed that such exclusions did not largely impact their results (Brown & Tarasuk, 2019; Ionescu Ittu et al., 2015). In addition, as part of the robustness checks, we present results that include respondents from all provinces that participated in the food security module during any survey cycle between 2005 and 2012. The results did not vary between the two specifications.

Third, our data is based on the public-use microdata files of the CCHS. The public-use data do not include information on the number of children in a household, thus we could not determine whether the policy had a differential on families with multiple young children. Having an additional child below the age of six years would have provided eligible households with an additional $1,200 annually. At the same time, having more children below the age of six could make those households more vulnerable to food insecurity. Without information on the number of young children, our study could not assess whether the policy had a different effect on households with multiple young children.

Fourth, the public use data do not contain information on the birth year of the youngest child in the household. Previous studies used this information to test whether the duration of the UCCB benefits had an additional impact on their outcomes (Daley, 2017; Lebihan and Takongmo, 2019). Based on the public-use data, we cannot determine whether households that received the transfer for more years had larger reductions in food insecurity.

Finally, we use repeated cross-sectional data, so we do not observe the same households over time like panel data. However, the observable characteristics for our treatment and control groups were mostly similar, within and across the groups, before and after the policy intervention, with some small statistically significant differences.

1.8. Conclusion

Food insecurity is an important public health concern, even in high-income countries. Several studies have considered the impact of social policy interventions on household-level food insecurity in different settings and for different population subgroups. Our analysis, although based on a Canadian policy that has already been replaced by an income-tested benefit, adds to this growing body of literature by considering the impact of an exogenous income shock on the prevalence and severity of food insecurity among adults and children *within* households. As an increasing number of countries are designing policies to tackle food insecurity and hunger, especially among families with children, our findings provide policymakers with an improved understanding of the impact of income transfers on food insecurity within households.

CHAPTER 2

HETEROGENEOUS EFFECTS OF A UNIVERSAL INCOME TRANSFER ON FOOD INSECURITY WITHIN HOUSEHOLDS ACROSS SUBPOPULATIONS

2.1. Introduction

There are considerable disparities in the prevalence and severity of food insecurity across different population groups in Canada. For example, in 2017-2018, 12.7% of Canadian households experienced food insecurity, but the rate was much higher among families in Nunavut (57%), those with children (16.2%), single-parent households (33.1% for lone mothers and 21.6% for lone fathers), those with lower income (35.6%) and lower educational attainment (21.1%), those residing in rented houses (25.4%), social assistance recipients (60.4%) and Indigenous Peoples (28.2%) (Tarasuk & Mitchell, 2020). At the same time, past studies from food insecurity literature have generally reported stronger effects of various social and economic policy changes among vulnerable subgroups (Brown & Tarasuk, 2019; Ionescu-Ittu et al., 2015; Li et al., 2016; Loopstra et al., 2015; McIntyre et al., 2016).

In Chapter 1, we estimated the effect of a universal income transfer on food insecurity within households using the Universal Child Care Benefit (UCCB) as an exogenous income shock. Our findings suggested that the policy reduced the prevalence and severity of food insecurity at the child level. Given disparities in the prevalence of food insecurity across different subgroups, and the possibility that public policy changes may impact these groups differently, in this chapter, we examine the potential heterogeneous effects of the UCCB. In particular, we assess whether the policy had a differential effect on food insecurity for households with different living arrangements, levels of educational attainment, and income. In parallel, with our previous chapter,

we measure the heterogeneous effects separately at the adult, child, and household levels, respectively.

2.2. Literature Review

2.2.1. Disparities in Food Insecurity Prevalence in Canada

Food insecurity rates in Canada differ based on a range of demographic, social and economic characteristics such as age, gender, racial/ethnic identity, immigration status, disability status, household living arrangements, education, employment opportunities, homeownership, income and financial security (Dietitians of Canada, 2016). In this section, I discuss some of these disparities to provide the context for the examination of potential heterogeneity in the impact of the UCCB.

First, with respect to living arrangements, the prevalence of food insecurity is particularly high among single-parent households, especially among lone mothers (Dietitians of Canada, 2016; Tarasuk et al., 2013; Tarasuk et al., 2014; Tarsuk & Mitchell, 2020). For example, in 2017-2018, two-parent households with children under 18 had a food insecurity rate of 11.8%, whereas the rate was 21.6% for male single-parent households and 33.1% for female single-parent households (Tarasuk & Mitchell, 2020). Single-parent families are often faced with limited employment opportunities (because of childcare and other responsibilities) and lower income (due to the lack of another earning source). For example, in 2014, 69% of lone mothers and 82% of lone fathers were employed, compared to 75% and 95% of mothers and fathers in two-parent households, respectively (Statistics Canada, 2014).

Education is another important socio-economic determinant of food insecurity as differences in educational attainment affect employment opportunities and earnings capabilities. For example, in 2011-2012, the prevalence of food insecurity was 20.9% for households with less than high-school education compared to 6.1% for those with a Bachelor's degree or higher (Tarasuk, Fafard St-Germain et al., 2019). Similarly, during 2017-2018, 21.1% of households with no member having completed high school reported food insecurity where only 7.2% of households with at least one member having a Bachelor's degree or higher reported being food insecure (Tarasuk & Mitchell, 2020).

The association between income and food insecurity has been documented extensively in the literature (Dietitians of Canada, 2016; Gundersen et al., 2011; Health Canada, 2007; Kirkpatrick & Tarasuk, 2011; Loopstra & Tarasuk, 2013; McIntyre et al., 2016; Tarasuk et al., 2014; Tarasuk, Fafard St-Germain et al., 2019; Tarasuk & Mitchell 2020). In general, there exists a gradient between income and health as income is a crucial input in the process of generating better health outcomes. Similarly, food insecurity is impacted by a household's financial circumstances, and especially by household income, as it largely determines expenditure patterns and the ability to meet basic needs. Evidence suggests that, during 2017-2018, those with income in the lowest decile had 14 times (35.6% versus 2.5%) higher prevalence of food insecurity compared to those in the highest income decile (Tarasuk & Mitchell, 2020). Studies also find that households with lower income are more likely to experience severe food insecurity (Dietitians of Canada, 2016; Health Canada, 2007; Tarasuk et al., 2014; Tarasuk & Mitchell, 2020). For example, during 2017-2018, the rate of severe food insecurity was 11.9% for those in the lowest income decile and only 0.2% for those in the highest decile (Tarasuk & Mitchell, 2020).

2.2.2. Heterogeneity in Public Policy Impacts

Previous research has demonstrated that public policy interventions may affect population subgroups in different ways. In Canada, multiple studies examining various social policy changes provide empirical evidence in support of this statement. For example, past studies examining the impact of the UCCB on labor market and health outcomes found that the effects largely varied based on household demographic and socio-economic characteristics (Daley, 2017; Lebihan and Takongmo, 2019; Schirle 2015). Schirle (2015) showed that the UCCB had significant negative income effects on labor supply of married individuals, but the effect sizes varied considerably by education and gender, with larger effects among lower-educated females. Daley (2017) examined whether the UCCB had an impact on mental health among Canadian mothers and found that the policy reduced stress among lone mothers and improved life-satisfaction among married mothers. The study by Lebihan and Takongmo (2019) also showed that the same policy change had different effects on parental obesity based on gender, educational attainment, and family type. They found that following the policy change, mothers with lower education and the upper tail of the body mass index distribution experienced greater weight loss, while fathers did not report any statistically significant changes.

There is also evidence that the UCCB and other policies had different effects on household food insecurity across subgroups. For example, Ionescu-Ittu et al. (2015) examined the average impact of the UCCB on food insecurity, as well as the effects for subgroups differentiated based on household income, household type and respondent type. They found that the effects of the policy were stronger for households with below median income (4.3 percentage points reduction compared to 2.3 percentage points for all households) and single-parent households (5.4 percentage points reduction in food insecurity). Brown and Tarasuk (2019) examined the effect of

another child-related policy, the Canada Child Benefit, for three subsamples defined based on household income. They found that the benefit had a smaller effect on food insecurity among households reporting any income but had a sizable effect among those with income at or below the low-income measure. Some studies also focused particularly on vulnerable populations (i.e., low-income households or social assistance recipients) while evaluating policy impacts on household food insecurity (Loopstra et al., 2015; McIntyre et al., 2016). These studies generally found larger reductions (i.e., 44% to 50% decreases) in the food insecurity prevalence among target groups.

In our study, we explore potential heterogeneity in the impact of the UCCB on food insecurity within households (at the adult, child, and household levels separately) across subsamples differentiated based on three factors: living arrangements (i.e., single-parent and two-parent families), highest educational attainment in the household (less than secondary, secondary and post-secondary) and household income (below median income and at or above median income). Additionally, we test for income heterogeneity by defining subsamples based on income deciles.

The reasons why we are interested in examining the impact of the transfer across these subpopulations can be explained from theoretical and empirical perspectives. For example, we choose to study the effects separately by living arrangements as the net amount of the UCCB varied by household type. As mentioned by Battle (2008), households of different types (single parents, two parents with one earner and two parents with dual earners) with the same income received different after-tax amounts. Below the tax-paying thresholds every household had the same benefit amount. However, at higher income levels, single-parent households and two-parent households with dual earners had lower net benefits compared to those with one earner (Battle, 2008). Further,

as discussed in section 2.2.1, single-parent households have comparatively lower earnings which would suggest a higher marginal utility of the UCCB. We also differentiate households by educational attainment and income for this reason, as well as due to the interconnections between education, income, and health. Specifically, Grossman (1972) postulates individuals with higher education are more efficient producers of health. In a more latent channel, education influences earnings and thus health outcomes (in this case food insecurity).

2.3. Data and Methodology

As Chapter 2 is designed as an extension of Chapter 1, we utilize an analogous empirical methodology. We continue to use the same dataset, policy instrument, and set of dependent and control variables. In this section, we highlight key points about the subsamples used in this chapter and discuss extensions to our methodology that allow us to estimate the potential heterogeneous effects of the policy change on food insecurity.

2.3.1. Data and Analytical Sample

We continue to employ public-use microdata files of the Canadian Community Health Survey (CCHS), cycles 2005-2012 and we use the same sample defined in the previous chapter based on the inclusion/exclusion criteria detailed in section 1.4.2. Our main estimating sample includes 46,233 respondents. For the purpose of our heterogeneity analysis, we further differentiate this sample into subsamples based on living arrangements, education and income.

