

Effectiveness of a Sliding Scale Payment Model at a Community Food Market to Reduce Customer Food Insecurity Status

Maiya Ahluwalia¹, Heidi Emery¹, Nicole Steadman¹, David M. Beauchamp², Rachel K. von Holt², Nadia M. Cartwright², Elaina B.K. Brendel², Jennifer M. Monk^{2,*}

¹Department of Family Relations and Applied Nutrition, University of Guelph, Guelph ON, Canada

²Department of Human Health and Nutritional Sciences, University of Guelph, Guelph ON, Canada

*Corresponding author: jmonk02@uoguelph.ca

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Abstract Food insecurity is a global public health challenge, with those affected having inadequate or insecure access to food due to financial constraints. This study determined the effectiveness of reducing community food insecurity by implementing a sliding scale payment model approach at a local community food market in Guelph ON, Canada. In this payment model, fresh produce could be purchased at the market within a price range along a sliding scale, wherein lower income customers can confidentially select to pay prices at the lower end of the payment scale, whereas those with higher household incomes can select to pay the higher payment option. In this pilot study, customers of the community food market (n=119) were surveyed to determine their food insecurity status both prior to and after regularly shopping at the food markets, and how using the sliding scale payment model impacted their access to affordable produce. Market attendance was shown to reduce customers self-reported indicators of food insecurity ($P < 0.05$). Additionally, customer household income levels were correlated with the price they paid along the sliding scale; wherein lower and higher income households paid for produce at a corresponding level on the payment scale. These results demonstrate that the sliding scale payment model is supported by the community across household income levels and was successful at reducing customer food insecurity. This model could be implemented in other communities to reduce food insecurity.

Keywords: food insecurity, community food markets, sliding scale payment, community nutrition

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1. Introduction

Food insecurity refers to the inadequate or insecure access to food due to financial constraints [1]. The severity of food insecurity ranges between marginal, moderate, and severe, and the persistence, duration and severity of food insecurity can fluctuate depending on financial inconsistency and insufficiency [1]. Marginal food insecurity is associated with the uncertainty of access to food; moderate food insecurity includes a conscious compromise of food quality and/or quantity; and severe food insecurity involves a change in eating patterns including, but not limited to, missing meals, stretching out meals despite not meeting daily caloric requirements and ignoring hunger cues [1]. Food insecurity is a social determinant of health and the impact on individuals and households can extend from compensatory strategies involving material deprivation and compromised spending on other necessities including housing and medications

[2,3] to increased risk of serious health complications [1,4,5] and premature death [6,7]. Food insecurity is a global public health issue, wherein in 2020 1 in 3 people (equivalent to 2.37 billion individuals) did not have adequate access to food and 12% of the global population was severely food insecure [8]. Food insecurity prevalence is also increasing in developed countries, including Canada [1,9,10]. In 2021 15.9% of households within the ten provinces of Canada were found to experience some level of food insecurity within the past year, which is equivalent to 5.8 million people, which includes 1.4 million children under 18 years of age [1]. The prevalence of food insecurity varies across the provinces with the highest prevalence reported in the province of Alberta (20.3% of households experiencing food insecurity) and does not include individuals living in the northern territories of Canada or on Indigenous reservations, wherein previous studies have demonstrated these communities experience high vulnerability to food insecurity [11-12]. In this connection, data from the three northern Canadian territories does not include marginal

food insecurity status, however, the prevalence of moderately to severely food insecure households in this region ranged between 15.3% to 46.1%, highlighting the additional challenges experienced by individuals living in northern communities [13].

As an under-recognized social determinant of health, food insecurity contributes both directly and indirectly to the well-being of those affected, as well as the social system in which they exist, extending beyond nutritional vulnerability [14]. There is a positive association between food insecurity and mortality risk, with the most severely impacted food insecure individuals experiencing the greatest mortality risk [7]. Household food insecurity is associated with many indicators of poor health status [15] including diabetes [16,17,18], heart disease [16,18,19], and hyperlipidemia [20]. Similarly, both adults [21,22] and children [23] experiencing food insecurity are at a greater risk of experiencing mental illness; particularly anxiety, depression, and suicidal indicators [24,25]. This may be in part, due to the exacerbating effects of worrying about access to food [26], inadequate nutrient intakes [27], and/or poor sleep [28]. Food insecurity is also associated with less successful disease management [29,30,20], greater disease severity [31], increased need to access health care [32], and consequently, increased health care costs [14,32], collectively highlighting the burden of food insecurity at the individual and community level.

There are two classifications of community hunger alleviation interventions that address food insecurity, which can be successful in decreasing participants short-term food insecurity, however, utilize different approaches [33,34]. Traditional interventions, such as food banks and soup kitchens, aim to eliminate the immediate need for food by focusing on short-term food distribution and food insecurity relief, providing much needed relief to address the immediate needs of households or individuals experiencing hunger [35,36]. Traditional interventions can lack food diversity, failing to provide an optimal panel of macronutrients and micronutrients to clients, which reduces the health benefits associated with these services [37]. Approximately 20-30% of food insecure individuals report utilizing food bank services, which can limit the ability of these services to adequately reach and support the vulnerable food insecure population, and they still do not address the underlying causes of food insecurity, such as income insecurity [3,36]. Alternative interventions, such as community gardens and kitchens, amongst others, orient their mission around improving food insecurity through the empowerment of participants to develop skills, knowledge and resources to help secure their own food security and/or address directly or advocate for policy changes to address the underlying causes of food insecurity [33,35,36]. Alternative or complimentary options providing access to food beyond food banks that increase accessibility to food and alleviate the severity or frequency of food insecurity are needed, which has been highlighted during the COVID-19 pandemic. Evidence from studies conducted in Canada indicated that food insecurity risk increased in some of the most vulnerable segments of the population including households with children, adult members lost employment or adult members were job insecure [38], with similar findings reported in the United States [39,40]. Thus, there is a need

for strategic implementation of resources to reduce food insecurity prevalence by providing lower cost foods, while simultaneously increasing access to a variety of nutritious types of food.

Among food markets, past strategies have utilized payment optional or no-cost models to try and reduce food insecurity; however, a significant challenge with these approaches is their long-term sustainability [41]. Subsidies for farmer's markets have been successful in reducing food insecurity status by providing a reduced produce cost for lower-income individuals [42], although the long-term sustainability is often dependent upon external and/or government funding [43]. Additionally, local selling of produce directly from farmers/producers to consumers (e.g., roadside stands) generally offer fresher produce options and tend to be associated with lower consumer costs as there are cost savings on transportation within the supply chain [43,44]. The sustainability of local produce distribution is dependent on both accessibility and consumer support and commitment [43,45]. Therefore, novel, and sustainable approaches to reduce community food insecurity are required. The objective of this study was to determine the effectiveness of a sliding scale payment model implemented at a local community food market to reduce customers experience of several food insecurity indicators in an economically sustainable manner.

2. Materials and Methods

2.1 Community Food Market, Participant Recruitment and Study Design

The community food market utilized in this study was located within Ontario, Canada and aimed to reduce local food insecurity by increasing the physical and financial accessibility of local in-season fresh produce. To reduce the stigma associated with accessing food assistance programs or the payment deferral and sacrificial strategies sometimes employed by food insecure individuals to afford and access food [3,46,47], the market utilized a novel sliding scale payment method, wherein the highest price point for produce equated to premium retail value and the lowest price point equated to the wholesale cost (approximately 30-50% below retail cost). With produce priced on a sliding scale, customers use a confidential check out and have the option to pay whatever amount they can afford within the given range of pricing options on the sliding scale. Therefore, customers from all income levels can shop at the same community food market.

This study was conducted prior to the COVID-19 pandemic, wherein customers of the community food market were invited to complete a food insecurity survey (n=119 total participants) either in-person while attending the food market (survey completed on paper in a private room) or in an online survey hosted in Qualtrics (Qualtrics Insight Platform, Provo, UT, USA) through a private link in an email invitation using the markets online newsletter. Survey responses were kept confidential and participants were free to skip any questions they did not want to answer. Eligibility for participation consisted of any individual who was 18 years of age or older that was a current customer of the market. As an incentive for

participation, all in-person survey respondents received a \$10 gift card for the market that they could use personally or anonymously donate back to the market to support a food insecure customer. Online survey respondents were entered into a random draw to win a \$10 gift card to the market (odds of winning were 1 in 20). All participants gave informed consent, and this study was approved by the institutional Research Ethics Board (REB#18-12-024).

Survey questions pertaining to indicators of food insecurity were based on the past 12-month period and were adapted from the Household Food Security Survey Module within the Canadian Community Health Survey [48]. The survey consisted of questions pertaining to i) demographic information including number of people per household and annual household income, ii) indicators of food insecurity, iii) how customers utilized the sliding scale payment option, and iv) perceptions of the community environment generated at the market, which may act to eliminate the potential stigma associated with accessing community food programs [46,47]. Food security survey questions used in the current study are shown in **Appendix 1**. The frequency that participants experienced each food insecurity indicator was graded on a Likert scale of 1-4, wherein 1 = never, 2 = monthly, 3 = weekly and 4 = daily. Participants were asked to reflect upon their food insecurity experiences within the past 12 months prior to accessing the community food market and to indicate if those experiences had changed after they started and continued to access the markets.

2.2. Statistical Analysis

Statistical analysis was conducted using IBM SPSS Statistics software IBM SPSS Statistics for Macintosh, Version 26.0 (IBM Corp; Armonk, NY, USA) and GraphPad Prism (GraphPad Software, Inc., La Jolla, CA, USA). Correlation analyses were conducted to determine the relationship between demographic data, community food market payment option and food insecurity indicators. Paired student's t-tests were used to determine differences in food insecurity indicators before and after attending the community food market. A *P*-value of 0.05 was set to denote statistically significant differences.