First, we estimate the heterogeneous effects of the policy across subsamples distinguished by household living arrangements. For this subgroup analysis, we divide our sample into two categories: single-parent households (n=6,225) and two-parent households (n=40,008). Next, we test for the heterogeneity across household educational attainment, and we stratify our main sample

into three groups: households with less than secondary education (n=1,329), households with secondary education (n=5,388) and households with post-secondary education (n=39,516). Finally, we examine the differential impact of the transfer across the household income distribution. We do so by categorizing the sample into two groups: households below the median income (n=16,623) and households at or above the median income (n=29,610). We also define subsamples by income decile.

2.3.2. Dependent and Control Variables

We continue to use both the categorical and continuous measurements of food insecurity as our main dependent variables. As mentioned earlier, we estimate the heterogeneous effects of the UCCB on food insecurity separately at the adult, child, and household levels, respectively. For each of our subgroup analyses, we control for the full range of individual and household-level covariates discussed in section 1.4.4. We also control for economic variables (i.e., provincial unemployment rate and annual average all-items Consumer Price Index by province), and we include province fixed effects.

2.3.3. Empirical Strategy

In congruence with the identification strategy of Chapter 1, we use a standard difference-in-differences methodology to estimate the potential heterogeneous impact of the UCCB across our defined subpopulations. Our main empirical strategy remains comparable to previous studies that estimated the effect of the UCCB on other outcomes (Daley, 2017; Lebihan and Takongmo 2019; Schirle, 2015). However, we estimate separate regressions for each of our population subgroups classified based on living arrangements, education, and income.

For each population subgroup, we estimate an ordered probit model (represented by equation (1)) for our categorical food insecurity outcomes and a linear model (represented by equation (2)) for our continuous outcomes, separately at the adult, child, and household levels.

$$Prob\left(Y_{ipt}\middle|Treat_i, Post_t, X_{it}, Z_{pt}\right) = \phi(\beta_0 + \beta_1 Treat_i + \beta_2 Post_t + \beta_3 (Treat_i * Post_t) + \alpha X_{it} + \gamma Z_{pt} + Province_p + \epsilon_{ipt}) \quad (1)$$

$$E\left(Y_{ipt}\middle|Treat_i, Post_t, X_{it}, Z_{pt}\right) = \beta_0 + \beta_1 Treat_i + \beta_2 Post_t + \beta_3 (Treat_i * Post_t) + \alpha X_{it} + \gamma Z_{pt} + Province_p + \epsilon_{ipt} \quad (2)$$

Similar to Chapter 1, Y_{ipt} denotes dependent variable of interest for respondent i from province p and time period t. $Treat_i$ is a dummy variable to indicate eligibility for the UCCB and $Post_t$ is a dummy variable to indicate time-period. X_{it} is a vector of time-varying individual and household-level covariates and Z_{pt} is a vector of time-varying province-level economic controls. βs are the parameters to be estimated and β_3 is the key difference-in-differences estimate representing the effect of the UCCB on the outcome. As before, we also control for province fixed effects ($Province_p$), and we continue to use normalized sampling weights in each of our regressions.

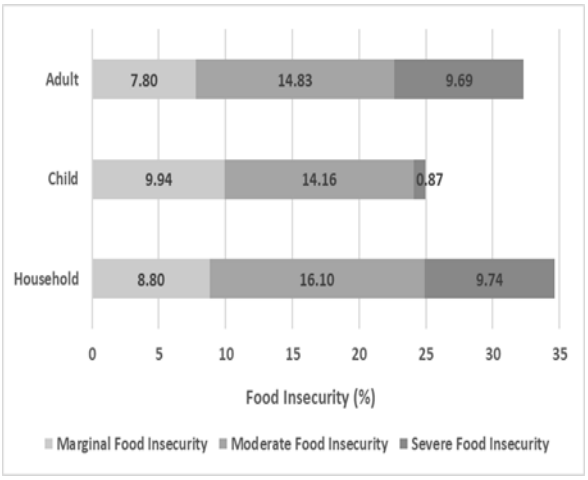
2.4. Results

2.4.1. Descriptive Statistics

Figures 2.1- 2.4 present the differences in prevalence and severity of adult, child, and household food insecurity, during 2005-2012, by living arrangements, highest educational attainment in the household and household income.

Figure 2.1: Prevalence and severity of adult, child, and household food insecurity by living arrangements

(a) Single-Parent Households (n=6,225)



(b) Two-Parent Households (n=40,008)

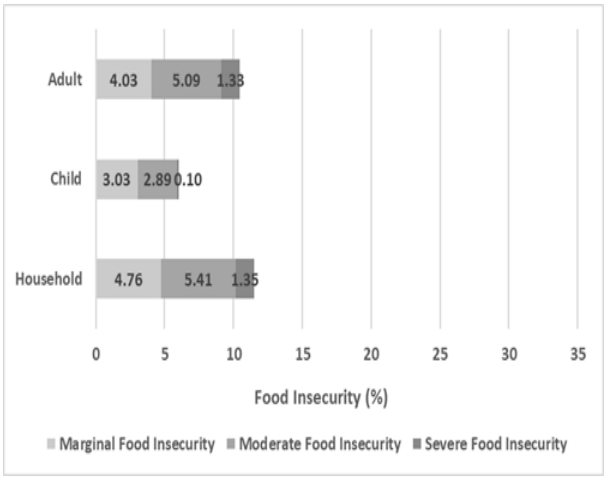
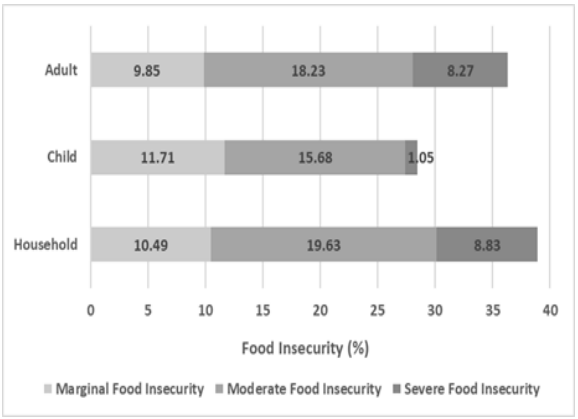
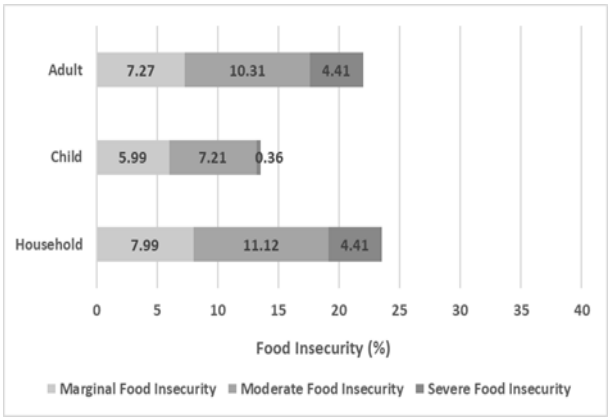


Figure 2.2: Prevalence and severity of adult, child, and household food insecurity by highest educational attainment in the household

(a) Less than Secondary (n=1,329)



(b) Secondary (n=5,388)



(c) Post-Secondary (n=39,516)

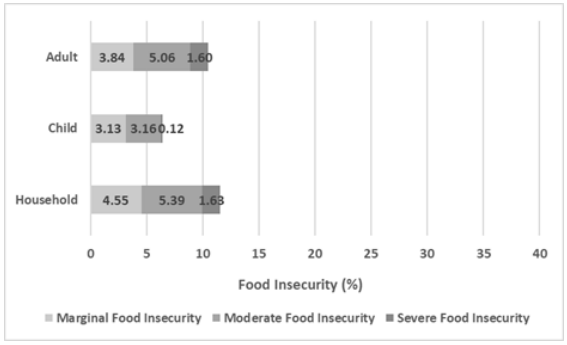
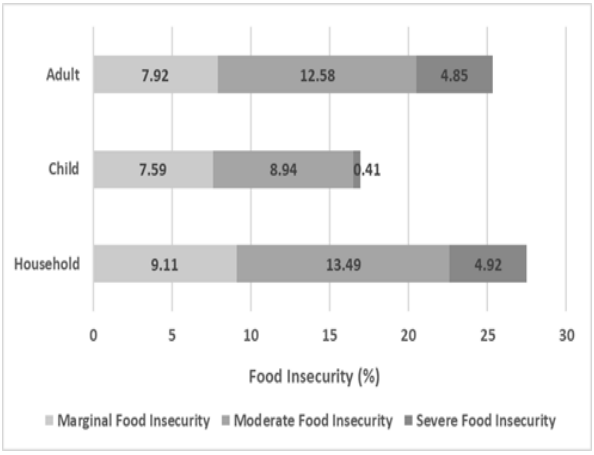


Figure 2.3: Prevalence and severity of adult, child, and household food insecurity by median income

(a) Less than Median (n=16,623)



(b) At or above Median (n=29,610)