3. Results

3.1. Demographics of the Study Participants

Demographic data pertaining to survey participants household income, age, and number of people per household is shown in **Table 1**. The average after-tax household income in Canada is \$61,400 [49] and 68.4% of customers reported household incomes that were below this level, with the largest percentage of participants (34.2%) reporting an annual income below \$20,000. Household income has been shown to be a robust predictor of food insecurity, wherein the probability of experiencing food insecurity decreases as after-tax household income rises [1]. Therefore, those in the lowest after-tax income brackets are at higher risk of experiencing moderate or severe forms of food insecurity [1]. All participants in this study were customers of the

community food market and represented a spectrum of household incomes i.e., both from lower and higher income levels and a range of ages including younger adults (18-25 years) to older adults (≥ 55 years). The number of people per household were predominantly single (33.6%) or double (29.4%) occupancy households.

Table 1. Participant demographic information

<i>Demographic Information</i>	<i>% of Participants</i>
<i>Annual Household Income</i>	
\$0 - \$19,999	31.9% (n=38)
\$20,000 - \$39,999	25.2% (n=30)
\$40,000 - \$59,999	6.7% (n=8)
\$60,000 - \$79,999	9.2% (n=11)
\$80,000 - \$100,000	5.9% (n=7)
\$100,000 +	14.3% (n=17)
<i>Unsure/Prefer not to say</i>	6.7% (n=8)
<i>People per Household</i>	
1	33.6% (n=40)
2	29.4% (n=35)
3	15.1% (n=18)
4	13.5% (n=16)
5	5.0% (n=6)
6+	3.4% (n=4)
<i>Frequency of Accessing the Community Food Market</i>	
1 visit per week	39.5% (n=47)
2-3 visits per month	17.6% (n=21)
1 visit per month	17.6% (n=21)
Occasionally (<1 visit per month)	25.2% (n=30)
<i>Sliding Scale Payment Preference</i>	
<i>Low (wholesale cost 30-50% below retail value)</i>	31.1% (n=37)
<i>Middle (mid-range retail value)</i>	37.8% (n=45)
<i>High (premium retail value)</i>	31.1% (n=37)

Percentages of survey participants divided into demographic sub-categories for average household income, age, and number of people per household (n=119).

In Canada, food insecurity rates are higher in single occupancy (i.e., unattached individuals living alone) compared to other household types, wherein 20.3% of single/unattached living alone households are food insecure versus 9.1% of households comprised of two adults with no children are food insecure [1]. No children were living in 75% of households included in this study, and within the 25% of households that did include children 30% of them, or 7.5% of households overall, were single-parent families, which have been shown to experience a higher prevalence of food insecurity compared to two adult households with children [1]. Participants frequency in accessing the community food market and their preferred selection for payment on the sliding scale are also shown in **Table 1**.

3.2 Effect of Accessing the Community Food Market on Indicators of Food Insecurity within the Study Population (Both Food Secure and Food Insecure Households)

The aim of the community food market is to improve access to fresh local produce by eliminating barriers, such as stigma, and higher food costs [46,47]. A majority of participants (61.4%) indicated that they were able to

purchase more fruits and vegetables as a direct result of accessing produce from the community food market. Furthermore, 80% of respondents reported feeling that they were now consuming enough fruits and vegetables to meet their dietary requirements in comparison to their experience prior to accessing the community food market.

To determine the effect of attending the community food market on customers' food insecurity status, participants were asked to reflect on their experiences with five key indicators of food insecurity [51] both before and after accessing the market. The food insecurity indicators included the impact of limited or insufficient financial means on i) worrying about running out of food, ii) food variety (i.e., limiting the variety or types of foods that could be purchased/acquired), iii) food quality (i.e., having to access lower nutritional quality foods in place of more nutritious or higher quality types of food), iv) food quantity (i.e., accessing smaller or insufficient quantities of food items than what is needed), and v) skipping/missing meals (i.e., intentionally missing meals and/or going without food) [51]. It is important to note that the market is attended and supported by customers that are food insecure as well as customers that are food secure, which supports the longer-term economic sustainability of the market. The results for each indicator of food insecurity for all survey participants (n=119) are shown in Table 2, along with a breakdown of the percentage of participants who i) never experienced any food insecurity indicators (i.e., are food secure), ii) identified as experiencing each indicator of food insecurity (before and after accessing the community food market), and iii) the percentage of participants who no longer experience the indicators of food insecurity as a result of accessing the market. Within the entire study population (that includes both food secure and food insecure individuals) as a result of accessing the community food market, there was a significant reduction in the percentage of individuals who reported no longer experienced worrying about running out of food (decreased by 21%), needing to limit the types of food accessed (decreased by 19.3%), or reducing the quantity

(decreased by 16.8%) and quality (decreased by 23.6%) of foods ($P<0.05$; Table 2).

Table 2. Changes in food insecurity indicators experienced by all survey respondents (both food secure and food insecure) before and after accessing the community food market

Food Insecurity Indicator	% Respondents Experiencing Each Food Insecurity Indicator			
	DO NOT experience	Experienced BEFORE using the market	Experienced AFTER using the market	NO LONGER experience after using the market
<i>Worry about running out of food</i>	63.9% (n=76)	36.1% (n=43)	15.1% (n=18)	21.0% (n=25)*
<i>Limiting the types of foods</i>	47.9% (n=57)	52.1% (n=62)	32.8% (n=39)	19.3% (n=23)*
<i>Reducing the quantity of food</i>	63.0% (n=75)	37.0% (n=44)	20.2% (n=24)	16.8% (n=20)*
<i>Reducing the quality of food</i>	57.1% (n=68)	42.9% (n=51)	19.3% (n=23)	23.6% (n=28)*
<i>Skip meals or go without food</i>	69.7% (n=83)	30.3% (n=36)	23.5% (n=28)	6.8% (n=8)

Data are presented as percentages (number of participants) for the frequency of experiencing each food insecurity parameter, which was graded on a Likert scale from 1-4 (1=never; 2=monthly; 3=weekly; 4=daily). Data are presented as participants not experiencing each food insecurity indicator (i.e., a score of 1 both before and after accessing the community food market) and the percentage of participants who identified experiencing some frequency of each food insecurity parameter i) before accessing the community food market (i.e., reflective of the food insecure proportion of survey participants), ii) remained/are still experiencing some degree of each food insecurity indicator after accessing the community food market, and iii) no longer experience each indicator of food insecurity. A statistically significant change ($P<0.05$) in the percentage of participants who no longer experience each food insecurity indicator compared to before using the market are denoted with an asterisk (*).

Table 3. Changes in food insecurity indicators experienced by only the food insecure survey respondents before and after accessing the community food market

Food Insecurity Indicator	Food Insecurity Frequency Score		Proportion of Respondents Experiencing Each Food Insecurity Indicator		
	Before using the market	After using the market	Experienced BEFORE using the market	Experienced AFTER using the market	NO LONGER experience after using the market
<i>Worry about running out of food</i>	2.70±0.11	1.42±0.08*	100% (n=43)	41.9% (n=18)	58.1% (n=25) ⁺
<i>Limiting food variety (i.e., the types of foods)</i>	2.82±0.10	1.63±0.06*	100% (n=62)	62.9% (n=39)	37.1% (n=23) ⁺
<i>Reducing the quantity of food</i>	2.68±0.11	1.51±0.07*	100% (n=44)	54.5% (n=24)	45.5% (n=20) ⁺
<i>Reducing the quality of food</i>	2.77±0.11	1.44±0.07*	100% (n=51)	45.1% (n=23)	54.9% (n=28) ⁺
<i>Skip meals or go without food</i>	2.78±0.14	1.85±0.07*	100% (n=36)	77.7% (n=28)	22.3% (n=8) ⁺

Data are means ± SEM for each food insecurity indicator assessed within the study participants who self-identified as experiencing some form of food insecurity prior to accessing the community food market. The frequency of experiencing each food insecurity indicator was graded on a Likert scale from 1-4 (1=never; 2=monthly; 3=weekly; 4=daily) and the number of participants who experienced each food insecurity indicator is shown i) before accessing the market, ii) since accessing the market and still experience this indicator of food insecurity, and iii) for those who no longer experience each food insecurity indicator since accessing the market. Statistically significant changes ($P<0.05$) in the frequency score for each food insecurity indicator experienced before and after accessing the community food market is denoted with an asterisk (*) and the percentage of participants who no longer experience each food insecurity indicator compared to before accessing the community food market is denoted with the cross symbol (+).

3.3. Effect of Accessing the Community Food Market on Households Experiencing Food Insecurity

Subsequently, we determined the influence of accessing the community food market within the food insecure proportion of the study population. Food insecurity status was based on respondents self-identified experience of any of the five food insecurity parameters prior to accessing the market, as shown in Table 3. Not all individuals who are food insecure will experience each of the five indicators simultaneously, therefore, the sample sizes for each food insecurity indicator are not equal but are also shown in the table. We determined the frequency of experiencing each food insecurity parameter (which ranged on scale from monthly to daily for the food insecure individuals) and compared this before and after using the community food market. The frequency of experiencing each of the five food insecurity indicators was significantly reduced after accessing the market ($P < 0.05$, Table 3), indicating that accessing the markets alleviated the frequency of all these food insecurity experiences.

To assess the magnitude of the impact of accessing the community food market on each food insecurity indicator, we determined the change in the proportion of survey participants who still experience each food insecurity indicator and those who no longer experience each food insecurity indicator after accessing the market. The proportion of food insecure survey participants who no longer experience each food insecurity indicator was significantly reduced by attending and accessing the community food market. Specifically, the percentage of food insecure survey participants who reported no longer experiencing worrying about running out of food was reduced by 58.1% and those no longer needing to limit the type/variety of foods they could afford to purchase was reduced by 37.1% ($P < 0.05$, Table 3) as a result of accessing the market. Similarly, the percentage of food insecure individuals that were required to reduce the quantity and quality of foods that could be purchased due to financial constraints decreased by 45.5% and 54.9%, respectively ($P < 0.05$, Table 3). Finally, the percentage of food insecure individuals who no longer experienced skipping meals or going without food since accessing the market was reduced by 22.3% ($P < 0.05$, Table 3). Interestingly, continuing to skip or miss meals since utilizing the community food market was positively correlated with the number of individuals per household ($r = 0.270$, $P = 0.04$), indicating that the strategy of skipping meals to mitigate food insecurity was still being utilized in households where there were more individuals to support. Moreover, within the 77.7% of participants that indicated that they continue to skip meals, 75% of them reported being able to purchase more fruits and vegetables from the community food market to help alleviate this issue. Collectively, these results show that access to fresh fruits and vegetables sold at the market helped to improve food security status and reduced the frequency of experiencing food insecurity indicators among those surveyed.