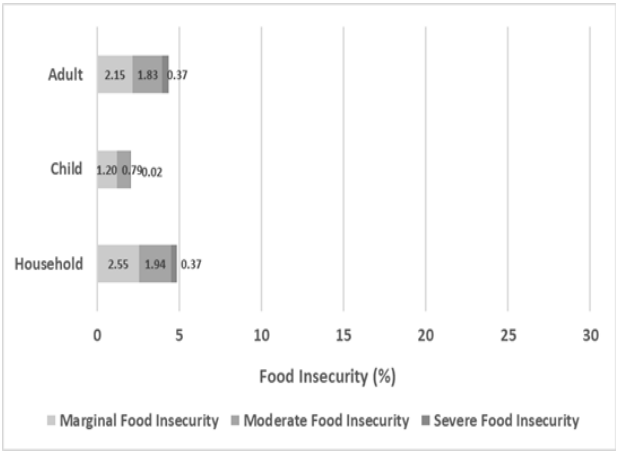
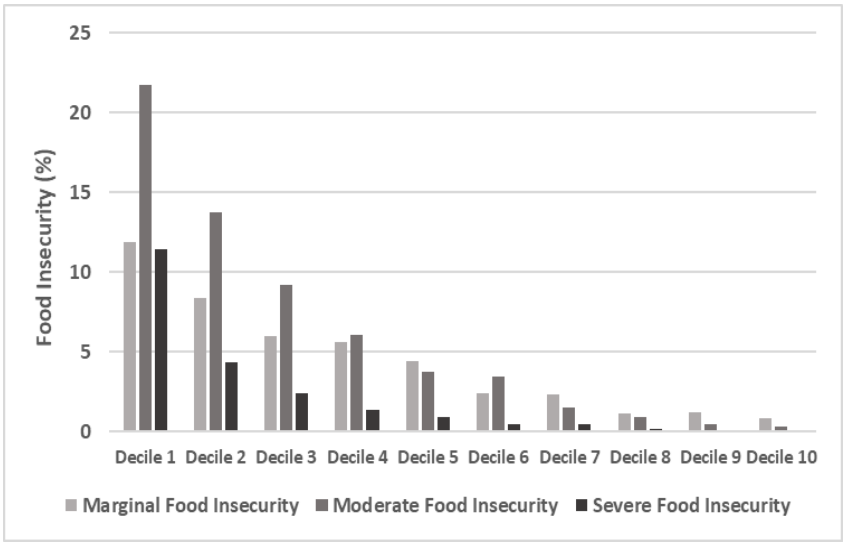
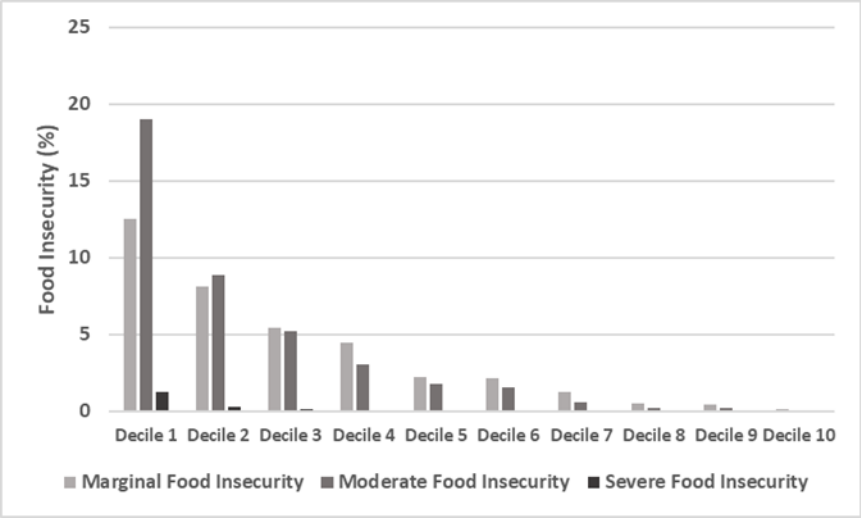


Figure 2.4: Prevalence and severity of adult, child, and household food insecurity by income deciles

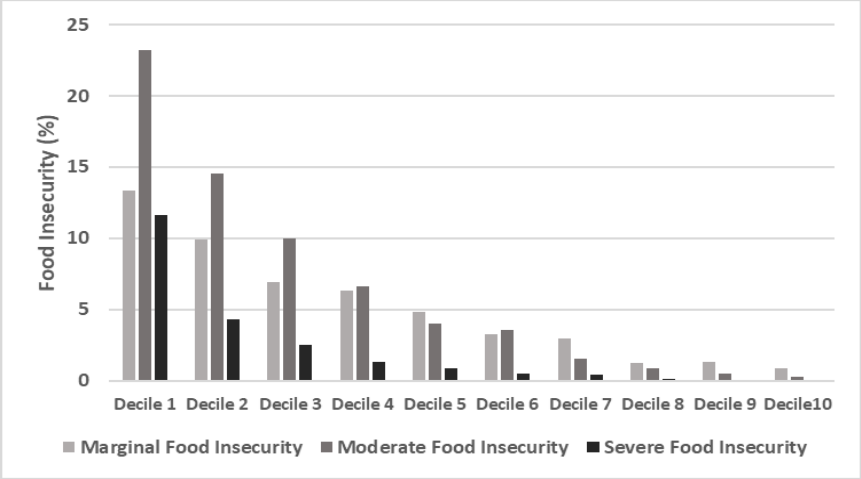
(a) Adult



(b) Child



(c) Household



As shown in Figure 2.1 (a) and (b), food insecurity rates were much higher among single-parent households compared to two-parent households. In particular, for single-parent households the rates of adult, child and household level food insecurity were 32.32%, 24.97% and 34.64%, respectively. However, the rates were only 10.44%, 6.03% and 11.47%, respectively for two-parent households. Figure 2.2 (a)-(c) indicates that the prevalence and severity of food insecurity decreased with higher levels of educational attainment in the household. For example, the prevalence of adult food insecurity was 36.35% among households without any secondary education, while the rates were 21.99% and 10.50% among households with secondary and post-

secondary education, respectively. In terms of the relationship between income and food insecurity, our descriptive statistics depict a pattern similar to the past literature. Specifically, the prevalence and severity of food insecurity at all levels (i.e., adult, child, and household) decreased with higher income in the household (Figures 2.3-2.4).

2.4.2. Regression Estimates Across Subsamples

Tables 2.1 and 2.2 present the difference-in-differences estimates (i.e., the effect of the UCCB on food insecurity at the adult, child, and household levels) using the categorical and continuous measures, separately for the subgroups by living arrangements. The estimates presented in Table 2.1 are calculated from the adjusted predicted probabilities given in Table D.1. of Appendix D based on ordered probit regression models. Table 2.2 contains the key difference-in-differences estimates, taken directly from the linear regression models.

Table 2.1: Difference-in-differences in adjusted predicted probabilities of categorical food insecurity by living arrangements

	Single-Parent Households (n=6,225)			Two-Parent Households (n=40,008)		
	Adult	Child	Household	Adult	Child	Household
Food Secure	3.46	1.98	3.93	1.10	1.71**	1.21
	(3.56)	(3.52)	(3.56)	(0.98)	(0.77)	(1.00)
Marginally Food Insecure	-0.43	-0.61	-0.47	-0.36	-0.75**	-0.42
	(0.41)	(0.83)	(0.41)	(0.31)	(0.34)	(0.33)
Moderately Food Insecure	-1.33	-1.26	-1.53	-0.54	-0.90**	-0.59
	(1.33)	(2.34)	(1.36)	(0.48)	(0.41)	(0.49)
Severely Food Insecure	-1.70	-0.12	-1.93	-0.20	-0.06**	-0.21
	(1.85)	(0.37)	(1.81)	(0.18)	(0.03)	(0.18)

Note: Normalized sampling weights are used in all regressions. We include all covariates in each regression. Standard errors are reported in parentheses. Statistical significance is given by: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 2.2: Difference-in-differences in continuous food insecurity by living arrangements

	Single-Parent Households (n=6,225)			Two-Parent Households (n=40,008)		
	Adult	Child	Household	Adult	Child	Household
Mean Score	1.44	0.60	2.04	0.32	0.12	0.44
(Standard Deviation)	(2.84)	(1.33)	(3.98)	(1.24)	(0.57)	(1.69)
Treat*Post	-0.44*	-0.11	-0.54	-0.04	-0.04**	-0.08
	(0.25)	(0.12)	(0.35)	(0.04)	(0.02)	(0.06)

Note: Normalized sampling weights are used in all regressions. We include all covariates in each regression. Standard errors are reported in parentheses. Statistical significance is given by: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Based on our results from Table 2.1 we find that, when we differentiate by household living arrangements, the UCCB had a statistically significant effect on food insecurity at the child level for two-parent households. Specifically, it increased the probability of experiencing food security by 1.71 percentage points, and it decreased the likelihood of being marginally, moderately, or severely food insecure by 0.75, 0.90 and 0.06 percentage points, respectively. The signs and magnitudes of estimates for single-parent households are quite similar to their two-parent counterparts, however, they are not statistically significant.

Table 2.2 mirrors these findings using a continuous measure of food insecurity. The difference-in-differences estimates in Table 2.2 indicate that the UCCB reduced the average child food insecurity score by 0.04 units (a decrease of 33.33% relative to the mean) for two-parent households. We also observe a statistically significant decrease in adult food insecurity scale for single-parent households.

Tables 2.3 and 2.4 show the difference-in-differences estimates for the subsamples categorized by the highest level of educational attainment in the household. Table 2.3 estimates are derived from the adjusted predicted probabilities given in Table D.2. of Appendix D and are based on ordered probit regressions. Table 2.4 shows the key estimates calculated directly from the linear regression models. From Table 2.3, we find that the UCCB reduced child food insecurity

in households with secondary education. Specifically, the probability of experiencing child food security increased by 5.65 percentage points and the probability of facing marginal, moderate and severe child food insecurity decreased by 1.97, 3.36 and 0.31 percentage points, respectively. We observe a similar pattern among households with less than secondary or post-secondary education, however, the estimates for these subgroups are not statistically significant. When measured using the continuous scale, we again find that the UCCB reduced food insecurity for households with secondary education (Table 2.4). In particular, after the policy change, we observe a reduction of 0.27, 0.20 and 0.47 units (decreases of 30%, 62.50% and 38.52% relative to the mean scores) at the adult, child and household levels, respectively.

Table 2.3: Difference-in-differences in adjusted predicted probabilities of categorical food insecurity by household highest educational attainment

	Less than Secondary Education (n= 1,329)			Secondary Education (n=5,388)			Post-Secondary Education (n=39,516)		
	Adult	Child	Household	Adult	Child	Household	Adult	Child	Household
Food Secure	1.26	1.86	2.30	2.00	5.65**	1.60	1.10	0.93	1.21
	(6.88)	(6.65)	(7.00)	(3.14)	(2.60)	(3.17)	(0.97)	(0.80)	(0.99)
Marginally Food Insecure	-0.27	-0.39	-0.30	-0.47	-1.97**	-0.39	-0.34	-0.41	-0.41
	(0.79)	(1.80)	(0.83)	(0.71)	(0.90)	(0.72)	(0.29)	(0.34)	(0.32)
Moderately Food Insecure	-0.64	-1.25	-1.06	-0.92	-3.36**	-0.76	-0.53	-0.49	-0.57
	(2.93)	(4.28)	(3.13)	(1.44)	(1.58)	(1.49)	(0.47)	(0.43)	(0.47)
Severely Food Insecure	-0.35	-0.22	-0.97	-0.60	-0.31*	-0.46	-0.22	-0.03	-0.23
	(3.20)	(0.60)	(3.10)	(0.99)	(0.17)	(0.96)	(0.21)	(0.03)	(0.20)

Note: Normalized sampling weights are used in all regressions. We include all covariates in each regression. Standard errors are reported in parentheses. Statistical significance is given by: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 2.4: Difference-in-differences in continuous food insecurity by household highest educational attainment

	Less than Secondary Education (n= 1,329)			Secondary Education (n=5,388)			Post-Secondary Education (n=39,516)		
	Adult	Child	Household	Adult	Child	Household	Adult	Child	Household
Mean Score (Standard Deviation)	1.48 (2.75)	0.65 (1.37)	0.54 (1.98)	0.90 (2.26)	0.32 (0.94)	1.22 (3.04)	0.34 (1.34)	0.12 (0.59)	0.46 (1.82)
Treat*Post	0.10 (0.43)	-0.04 (0.21)	0.06 (0.60)	-0.27* (0.16))	-0.20** (0.07)	-0.47** (0.22)	-0.05 (0.04)	-0.02 (0.02)	-0.06 (0.06)

Note: Normalized sampling weights are used in all regressions. We include all covariates in each regression. Standard errors are reported in parentheses. Statistical significance is given by: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Finally, to test for the possibility of heterogeneous effects across the income distribution, we estimate our regression models for households relative to the median income and based on income deciles. Tables 2.5 and 2.6 present the difference-in-differences estimates using the categorical and continuous measures of food insecurity, separately for households categorized based on their position relative to the median income threshold. Estimates in Table 2.5 are calculated from the adjusted predicted probabilities shown in Table D.3. in the Appendix and estimates in Table 2.6 are derived directly from the linear regressions. Tables 2.7 and 2.8 and Figures 2.5-2.8 show the difference-in-differences estimates using categorical and continuous food insecurity measures for households separated based on income deciles. The adjusted predicted probabilities for calculating Table 2.7 estimates are available upon request.

Table 2.5: Difference-in-differences in adjusted predicted probabilities of categorical food insecurity by median income

	Below Median Income (n=16,623)			At or Above Median Income (n=29,610)		
	Adult	Child	Household	Adult	Child	Household
Food Secure	1.48	1.55	1.48	0.70	1.12**	0.81
	(2.07)	(1.85)	(2.09)	(0.78)	(0.51)	(0.83)
Marginally Food Insecure	-0.32	-0.58	-0.33	-0.31	-0.61**	-0.39
	(0.40)	(0.61)	(0.42)	(0.33)	(0.28)	(0.37)
Moderately Food Insecure	-0.73	-0.91	-0.73	-0.31	-0.49**	-0.35
	(1.00)	(1.14)	(1.02)	(0.36)	(0.22)	(0.36)
Severely Food Insecure	-0.43	-0.06	-0.41	-0.08	-0.02	-0.08
	(0.66)	(0.10)	(0.65)	(0.10)	(0.02)	(0.10)

Note: Normalized sampling weights are used in all regressions. We include all covariates in each regression. Standard errors are reported in parentheses. Statistical significance is given by: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 2.6: Difference-in-differences in continuous food insecurity by median income

	Below Median Income (n=16,623)			At or Above Median Income (n=29,610)		
	Adult	Child	Household	Adult	Child	Household
Mean Score	1.01	0.38	1.40	0.12	0.04	0.15
(Standard Deviation)	(2.33)	(1.04)	(3.18)	(0.71)	(0.28)	(0.92)
Treat*Post	-0.10	-0.05	-0.15	-0.04	-0.02**	-0.06**
	(0.10)	(0.05)	(0.14)	(0.02)	(0.01)	(0.03)

Note: Normalized sampling weights are used in all regressions. We include all covariates in each regression. Standard errors are reported in parentheses. Statistical significance is given by: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 2.7: Difference-in-differences in adjusted predicted probabilities of categorical food insecurity by income decile

	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10
					Adult					
Food Secure	0.47 (4.72)	1.17 (4.18)	5.00 (4.04)	-2.54 (3.28)	-0.29 (2.82)	2.52 (1.71)	0.90 (1.84)	0.96 (1.29)	-4.84** (2.03)	0.81 (1.42)
Marginally Food Insecure	0.05 (0.42)	-0.24 (0.79)	-1.24 (0.90)	0.72 (0.99)	0.01 (1.05)	-0.78 (0.54)	-0.47 (0.84)	-0.42 (0.57)	2.86** (1.13)	-0.57 (0.97)
Moderately Food Insecure	-0.13 (2.04)	-0.62 (2.18)	-2.70 (2.18)	1.30 (1.67)	0.15 (1.28)	-1.43 (0.97)	-0.33 (0.71)	-0.42 (0.58)	1.89** (0.94)	-0.23 (0.59)
Severely Food Insecure	-0.40 (2.29)	-0.31 (1.21)	-1.06 (0.99)	0.52 (0.64)	0.12 (0.50)	-0.31 (0.23)	-0.10 (0.30)	-0.12 (0.15)	0.09 (0.06)	-0.01 (0.02)
					Child					
Food Secure	1.26 (4.48)	-0.58 (4.14)	3.80 (3.16)	-0.27 (2.47)	2.23 (1.59)	3.13** (1.40)	0.40 (1.36)	-1.24 (1.41)	-0.07 (0.94)	------
Marginally Food Insecure	-0.29 (0.94)	0.08 (1.36)	-1.57 (1.26)	0.10 (1.22)	-1.09 (0.79)	-1.61** (0.77)	-0.27 (0.77)	0.74 (0.82)	0.04 (0.54)	------
Moderately Food Insecure	-0.86 (3.11)	0.45 (2.63)	-2.14 (1.83)	0.16 (1.23)	-1.12 (0.80)	-1.49** (0.68)	-0.12 (0.51)	0.46 (0.56)	0.03 (0.40)	------
Severely Food Insecure	-0.11 (0.45)	0.06 (0.16)	-0.08 (0.09)	0.01 (0.02)	-0.02 (0.02)	-0.02 (0.02)	-0.01 (0.08)	0.05 (0.06)	0.00 (0.00)	------
					Household					
Food Secure	-0.46 (4.63)	1.27 (4.30)	5.21 (4.07)	-2.36 (3.33)	-0.30 (2.80)	2.92 (1.97)	1.26 (1.99)	0.79 (1.33)	-4.48** (2.12)	0.87 (1.10)
Marginally Food Insecure	0.22 (0.40)	-0.28 (0.86)	-1.34 (0.94)	0.70 (1.06)	0.04 (1.08)	-1.05 (0.75)	-0.71 (1.00)	-0.36 (0.60)	2.61** (1.17)	-0.61 (0.69)
Moderately Food Insecure	0.34 (2.04)	-0.67 (2.24)	-2.81 (2.20)	1.21 (1.70)	0.16 (1.27)	-1.56 (1.03)	-0.42 (0.71)	-0.34 (0.58)	1.79* (0.98)	-0.25 (0.18)
Severely Food Insecure	-0.10 (2.24)	-0.32 (1.22)	-1.06 (0.95)	0.44 (0.59)	0.11 (0.45)	-0.32 (0.22)	-0.13 (0.29)	-0.10 (0.15)	0.08 (0.06)	-0.01 (0.02)
Obs.	4,063	3,847	4,106	4,607	4,497	5,504	5,481	5,013	4,889	3,746

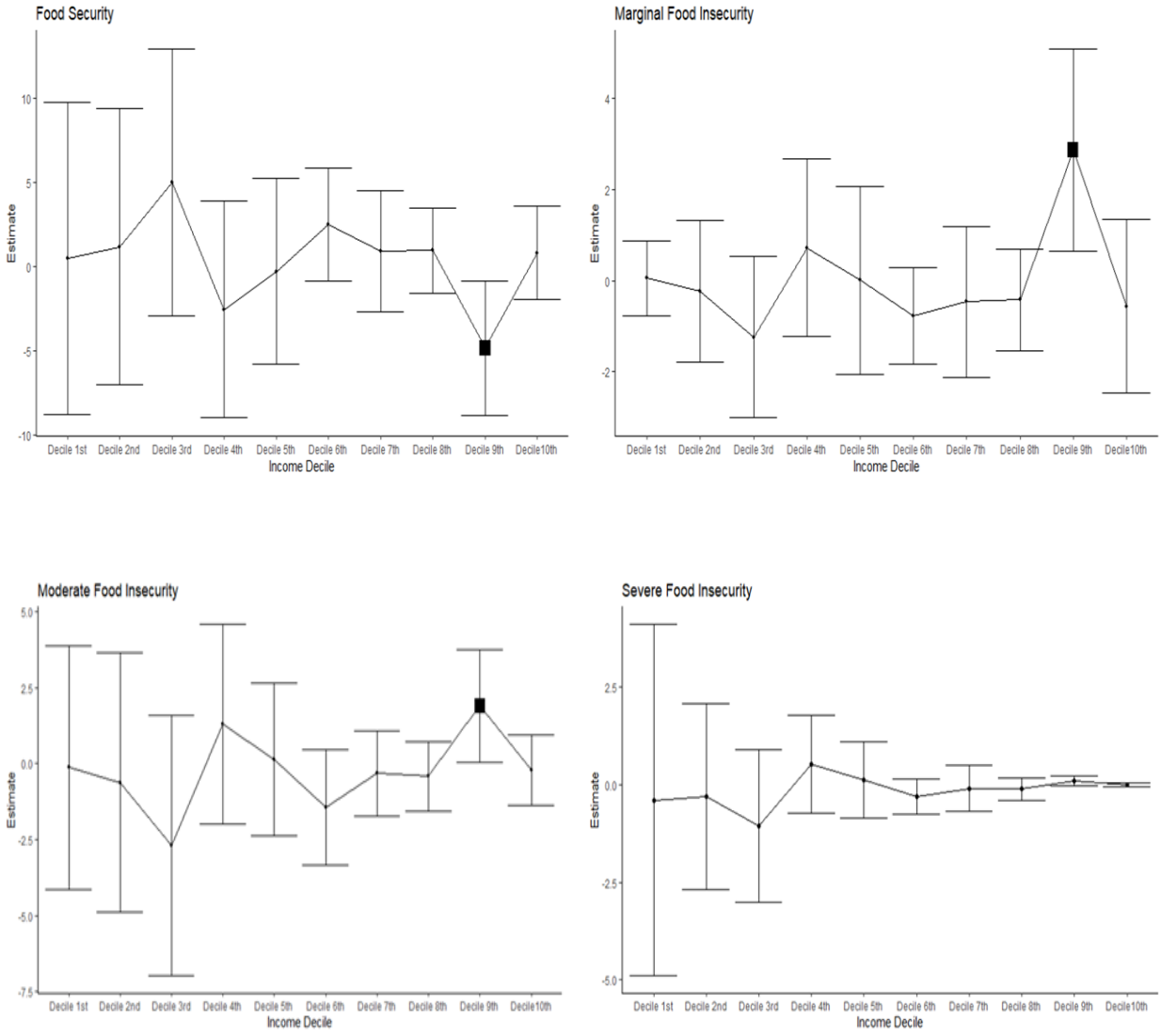
Note: The regression model for child-level food insecurity at the 10th income decile did not converge. Normalized sampling weights are used in all regressions. We include all covariates in each regression. Standard errors are reported in parentheses. Statistical significance is given by: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 2.8: Difference-in-differences in continuous food insecurity by income decile