3.4. Effect of the Community Food Market on Food Insecurity Indicators in Families with Children

Food insecurity has a significant effect on overall family health and well-being, especially in families with younger children [47]. Therefore, we determined the impact of accessing the community food market on food insecurity status specifically within families, wherein 25% of survey respondents were from households with one or more children. Prior to accessing the Community Food Market in customers with families, household income level was positively correlated the frequency of i) worrying about running out of food due to financial constraints ($r = 0.362$, $P = 0.05$), ii) having to limit the types of foods that could be provided due to financial constraints ($r = 0.507$, $P = 0.005$), and iii) reducing the quantity of foods that could be provided due to financial constraints ($r = 0.384$, $P = 0.04$). Among the families that identified as food insecure, the percentage of participants who experienced worrying about running out of food and needing to limit the types of food they could afford to purchase was reduced by 24.1%, and 14.8%, respectively, after accessing the market. Additionally, after attending the market, families benefited from experiencing a 10.7% reduction in the need to limit the quantity of food they could afford to purchase, and a 18.5% reduction in having to reduce the quality of food they could afford to purchase. There was a minor reduction of 3.57% in families reporting they missed or skipped meals after accessing the market. The results demonstrated that food insecurity status was improved in families.

Table 4. Changes in food insecurity indicators experienced by families before and after accessing the community food market

Food Insecurity Indicator	Food Insecurity Frequency Score	
	BEFORE using the market	AFTER using the market
All Families		
<i>Worry about running out of food</i>	1.76 ± 0.20	1.14 ± 0.07*
<i>Limiting food variety (i.e., the types of foods)</i>	2.07 ± 0.23	1.41 ± 0.10*
<i>Reducing the quantity of food</i>	1.76 ± 0.21	1.29 ± 0.09*
<i>Reducing the quality of food</i>	1.85 ± 0.23	1.22 ± 0.08*
<i>Skip meals or go without food</i>	1.43 ± 0.17	1.18 ± 0.07
Single Parent Families		
<i>Worry about running out of food</i>	2.00 ± 0.42	1.13 ± 0.13*
<i>Limiting food variety (i.e., the types of foods)</i>	2.50 ± 0.42	1.50 ± 0.19*
<i>Reducing the quantity of food</i>	2.00 ± 0.42	1.25 ± 0.16
<i>Reducing the quality of food</i>	2.14 ± 0.55	1.29 ± 0.18
<i>Skip meals or go without food</i>	1.71 ± 0.36	1.43 ± 0.20

Data are means ± SEM for each food insecurity parameter assessed in study participants with families. Values marked with an asterisk (*) denotes a statistically significant difference ($P < 0.05$) between participants frequency of experiencing each food insecurity indicator before and after using the community food market. The survey scale for the frequency of experiencing each food insecurity indicator was from 1-4 (1=never; 2=monthly; 3=weekly; 4=daily).

The average frequency in which families experienced each of the five food insecurity indicators is shown in Table 4. Since accessing the market, customers with families reported a significantly lower frequency of experiencing four of the five food insecurity indicators including i) worrying about running out of food, ii) limiting the variety of foods purchased, iii) reducing the quantity of foods purchased, and iv) reducing the quality of foods purchased ($P < 0.05$). Conversely, within the families surveyed there was no significant effect of accessing the market on the frequency of skipping meals or going with food due to financial constraints ($P > 0.05$).

3.5. Effect of the Community Food Market on Food Insecurity Indicators in Single-Parent Families

The prevalence of food insecurity has been shown to be higher in single-parent households compared to two-adult households [1, 51, 13]. In the current pilot study, single-parent households represented 30% of families, or 7.5% of all survey respondents. Within this small subset of the study population, prior to accessing the community food market, a lower household income level was strongly correlated with the frequency of experiencing the food security indicators of i) needing to limit the types of foods that could be purchased ($r = 0.714$, $P = 0.031$), and ii) reducing the quantity of foods that could be purchased ($r = 0.725$, $P = 0.027$). Table 4 shows the frequency of single-parent families experiencing each of the five indicators of food insecurity before and after accessing the market. There were statistically significant reductions in experiencing two of the food insecurity indicators after accessing the market: i) frequency of worrying about running out of food and ii) needing to limit the types of foods that could be purchased due to financial constraints ($P < 0.05$). The frequency of experiencing all other food insecurity indicators were improved (i.e., reduced); however, the magnitude of the effect was not statistically significant ($P > 0.05$). The ability to purchase more fruits and vegetables by utilizing the sliding scale payment model at the market was strongly positively correlated with improving the quality of foods that were being consumed by participants in single-parent households ($r = 0.738$, $P = 0.05$).