	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10
					Adult					
Mean	1.87	0.91	0.54	0.34	0.23	0.18	0.11	0.05	0.03	0.02
(Standard Deviation)	(3.02)	(2.11)	(1.56)	(1.16)	(0.98)	(0.88)	(0.73)	(0.46)	(0.25)	(0.21)
Treat*Post	-0.09	-0.14	-0.11	0.04	-0.02	-0.10	-0.07	-0.02	0.04*	-0.04*
	(0.31)	(0.20)	(0.15)	(0.10)	(0.07)	(0.06)	(0.05)	(0.03)	(0.05)	(0.02)
					Child					
Mean	0.80	0.36	0.21	0.12	0.08	0.06	0.04	0.01	0.01	0.00
(Standard Deviation)	(1.48)	(0.96)	(0.72)	(0.50)	(0.44)	(0.38)	(0.31)	(0.14)	(0.15)	(0.07)
Treat*Post	-0.03	-0.01	-0.07	0.01	-0.05	-0.06*	-0.02	0.01	-0.01	-0.00
	(0.16)	(0.10)	(0.07)	(0.04)	(0.03)	(0.03)	(0.02)	(0.01)	(0.01)	(0.00)
					Household					
Mean	2.67	1.27	0.75	0.47	0.31	0.24	0.14	0.07	0.04	0.02
(Standard Deviation)	(4.23)	(2.90)	(2.12)	(1.53)	(1.32)	(1.19)	(0.96)	(0.57)	(0.37)	(0.24)
Treat*Post	-0.12	-0.14	-0.18	0.05	-0.07	-0.15	-0.10	-0.01	0.03	-0.04*
	(0.45)	(0.29)	(0.20)	(0.12)	(0.10)	(0.09)	(0.07)	(0.04)	(0.03)	(0.02)
Obs.	4,063	3,847	4,106	4,607	4,497	5,504	5,481	5,013	4,889	3,746

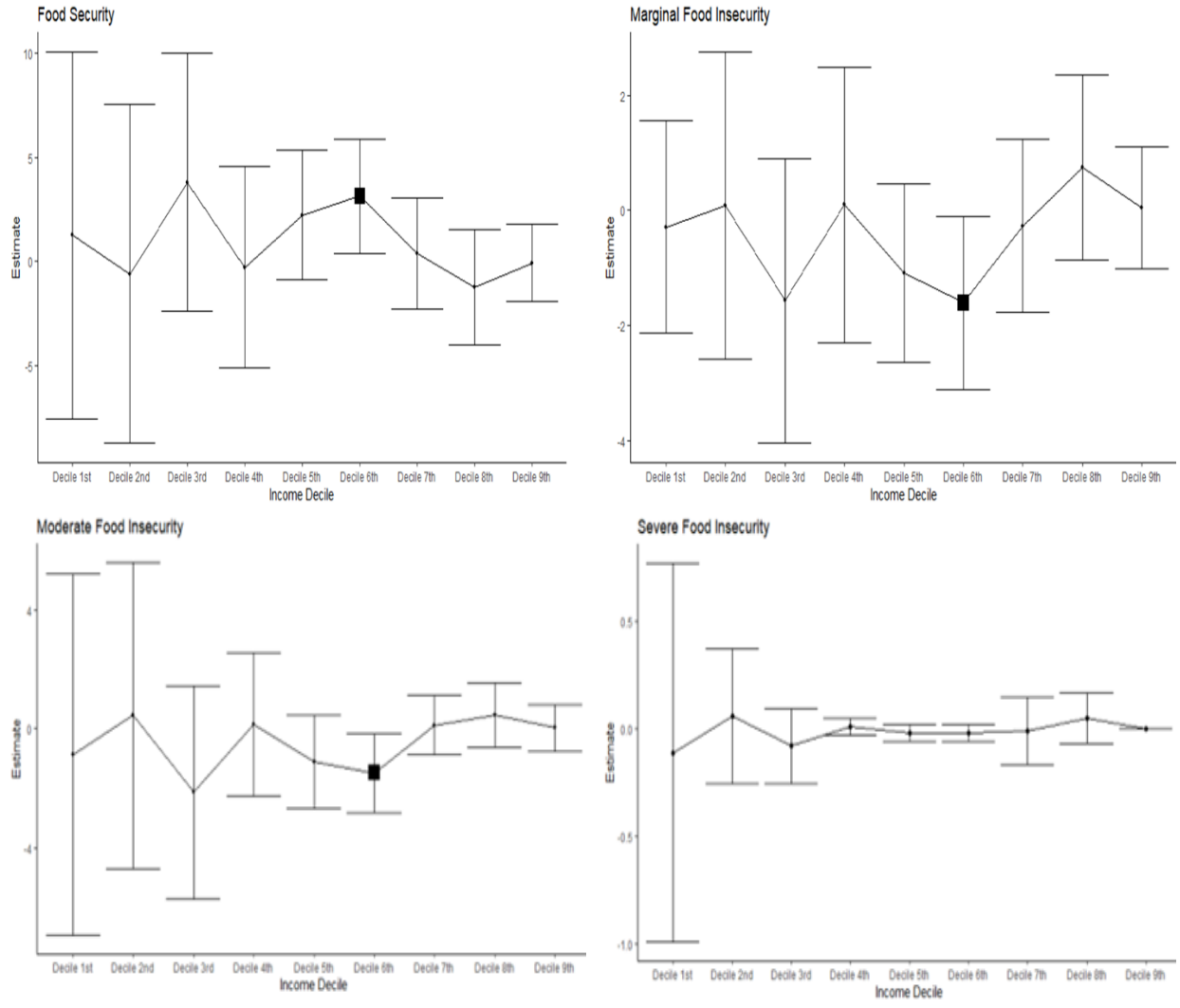
Note: Normalized sampling weights are used in all regressions. We include all covariates in each regression. Standard errors are reported in parentheses. Statistical significance is given by: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Figure 2.5: The effect of the UCCB on adult food insecurity (difference-in-differences estimates) using categorical measure across income deciles



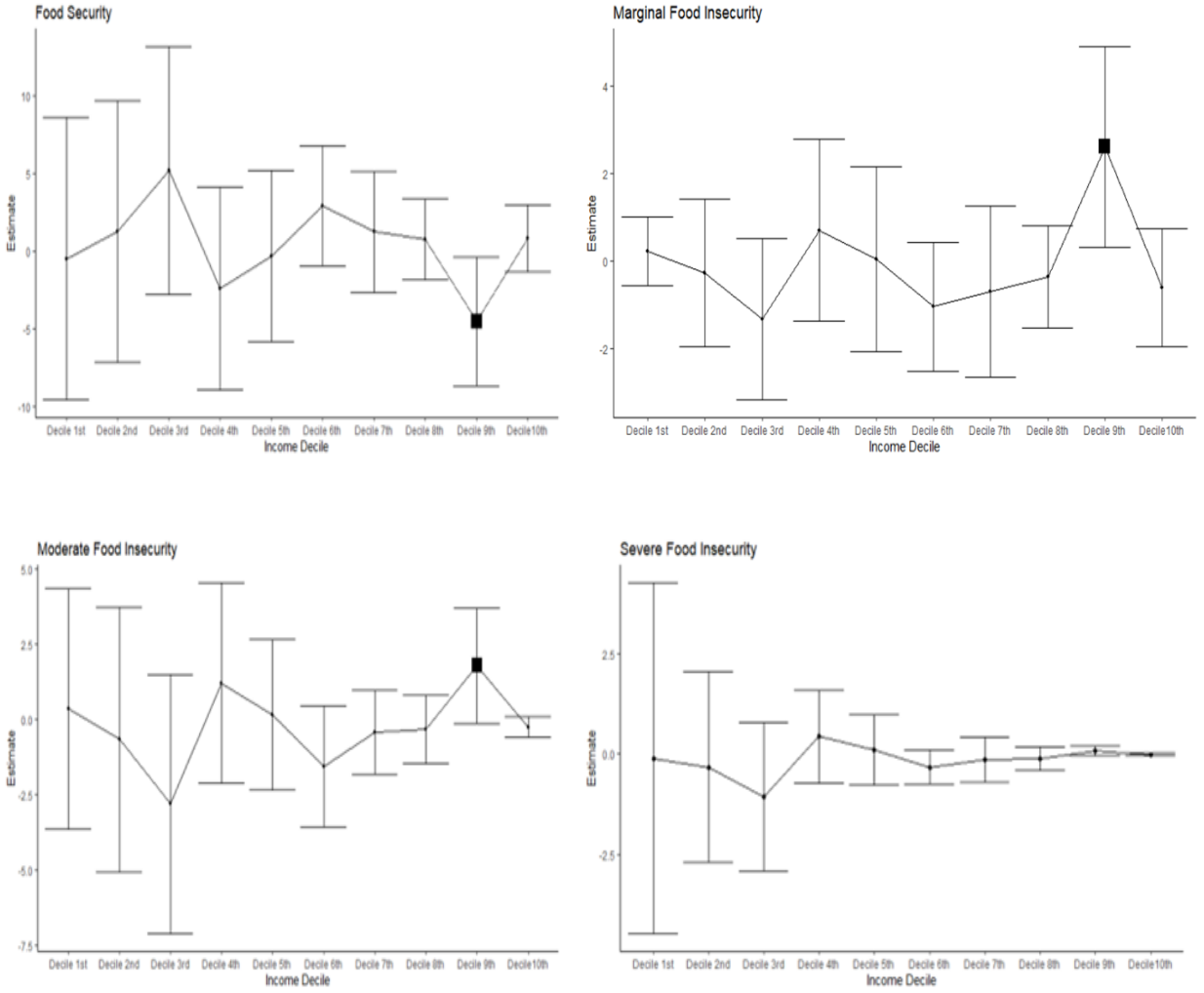
Note: The points in the figure represent the difference-in-differences estimates and the bars show 95% confidence intervals. Statistically significant estimates are indicated by this ■ symbol.