3.6. Evidence of Sustainability of the Sliding Scale Payment Method

For economic sustainability of the sliding scale payment method utilized at the community food market there is a logistic requirement that customers with higher household incomes pay for food at the higher end of the available payment options. To demonstrate the economic sustainability of the sliding scale payment method available at the community food market we determined if customers were paying the price point for foods purchased from the market that corresponded with their annual household income level. There was a positive correlation between customers household income level and the price point the customer elected to pay for produce within the sliding scale payment options ($r = 0.600$, $P < 0.0001$).

Therefore, customers with higher household incomes typically paid the highest price point for food (a price point equal to premium retail value) and customers with the lowest household incomes typically paid the lowest price point for food (a price point equal to the wholesale cost, typically ranging between 30-50% below retail cost). Most customers (77.2%) paid for food at a payment option on the sliding scale that directly aligned with their annual household income, thereby supporting the longer-term sustainability of the market. Customers are free to select the payment level on the sliding scale for their food during checkout (lower, middle, or higher end), and therefore, higher household income individuals could elect to pay for food from the market on the lower end of the payment scale, however, this only occurred in 4% of customers in the current study. Conversely, lower household income individuals may not always pay for food at the lowest available price point, thereby effectively overpaying for food based on household income level, which was apparent in 18.8% of survey respondents in the current study. Out of the respondents who reported utilizing the lowest-cost payment option, 80% reported feeling comfortable disclosing this information to the confidential cashier at the time of payment. Societal stigma or perceived stigma surrounding accessing community hunger alleviation/food distribution resources or programs remain an obstacle for many food insecure individuals [46,47]. Importantly, independent of food insecurity status 98% of respondents indicated feeling welcome and 96% reported feeling a sense of community and acceptance while accessing the community food market.

4. Discussion

The current study investigated the utility of a sliding scale payment model at community food market to help customers to reduce their overall food insecurity status by increasing their physical and financial access to healthier foods and produce. The sustainability of the sliding scale payment model is predicated on higher household income customers electing to pay the premium retail value for food to support the long-term sustainability of the market and lower household income customers paying the lower wholesale price point for food. Thus, to be economically sustainable, the majority of customers accessing the community food market need to purchase foods at a price point that aligns with their household income. Additionally, the market needs to be supported by the community and patronized by higher income individuals paying premium retail prices to enable the sale of lower cost food to those who are experiencing food insecurity. In this connection, both community food market sustainability criteria were met, wherein the majority of customers (77.2%) paid for produce at a payment option on the sliding scale that directly aligned with their annual household income and 21.6% of customers in this study were from households with higher annual incomes (i.e., $> \$80,000$). Additionally, several indicators of food insecurity that are typically caused by financial constraints [51] were improved in food insecure customers after they started accessing the market including i) a 58.1% reduction in worrying about having access to food, ii) a

37.1% reduction in limiting the variety of types of foods purchased, iii) a 45.5% reduction purchasing lower quality food (i.e., only having access to lower nutritional quality foods in place of more nutritious or higher quality types of food), and iv) a 54.9% reduction in purchasing lower quantities of food (i.e., accessing smaller or insufficient quantities of food items than what is needed) (Table 3). This may be due to paying less money for foods (predominantly fresh fruits and vegetables accessed at the market), thereby increasing the quantity of foods that could be purchased with the same amount of available funds for food or improving access to high quality types of foods to reduce reliance on processed foods with limited nutritional value. Additionally, there was a 22.3% reduction in the number of food insecure customers who reported no longer experiencing skipping/missing meals or going without food since accessing the market (Table 3). Missing meals can be a commonly employed food insecurity mitigation strategy, in particular adults missing meals to sustain their children's food security, and it remains a compensation behavior that is reflective of household food insecurity [52]. It is important to acknowledge that there are other reasons apart from food insecurity that individuals may decide to skip or miss meals including dieting or as a time-saving measure, which was not assessed in the current study. Meta-analyses have shown that skipping meals (especially breakfast), independent of food insecurity status, is associated with a 22% increased risk of cardiovascular disease, a 21% increased risk in type 2 diabetes, and a 25% increased risk of all-cause mortality [4,53]. These changes in health outcomes may be reflected in food insecure populations who are forced to miss breakfast, due to decreased access to food. Further, these findings align with studies demonstrating that food insecure individuals are at greater risk of developing a range of chronic diseases and conditions, including but not limited to, cardiovascular disease, diabetes, metabolic syndrome, depression and anxiety [1] [29-54] [55,5,18]. Changes in customer health status over time was not assessed in this pilot study, however, it represents a relevant future research direction. Collectively, the results of this study demonstrate the proof-of-concept that the sliding scale payment method utilized at the community food market can provide lower-cost food options to lower household income customers food insecurity in a discrete and sustainable manner.