Figure 2.6: The effect of the UCCB on child food insecurity (difference-in-differences estimates) using categorical measure across income deciles



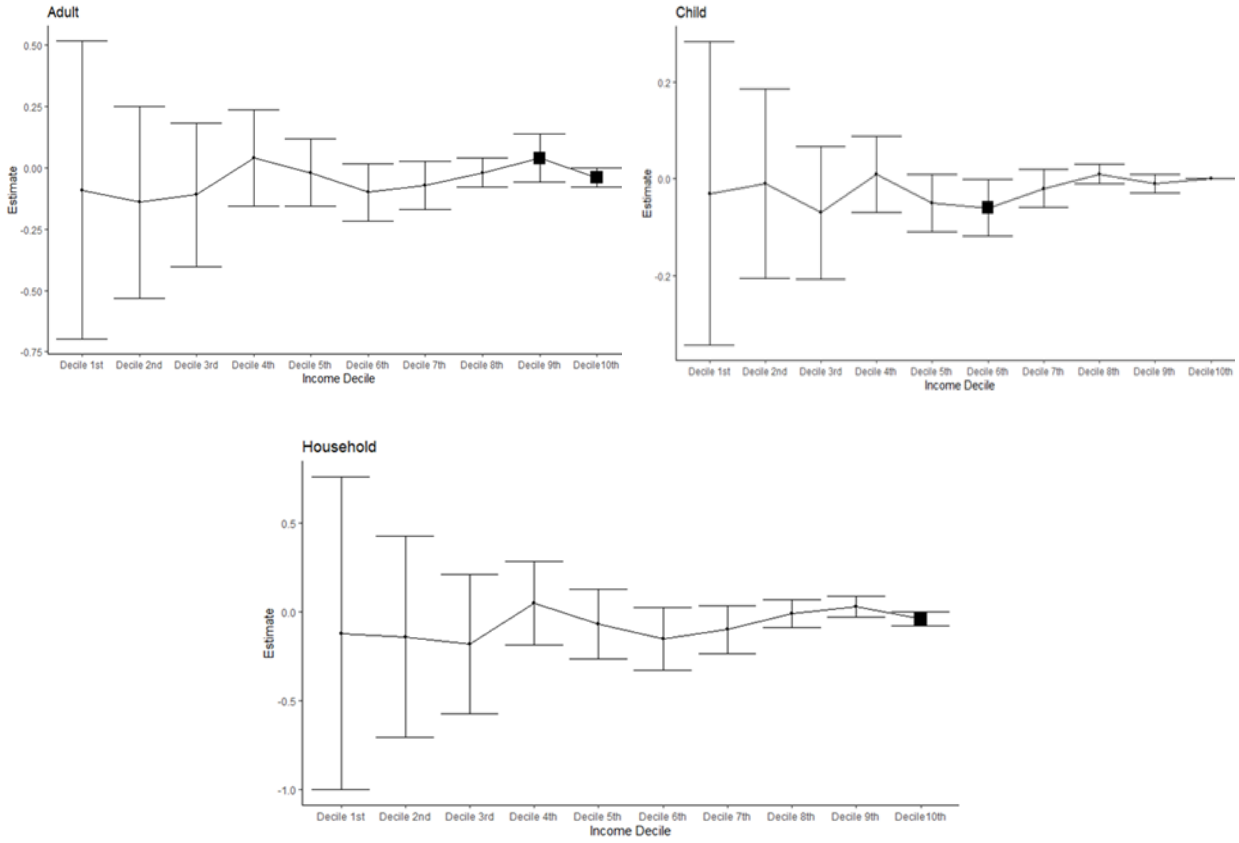
Note: The points in the figure represent the difference-in-differences estimates and the bars show 95% confidence intervals. Statistically significant estimates are indicated by this ■ symbol.

Figure 2.7: The effect of the UCCB on household food insecurity (difference-in-differences estimates) using categorical measure across income deciles



Note: The points in the figure represent the difference-in-differences estimates and the bars show 95% confidence intervals. Statistically significant estimates are indicated by this ■ symbol.

Figure 2.8: The effect of the UCCB on food insecurity (difference-in-differences estimates) using continuous measure across income deciles



Note: The points in the figure represent the difference-in-differences estimates and the bars show 95% confidence intervals. Statistically significant estimates are indicated by this ■ symbol.

Our findings based on the median income indicate that the UCCB had a statistically significant effect on food insecurity for households with income at or above the median. Like our other subgroups, we notice a similar pattern in terms of the sign and magnitude of estimates for those with below the median, however, without statistical significance. For those at or above the median, the policy increased the probability of child food security by 1.12 percentage points and decreased the likelihood of marginal and moderate child food insecurity by 0.61 and 0.49 percentage points, respectively (Table 2.5). The results from the continuous measure provide additional support for this finding. Specifically, estimates from Table 2.6 indicate that the UCCB

reduced food insecurity by 0.02 and 0.06 units (50% and 40% relative to the mean scores) at the child and household levels, respectively.

However, looking at the impact of the policy across the income deciles, we find mixed patterns. In general, at the adult level, we observe that at the lower end of the distribution (from 1st to 3rd decile) the UCCB increased the probability of being food secure and decreased the probability of being marginally, moderately, or severely food insecure. However, the effects are not statistically significant and very small in magnitude. Moreover, we find an opposite effect for adults from households at the upper end of the income distribution (9th decile). At the child level, we do not find any systematic patterns. At some points of the income distribution, the UCCB had a positive effect on child food insecurity, while at other points the policy had a negative effect. Like the results for adults, most of the estimates at the child level are statistically insignificant, except for an observed significant effect for households in the 6th decile. At the household level, the effects generally seem to follow a similar pattern as observed at the adult level (i.e., increased probability of being food secure and decreased likelihood of being food insecure at the lower end of the distribution, and the opposite in the 9th decile). Overall, the difference-in-differences estimates shown in Table 2.7 and Figures 2.5-2.7 are small in magnitude with large confidence intervals, making the results statistically insignificant and indicating that the income transfer likely did not have a different impact across income deciles.

Using the continuous food insecurity measures, we again do not find statistically significant differences across income deciles (Table 2.8 and Figure 2.8). In line with our categorical estimates, we do not observe any systematic patterns in the direction of the effects, and the effect sizes are small with large overlapping confidence intervals. In general, the policy seems to affect households

below versus above median income differently, with large variations for households in the lower end of the distribution (Figure 2.8).

2.5. Discussion

With a goal to assist policymakers in developing more targeted and effective policy interventions to help mitigate the occurrence and severity of food insecurity, studies have continued to examine the average effects of policy changes as well as potential heterogeneous impacts across subgroups differentiated based on several socio-economic and demographic features including family type, income, homeownership, main source of income and social assistance receipts (Brown & Tarasuk, 2019; Ionescu-Ittu et al., 2015; Li et al., 2016; Loopstra et al., 2015; McIntyre et al., 2016). This chapter adds to the existing literature by examining the heterogeneous impacts of the UCCB on food insecurity within households (i.e., separately at the adult, child, and household levels) across subpopulations stratified on the basis of living arrangements, educational attainment and income.

Our findings from subgroup analyses suggest that the income transfer did have differential effects on food insecurity across different population groups. We find that the UCCB had a statistically significant impact, especially on child food insecurity, among two-parent households, households with secondary education as the highest attainment and households with income at or above the median income threshold. For example, for two-parent households, the UCCB reduced the likelihood of marginal, moderate, and severe child food insecurity by 0.75, 0.90 and 0.06 percentage points, respectively. When measured using continuous scales, child food insecurity decreased by around 33.33% relative to the mean score, for these households in the post-UCCB period. Similarly, the UCCB decreased the probability of experiencing marginal, moderate, and severe child food insecurity by 1.97, 3.36 and 0.31 percentage points, respectively, among

households with secondary education. When differentiated based on income, our results indicate that the policy impacted those below the median and at or above the median income differently. Specifically, it reduced the probability of marginal, and moderate food insecurity among children by 0.61 and 0.49 percentage points. However, we could not detect statistically significant differential effects of the policy on food insecurity across income deciles. Our estimates from subsamples categorized based on income deciles have comparatively smaller sample sizes and large overlapping confidence intervals, making those estimates likely to be statistically insignificant in most instances.

Our results from this chapter offer fairly different insights from previous literature findings on the heterogeneity of public policy implications for food insecurity. In general, past studies found stronger effects of policy interventions among vulnerable subgroups (i.e., low-income households, and single-parent families) (Brown & Tarasuk, 2019; Ionescu-Ittu et al., 2015). But our heterogeneity analysis reports statistically significant effects for households comparatively less vulnerable to food insecurity (such as two-parent households, households with income at or above the median). Though we do not have a formal assessment of possible mechanisms that could have driven these findings, one possible explanation for these results could be that the benefit amount from the UCCB was not sufficiently large enough to provide adequate support for the relatively vulnerable groups. Also, our estimates tend to indicate that there were considerable variations in terms of policy impact within these comparatively susceptible groups (i.e., the policy likely did not have a similar effect for all single-parent households, or all households in the lowest income decile).

2.5.1. Limitations

In addition to the limitations discussed in Chapter 1, this study is subject to some further constraints. First, we estimate the heterogeneous effects by running separate regressions for each of our population subgroups. This led us to comparatively small sample sizes for some of the subgroup analyses and it was difficult to analyze the differential effect of the policy (for example, our regression model for categorical child food insecurity for households in the 10^{th} income decile did not converge). Another limitation is that we do not have exact information on household income. The total household income is reported as a categorical variable in the public-use microdata files of the CCHS. From that given information, we constructed a quasi-continuous income measure (detailed in section 1.4.4.). Exact information on household income would have lent more rigor in our income heterogeneity analysis.

2.6. Conclusion

Interest in different levels of government (i.e., federal, provincial, municipal) social and economic policy changes in relation to food insecurity are growing noticeably in different countries. Given the sharp disparities in food insecurity prevalence across different population groups, it is important to continue considering the differential effects in addition to the average effects while assessing the impact of public policy interventions. Our study provides additional empirical evidence on the heterogeneous impact of income-based policy intervention, both *within and across* households.

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APPENDIX A

HOUSEHOLD FOOD SECURITY MODULE SURVEY QUESTIONS

The following questions are asked to the person most knowledgeable in the household in a skip pattern about the experiences of income-related food insecurity among adults and children (if present) in their household.

Q1: You and other household members worried that food would run out before you got money to buy more. Was that often true, sometimes true, or never true in the past 12 months?

Q2: The food you and other household members bought just didn't last, and there wasn't any money to get more. Was that often true, sometimes true, or never true in the past 12 months?

Q3: You and other household members couldn't afford to eat balanced meals. In the past 12 months was that often true, sometimes true, or never true?

Q4: You or other adults in your household relied only on a few kinds of low-cost food to feed the children because you were running out of money to buy food. Was that often true, sometimes true, or never true in the past 12 months?

Q5: You or other adults in your household couldn't feed the children a balanced meal because you couldn't afford it. Was that often true, sometimes true, or never true in the past 12 months?