In the current study, the only socioeconomic data collected was the number of people per household and annual household income, however, future studies utilizing an expanded sample size should include more socioeconomic parameters to better identify the intersectionality of these parameters with the impact of the community food market on food insecurity status. Food insecurity can impact any segment of the population suffering from food insufficiencies and financial vulnerability, and therefore, is experienced by a diverse range of individuals [1]. Within Canada specifically, but still applicable more broadly in other countries, certain household sociodemographic and economic characteristics are associated with higher vulnerability for experiencing and prevalence of food insecurity. This includes, but not limited to i) household type (including single or lone-

parent status or single person occupancy), ii) home ownership status, iii) education level, iv) income level, v) primary income source(s) (i.e., self-employment, wages/salary, government assistance programs, etc.), vi) racial or cultural identity, and vii) geographic region of residence, including living in remote regions or on Indigenous reservations [1] [11,12] [56,57]. Within this study, households with children demonstrated improvements in food insecurity status after accessing the community food market. Improvements occurred in both dual-parent and single-parent households (Table 4), with a significant reduction in the frequency of i) worrying about running out of food, ii) having to limit the types of foods that were consumed, and iii) limiting both the quality and quantity of foods purchased due to financial constraints as a result of accessing the market. In Canada, the percentage of households with two adults experiencing food insecurity is 15.6%, whereas lone or single-parent households experience a higher prevalence of food insecurity that exceeds the national food insecurity average [1]. Specifically, 20.9% in male lone-parent households and 38.1% of female lone-parent households experience food insecurity, which highlights a greater vulnerability within this segment of households in the population [1] and aligns with previous estimates of moderate and severe food insecurity in Canada during 2018 and 2019 [13]. Similar to families and lone/single parent households, 20.3% of adults who are unattached or living alone also experience a higher prevalence of food insecurity [1] and represent the largest percentage of household types (i.e., 38%) that are food insecure in Canada [1], which has been consistently demonstrated previously [51,13]. This highlights a particularly vulnerable segment of the population that is ineligible for assistance programs benefiting couples or families [58]. The largest demographic of customers accessing the market had a household income of less than \$20,000 (34.2% of survey participants), and 33.6% of customers lived alone. Although 63.8% of survey participants reported a household income was that was below the median after-tax income level [49], it is important to note that the community food market was supported by 36.2% of customers from higher household incomes, which contributes to the sustainability of the market. It will be important for future studies to determine how the demographics of the market customers reflect the larger community socio-economic demographics of the region.

Research has shown that food insecurity has an adverse impact on the health of both children and adults. Food insecurity experienced by children increases their odds of poor health outcomes including, developmental risk, mental health conditions and other chronic health outcomes [23,54] [59-62]. Additionally, experiencing food insecurity during puberty can lead to developmental and behavioral issues in adolescents [63], which may contribute to the caregivers' stress regarding impaired food access [64]. Food insecure adults are at risk of developing a higher body mass index and various chronic health conditions including cardiovascular disease, diabetes, and hypertension [4-16], due in part, to a reliance on less-expensive, processed, energy-dense foods that are low in nutrient quality [4,53,60,64]. Additionally, the stress associated with the lack of consistent food provisions, may adversely impact the mental health status of adults living in food-insecure

households, presenting commonly as depression, anxiety, and social isolation [54,65] and food insecure individuals are more likely to utilize mental health care services, with the more severely food insecure individuals accessing these services the most [66]. Overall mortality rates are 28% higher in food insecure individuals when compared to age-matched food secure individuals [7]. Although community food markets and other hunger alleviation or food distribution services aim to help both food-insecure individuals and families, it is important to consider the effect of food insecurity on both children and adults. Further studies are required to determine the impact of the community food market and sliding scale payment model within families/households with children, as the sample size in this pilot study was low. Collectively, increasing the availability and access to foods, including fruits and vegetables, which are the predominant types of foods provided at the market, to food insecure households could help to reduce rates of many of the aforementioned adverse health conditions that are exacerbated by food insecurity [1,4,5].

Ensuring that the community food market, and more broadly any community nutrition program, remains welcoming and inclusive is important as there are identified stigmas associated with accessing low-cost food markets or food assistance programs that can remain a barrier for food insecure individuals to access support [46,47]. Other research suggests that feelings of uselessness or failure can be common in those who access food banks, which often stems from self-judgment and fear that others will judge them [47]. Food assistance programs and initiatives, such as food banks are typically intended for short-term solutions to support food insecure individuals who are economically or socially disadvantaged and they have limited capacity to improve overall food insecurity outcomes when operational resources and/or food quality is limited, as reviewed elsewhere [67]. Food banks are not traditionally viewed as a solution for achieving food security [68], which indicates that sustainable alternative approaches to mitigate food insecurity may be successful, either when accessed alone or in combination with food assistance programs. One such sustainable alternative could be community food markets that utilize a sliding scale payment model, where market customers are a mixture of both high- and low-household income individuals who comprise the larger community. Market customers are unaware of the payment method employed by fellow customers as food check outs are conducted confidentially to minimize the stigma associated with food insecurity [2,3,46,47]. In this connection, normalization of seeking food aid when needed is critical for the success of novel food programs [69]. Thus, the atmosphere at the community food market is important for combating the potential stigma food insecure customers may experience. In this connection, 98% of customers felt welcome at the markets and 80% of customers reported feeling comfortable in telling the cashier that they were paying the lowest option. Sustainability is an identified problem in food markets, particularly due to lack of government support funding [41], which highlights the need for alternative approaches to alleviate food insecurity that are sustainable, functional and community supported without

the reliance on government funding to operate. By providing a lower cost option for accessing fresh fruits and vegetables, customers utilizing the community food market may have more available funds to access larger quantities of food both directly from the community market and/or from other sources (i.e., grocery stores, farmers markets, restaurants). Since the community food market is accessed by customers from all income levels, its operational sustainability is enhanced. In this study, 77.2% of customers were paying the price point for food that corresponded to their household income level and only 4% were paying at a price point below their income level (i.e., high income households paying the low-cost/wholesale price point), which contributes to the long-term sustainability of the market. Conversely, 18.8% of food insecure individuals reported paying for food from the market that was above the lowest price-point, which may be reflective of the stigmas associated with accessing community food insecurity supports [46,47].

Nutritional quality of foods provided are one of many challenges experienced by food banks [67], however, efforts to change operational strategies to address concerns about poor nutritional quality of the food provided are reported [68]. Food assistance programs (e.g., food banks and food hampers) have been shown to provide lower quality foods and/or insufficient amounts of food to meet clients' nutritional requirements, which can result in nutrient deficiencies within an already food insecure population [70,71]. Specifically, an insufficient availability of fresh produce and food bank clients' intake of fresh produce are of primary concern [71-72]. Other approaches have reported success, for example, cooking classes at a local food bank increased fruit and vegetable intake and reduced food insecurity amongst program participants [73]. Therefore, alternative approaches implemented alone or in combination with food assistance programs, such as the sliding scale payment model at the community food market, may help increase food insecure individuals' access to better quality foods, as the market aims to improve access to fresh local produce while eliminating the economic and social barriers to healthier food options [3,46,47,67,74]. Food insecure customers reported a reduced need to limit the type or variety of foods that could be purchased, resulting in 37.1% of food insecure customers reporting they no longer needed to make these food choice restrictions as a result of accessing the market (Table 3). Additionally, the need to limit the quality of foods purchased as a result of accessing the market was also reduced, wherein 54.9% of food insecure customers reported no longer needing to utilize this strategy to meet their dietary needs due to financial constraints (Table 3). Similarly, food insecure families reported a 18.5% reduction in having to reduce the quality of food they could afford to purchase. Fresh produce (fruits and vegetables) are the main types of food sold at the market, which helps fill an identified challenge for food banks and food distribution programs to provide clients with sufficient produce [71-72]. The majority of participants (61.4%) indicated that they were able to purchase more of fruits and vegetables as a result of accessing the community food markets, and 80% of participants reported that they are now consuming enough fruits and vegetables to meet their dietary requirements.

5. Conclusion

This pilot study assessed the impact and sustainability of a novel sliding scale payment model for produce sold at a community food market that engages both low and high household income customers. The reduced frequency of customers experiencing key indicators of food insecurity is proof-of-concept that the sliding scale payment model could be adopted in other communities. As similar markets using this novel payment model develop, it will be important to assess both their effectiveness at reducing food insecurity and financial sustainability, as results may vary based upon the community, clientele, and geographic location.

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Statement of Competing Interests

The authors have no competing interests.

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Appendix 1. Food Insecurity Survey Questions

- Before you began shopping at the Community Food Market, how often did you worry about running out of food?
 - Daily
 - Weekly
 - Monthly
 - Never

- Since you began to shop at the Community Food Market, do you still worry about running out of food?
 - Yes
 - No

- Have the Community Food Markets had an impact on how often you worry about running out of food? Please explain. _____.

- Before you began shopping at the Community Food Market, how often did you limit the types of food you would like to buy because of a lack of money for food?
 - Daily
 - Weekly
 - Monthly
 - Never

- Since you began to shop at the Community Food Markets, do you still limit the types of food you would like to buy because of a lack of money for food?
 - Yes
 - No

- Have the markets had impact on the quantity of food you are able to purchase?
Please explain. _____.

- Before you began shopping at the market, how often did you have to reduce the quality of food you eat because of a lack of money for food?
 - Daily
 - Weekly
 - Monthly
 - Never

- Since you began to shop at The Community Food Markets, do you still face a reduction in the quality of food you are able to purchase?
 - Yes
 - No

- Have the markets had an impact on the quality of food you are able to purchase?
Please explain. _____.

- Before you began shopping at the market, how often did you miss meals or go a day or two without food because of a lack of money for food?
 - Daily
 - Weekly
 - Monthly
 - Never

- Do you continue to skip meals since shopping at the Community Food Market?
 - Yes
 - No

- Have the Community Food Markets had an impact on how often you have had to skip meals? Please explain. _____.