Q6: The children were not eating enough because you or other adults in your household just couldn't afford enough food. Was that often true, sometimes true, or never true in the past 12 months?

Q7: In the past 12 months, did you or other adults in your household ever cut the size of your meals or skip meals because there wasn't enough money for food?

Q8: How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

Q9: In the past 12 months, did you (personally) ever eat less than you felt you should because there wasn't enough money to buy food?

Q10: In the past 12 months, were you (personally) ever hungry but didn't eat because you couldn't afford enough food?

Q11: In the past 12 months, did you (personally) lose weight because you didn’t have enough money for food?

Q12: In the past 12 months, did you or other adults in your household ever not eat for a whole day because there wasn’t enough money for food?

Q13: How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

Q14: In the past 12 months, did you or other adults in your household ever cut the size of any of the children’s meals because there wasn’t enough money for food?

Q15: In the past 12 months, did any of the children ever skip meals because there wasn’t enough money for food?

Q16: How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

Q17: In the past 12 months, were any of the children ever hungry but you just couldn't afford more food?

Q18: In the past 12 months, did any of the children ever not eat for a whole day because there wasn’t enough money for food?

APPENDIX B

SUMMARY OF PAST RESEARCH ON FOOD INSECURITY AND HEALTH

Table B.1: Summary of research findings from literature on food insecurity and health for adults

Author & Year	Measure of Food Insecurity	Key Outcome of Interest
Rose & Oliveira (1997)	Self-reported household food insufficiency	Nutrient intake
Tarasuk & Beaton (1999)	Household food insecurity	Nutritional adequacy
Tarasuk (2001)	Household food insecurity with hunger	Food intake patterns among women
Kirkpatrick and Tarasuk (2008)	Household food insecurity	Nutrient inadequacy among Canadian adults and adolescents
Towsend et al. (2001)	Household food insecurity	Overweight status in women
Rainville & Brink (2001)	Food insecurity measured based on three screening questions	Causes, consequences and coping strategies associated with food insecurity
Jones & Frongillo (2007)	Household food insecurity based on 18-item questionnaire	Body mass index and weight gain among women
Vozoris and Tarasuk (2003)	Household food insufficiency based on three questions	Physical, mental and social health
Domingo et al. (2020)	Household food insecurity	Obesity
Gregory & Coleman-Jensen (2017)	Household food insecurity	Chronic disease and health among working-age adults
Te Vazquez et al. (2021)	Dichotomous and categorical measures of food insecurity	Cardiometabolic conditions
Tait et al. (2018)	Household food insecurity based on 18-item questionnaire	Type-2 diabetes

Table B.1 (continued)

Author & Year	Measure of Food Insecurity	Key Outcome of Interest
Gucciardi et al. (2009)	Household food insecurity	Diabetes
Chan et al. (2015)	Household food insecurity	Management of Diabetes
Gundersen et al. (2018)	Household food insecurity based on 18-item questionnaire	All-cause mortality
Men et al. (2020)	Household food insecurity based on 18-item questionnaire	All-cause and cause-specific premature mortality
Tarask et al. (2015)	Household food insecurity	Annual health care costs
Muldoon et al. (2013)	Household food insecurity based on 18-item questionnaire	Mental illness
Martin et al. (2016)	Household food insecurity based on 10-item module	Self-reported mental illness
Davison & Kaplan (2015)	Food insecurity measured based on two screening questions	Nutritional and psychological health among those with mood disorders
Davison et al. (2015)	Household food insecurity based on 18-item questionnaire	Suicidal ideation
Jessiman-Perreault & McIntyre (2017)	Categorical household food insecurity based on 18-item questionnaire	Mental health outcomes among Canadian Adults
Tarasuk et al. (2018)	Household food insecurity based on 18-item questionnaire	Mental health care service utilization
Siefert et al. (2001)	Food insufficiency	Physical and mental health among low-income women
Siefert et al. (2004)	Food insufficiency	Physical and mental health
Pound & Chen (2021)	Household food insecurity based on 18-item questionnaire	Self-reported poor/fair mental health in Canadian adults

Table B.2: Summary of research findings from literature on food insecurity and health for children

Author & Year	Measure of Food Insecurity	Key Outcome of Interest
Cook et al. (2004)	Household food insecurity	Health outcomes in young children
Cook et al. (2006)	Household and Child food insecurity	Child health
Gundersen & Kreider (2009)	Household food insecurity	Child health outcomes
Kirkpatrick et al. (2010)	A three-level variable measuring hunger	Six health outcomes including general health, chronic health conditions and asthma
Fram et al. (2015)	Self-reported child food insecurity based on 5 items module	Child diet and child physical activity
Metallinos-Katsaras et al. (2016)	Household food insecurity	Anemia incidents among low-income infants
Eicher-Miller et al. (2009)	Household and Child food insecurity scales	Iron deficiency anemia among children and adolescents
Skalicky et al. (2006)	Child food insecurity	Iron status in young children
Mangini et al. (2015)	Household food insecurity	Childhood asthma
South et al. (2019)	Household and Child food insecurity	High blood pressure among children and adolescents
Dubois et al. (2011)	Household food insecurity	Childhood overweight
Robson et al. (2017)	Food insecurity measured by a single item question	Cardiometabolic risk factors in adolescents
Chi et al. (2014)	Household food insecurity	Oral health in children
Cook et al. (2013)	Household food insecurity	Adverse health outcomes in young children and mothers

Table B.2 (continued)

Author & Year	Measure of Food Insecurity	Key Outcome of Interest
Cuba et al. (2018)	Household food insecurity	Hospital charges for infants
Borders et al. (2007)	Food insecurity	Low birth weight
Carmichael et al. (2007)	Maternal food insecurity	Risks of birth defects
Huang et al. (2010)	Household food insecurity	Child behavior
Johnson & Markowitz (2018)	Household food insecurity	Children's kindergarten skills
Melchior et al. (2012)	Household food insecurity	Children's mental health
Whitaker et al. (2006)	Adult food insecurity	Depression and anxiety among mothers and behavior problems in preschool-aged children
McIntyre et al. (2013)	Child hunger	Depression and suicidal ideation in late adolescent and early adulthood
McLaughlin et al. (2012)	Food insecurity	Mental disorders in adolescents
Faught et al. (2017)	Household food insecurity	Academic achievement in school-aged children
Howard (2011)	Household food insecurity	Children's non-cognitive performance
Weinreb et al. (2002)	Hunger	Children's physical and mental health
Zaslow et al. (2009)	Household food insecurity	Attachment and mental proficiency in toddlerhood

APPENDIX C

FULL SET OF ORDINARY LEAST SQUARES REGRESSION COEFFICIENTS

Table C.1: Full set of ordinary least squares regression coefficients for continuous food insecurity outcomes

	Adult Food Insecurity Scale	Child Food Insecurity Scale	Household Food Insecurity Scale
Treat	-0.023	-0.003	-0.026
	(0.034)	(0.017)	(0.048)
Post-Policy	0.007	0.004	0.011
	(0.046)	(0.023)	(0.066)
Treat* Post-Policy	-0.057	-0.035*	-0.092
	(0.042)	(0.021)	(0.059)
Age 30 to 34 Years	-0.071**	0.020	-0.052
	(0.035)	(0.015)	(0.046)
Age 35 to 39 Years	-0.071*	0.029*	-0.041
	(0.036)	(0.016)	(0.049)
Age 40 to 44 Years	-0.076*	0.037**	-0.039
	(0.039)	(0.019)	(0.054)
Age 45 to 49 Years	-0.073	0.036	-0.036
	(0.049)	(0.025)	(0.069)
Female	0.088***	0.048***	0.136***
	(0.019)	(0.009)	(0.027)
Immigrant	-0.214***	-0.051***	-0.265***
	(0.037)	(0.016)	(0.050)
Visible Minority	0.050	0.065***	0.115**
	(0.042)	(0.018)	(0.057)
Single-Parent	0.378***	0.243***	0.621***
	(0.086)	(0.042)	(0.122)
Less than Secondary	0.121	0.123**	0.243
	(0.110)	(0.054)	(0.153)
Post-Secondary	-0.088**	-0.016	-0.104*
	(0.040)	(0.019)	(0.055)
Other as Main Source of Income	0.793***	0.312***	1.106***
	(0.097)	(0.047)	(0.136)
Homeownership	-0.419***	-0.150***	-0.569***
	(0.038)	(0.018)	(0.053)

Table C.1 (continued)

Three-Person Household	0.244**	0.203***	0.447***
	(0.101)	(0.048)	(0.141)
Four-Person Household	0.195*	0.211***	0.406***
	(0.105)	(0.050)	(0.146)
Five or More Person-Household	0.275**	0.286***	0.560***
	(0.112)	(0.054)	(0.156)
Log of Real Equivalent Household Income	-0.681***	-0.272***	-0.953***
	(0.040)	(0.019)	(0.056)
Provincial Unemployment Rate	-0.007	0.003	-0.004
	(0.012)	(0.006)	(0.017)
Annual Average All-Items Consumer Price Index	-0.001	-0.000	-0.001
	(0.004)	(0.002)	(0.006)
Nova Scotia	0.124**	0.028	0.152*
	(0.061)	(0.026)	(0.081)
Quebec	-0.193***	-0.045***	-0.238***
	(0.026)	(0.013)	(0.037)
Alberta	-0.024	0.012	-0.012
	(0.052)	(0.026)	(0.073)
British Columbia	-0.059*	-0.032**	-0.091**
	(0.032)	(0.015)	(0.044)
Observations	46,233	46,233	46,233

Note: Normalized sampling weights are used in all regressions. We include all covariates in each regression. Standard errors are reported in parentheses. Statistical significance is given by: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

APPENDIX D

ADJUSTED PREDICTED PROBABILITIES OF CATEGORICAL FOOD INSECURITY

Table D.1: Adjusted predicted probabilities of categorical food insecurity by living arrangements

	Single-Parent Households (n=6,225)				Two-Parent Households (n=40,008)			
	Treatment Group		Control Group		Treatment Group		Control Group	
	Pre-Policy	Post-Policy	Pre-Policy	Post-Policy	Pre-Policy	Post-Policy	Pre-Policy	Post-Policy
Adult								
Food Secure	62.80 (3.00)	70.66 (1.52)	63.88 (2.96)	68.28 (1.51)	89.31 (0.65)	90.59 (0.33)	88.40 (0.84)	88.57 (0.54)
Marginally Food Insecure	8.36 (0.71)	7.42 (0.61)	8.25 (0.69)	7.74 (0.61)	4.10 (0.25)	3.69 (0.17)	4.39 (0.30)	4.33 (0.23)
Moderately Food Insecure	16.38 (1.29)	13.40 (0.85)	15.99 (1.29)	14.34 (0.90)	5.13 (0.36)	4.50 (0.20)	5.58 (0.44)	5.50 (0.29)
Severely Food Insecure	12.45 (1.76)	8.52 (0.84)	11.87 (1.73)	9.64 (0.87)	1.46 (0.14)	1.22 (0.09)	1.63 (0.18)	1.59 (0.14)
Child								
Food Secure	69.67 (2.94)	78.44 (1.42)	68.76 (3.00)	75.54 (1.35)	93.50 (0.59)	94.82 (0.26)	93.48 (0.63)	93.09 (0.44)
Marginally Food Insecure	11.16 (0.94)	8.94 (0.68)	11.36 (0.96)	9.74 (0.73)	3.22 (0.28)	2.63 (0.15)	3.23 (0.30)	3.39 (0.23)
Moderately Food Insecure	17.66 (2.04)	11.91 (1.05)	18.27 (2.06)	13.78 (1.00)	3.14 (0.33)	2.45 (0.17)	3.15 (0.35)	3.36 (0.26)
Severely Food Insecure	1.51 (0.46)	0.72 (0.16)	1.61 (0.49)	0.94 (0.20)	0.14 (0.03)	0.10 (0.02)	0.14 (0.04)	0.16 (0.03)
Household								
Food Secure	59.95 (3.01)	68.34 (1.59)	61.66 (2.92)	66.12 (1.50)	88.47 (0.67)	89.68 (0.34)	87.31 (0.85)	87.31 (0.56)
Marginally Food Insecure	9.44 (0.71)	8.44 (0.62)	9.26 (0.69)	8.74 (0.62)	4.72 (0.27)	4.30 (0.18)	5.11 (0.33)	5.11 (0.25)
Moderately Food Insecure	17.87 (1.33)	14.61 (0.91)	17.23 (1.30)	15.51 (0.93)	5.35 (0.36)	4.77 (0.20)	5.92 (0.44)	5.92 (0.29)
Severely Food Insecure	12.75 (1.77)	8.61 (0.84)	11.84 (1.69)	9.63 (0.86)	1.45 (0.14)	1.25 (0.09)	1.66 (0.18)	1.66 (0.14)

Note: Normalized sampling weights are used in all regressions. We include all covariates in each regression. Standard errors are reported in parentheses.

Table D.2: Adjusted predicted probabilities of categorical food insecurity by highest educational attainment in the household

	Less than Secondary Education (n= 1,329)				Secondary Education (n=5,388)				Post-Secondary Education (n=39,516)			
	Treatment Group		Control Group		Treatment Group		Control Group		Treatment Group		Control Group	
	Pre-Policy	Post-Policy	Pre-Policy	Post-Policy	Pre-Policy	Post-Policy	Pre-Policy	Post-Policy	Pre-Policy	Post-Policy	Pre-Policy	Post-Policy
Adult												
Food Secure	63.13 (5.41)	67.23 (2.71)	58.54 (5.64)	61.38 (3.67)	76.86 (2.18)	79.50 (1.28)	76.56 (2.65)	77.20 (1.63)	88.80 (0.70)	90.53 (0.33)	88.27 (0.83)	88.90 (0.52)
Marginally Food Insecure	9.88 (1.57)	9.32 (1.35)	10.38 (1.57)	10.09 (1.49)	7.55 (0.72)	6.93 (0.60)	7.62 (0.82)	7.47 (0.63)	4.05 (0.25)	3.51 (0.16)	4.21 (0.29)	4.02 (0.23)
Moderately Food Insecure	17.81 (2.62)	15.98 (1.90)	19.76 (2.68)	18.57 (2.30)	10.78 (1.10)	9.57 (0.72)	10.92 (1.29)	10.63 (0.89)	5.34 (0.38)	4.50 (0.20)	5.60 (0.43)	5.29 (0.27)
Severely Food Insecure	9.17 (2.63)	7.46 (1.22)	11.32 (3.12)	9.96 (1.74)	4.80 (0.76)	4.00 (0.42)	4.90 (0.88)	4.70 (0.60)	1.82 (0.18)	1.45 (0.11)	1.93 (0.21)	1.79 (0.15)
Child												
Food Secure	75.70 (5.32)	73.90 (2.73)	71.67 (5.32)	68.01 (3.96)	76.10 (2.19)	78.04 (1.32)	74.78 (2.68)	75.12 (1.70)	87.77 (0.72)	89.60 (0.34)	87.12 (0.85)	87.74 (0.53)
Marginally Food Insecure	10.56 (2.12)	11.09 (1.55)	11.70 (2.05)	12.61 (1.75)	8.10 (0.74)	7.64 (0.62)	8.40 (0.85)	8.33 (0.66)	4.76 (0.28)	4.16 (0.18)	4.97 (0.32)	4.77 (0.25)
Moderately Food Insecure	12.92 (3.35)	14.06 (2.11)	15.50 (3.57)	17.89 (3.12)	11.26 (1.13)	10.34 (0.76)	11.88 (1.32)	11.72 (0.95)	5.63 (0.38)	4.76 (0.21)	5.93 (0.43)	5.64 (0.28)
Severely Food Insecure	0.81 (0.49)	0.95 (0.31)	1.13 (0.58)	1.49 (0.52)	4.54 (0.72)	3.98 (0.42)	4.94 (0.87)	4.83 (0.61)	1.84 (0.18)	1.48 (0.11)	1.98 (0.20)	1.85 (0.15)
Household												
Food Secure	63.11 (5.41)	64.85 (2.77)	58.55 (5.69)	57.96 (3.67)	76.10 (2.19)	78.04 (1.32)	74.78 (2.68)	75.12 (1.70)	87.77 (0.72)	89.60 (0.34)	87.12 (0.85)	87.74 (0.53)
Marginally Food Insecure	10.31 (1.58)	10.07 (1.38)	10.84 (1.58)	10.90 (1.52)	8.10 (0.74)	7.64 (0.62)	8.40 (0.85)	8.33 (0.66)	4.76 (0.28)	4.16 (0.18)	4.97 (0.32)	4.77 (0.25)
Moderately Food Insecure	18.22 (2.71)	17.42 (2.01)	20.27 (2.80)	20.52 (2.43)	11.26 (1.13)	10.34 (0.76)	11.88 (1.32)	11.72 (0.95)	5.63 (0.38)	4.76 (0.21)	5.93 (0.43)	5.64 (0.28)
Severely Food Insecure	8.35 (2.47)	7.66 (1.24)	10.34 (2.96)	10.62 (1.77)	4.54 (0.72)	3.98 (0.42)	4.94 (0.87)	4.83 (0.61)	1.84 (0.18)	1.48 (0.11)	1.98 (0.20)	1.85 (0.15)

Note: Normalized sampling weights are used in all regressions. We include all covariates in each regression. Standard errors are reported in parentheses.

Table D.3: Adjusted predicted probabilities of categorical food insecurity by median income

	Households with Below Median Income (n=16,623)				Households with equal to or above Median Income (n=29,610)			
	Treatment Group		Control Group		Treatment Group		Control Group	
	Pre-Policy	Post-Policy	Pre-Policy	Post-Policy	Pre-Policy	Post-Policy	Pre-Policy	Post-Policy
Adult								
Food Secure	73.58 (1.45)	76.32 (0.77)	72.22 (1.77)	73.48 (1.16)	95.25 (0.58)	96.31 (0.25)	94.65 (0.70)	95.02 (0.38)
Marginally Food Insecure	8.14 (0.44)	7.58 (0.36)	8.40 (0.49)	8.16 (0.43)	2.31 (0.27)	1.85 (0.13)	2.57 (0.32)	2.41 (0.19)
Moderately Food Insecure	13.09 (0.80)	11.75 (0.48)	13.75 (0.93)	13.14 (0.64)	2.02 (0.27)	1.54 (0.13)	2.29 (0.32)	2.12 (0.19)
Severely Food Insecure	5.19 (0.51)	4.35 (0.29)	5.62 (0.62)	5.22 (0.42)	0.42 (0.09)	0.30 (0.05)	0.49 (0.10)	0.45 (0.07)
Child								
Food Secure	81.22 (1.42)	85.15 (0.66)	79.80 (1.61)	82.18 (0.98)	97.90 (0.42)	98.40 (0.16)	98.00 (0.39)	97.39 (0.29)
Marginally Food Insecure	8.21 (0.54)	6.85 (0.34)	8.67 (0.60)	7.89 (0.46)	1.26 (0.26)	0.98 (0.10)	1.20 (0.23)	1.53 (0.17)
Moderately Food Insecure	10.03 (0.93)	7.65 (0.45)	10.91 (1.04)	9.44 (0.63)	0.82 (0.18)	0.61 (0.09)	0.78 (0.16)	1.05 (0.15)
Severely Food Insecure	0.54 (0.11)	0.34 (0.06)	0.62 (0.13)	0.49 (0.08)	0.03 (0.02)	0.02 (0.01)	0.02 (0.02)	0.04 (0.02)
Household								
Food Secure	71.90 (1.46)	74.19 (0.79)	70.18 (1.78)	70.99 (1.17)	94.68 (0.62)	95.92 (0.26)	93.96 (0.73)	94.40 (0.40)
Marginally Food Insecure	9.24 (0.46)	8.75 (0.38)	9.59 (0.51)	9.43 (0.45)	2.76 (0.31)	2.18 (0.15)	3.08 (0.36)	2.89 (0.22)
Moderately Food Insecure	13.75 (0.80)	12.62 (0.50)	14.59 (0.94)	14.20 (0.65)	2.14 (0.28)	1.60 (0.13)	2.46 (0.33)	2.27 (0.20)
Severely Food Insecure	5.10 (0.49)	4.43 (0.29)	5.64 (0.61)	5.38 (0.41)	0.42 (0.08)	0.29 (0.04)	0.50 (0.10)	0.45 (0.07)

Note: Normalized sampling weights are used in all regressions. We include all covariates in each regression. Standard errors are reported in parentheses.

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Prianka Maria Sarker was born in Khulna, Bangladesh on January 22, 1992. She completed her high school from Holy Cross Girls' High School and College in 2010. She attended Stamford University Bangladesh and graduated with a Bachelor of Social Science in Economics in 2015. She received the Chancellor's Award for Academic Excellence during her undergraduate program. She completed her MBA degree with a major in Finance in 2018 from the University of Dhaka. Prianka is a candidate for the Master of Science degree in Economics from the University of Maine in August 2022.