

Wikileeks: Digging up Secrets of Fruit and Vegetable Prices at Markets and Supermarkets in Wellington and Christchurch

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Abstract

Aims: Inadequate fruit and vegetable consumption is the most important dietary risk factor for disability and disease and yet several barriers have been identified which prevent an adequate daily intake, one of which is cost. The present study aimed to determine if it was cheaper to purchase fruit and vegetables from a market or a supermarket and thus provide insight into possible solutions to reduce cost barriers preventing adequate fruit and vegetable consumption in the New Zealand population.

Methods: Over a three week period, prices for 18 commonly purchased fruit and vegetable items were recorded from supermarkets (n=19) and markets selling fruit and vegetables (n=8) in the Wellington and Christchurch region. Each market was assigned a proximal supermarket and a distal supermarket (located more than 2 kilometers away from the market) in order to see if competition between markets and supermarkets resulted in lower supermarket prices as has been noted in the USA. Data from supermarkets were collected on both the weekend and mid-week along with data from an online supermarket (for comparison purposes). A sample food basket of fruit and vegetables was designed to demonstrate what savings, if any, would be present by shopping at a market instead of a supermarket for a family of four.

Results: We found that the markets selling fruit and vegetables were in two distinct types, farmers' markets and fruit and vegetable only markets (FVOM). When comparing the latter with supermarkets, results were consistent with the hypothesis: all 18 fruit and vegetable products selected were significantly cheaper to buy from these FVOMs than at supermarkets (for most items $p < 0.001$). Specifically, the sample food basket showed an average saving of \$19.30 per week if all produce was brought at a FVOM instead of a supermarket. However, actual farmers' markets had produce that was significantly more expensive than at FVOMs (for nearly all items). Prices tended to be lower at the online supermarket than the supermarkets that were visited (statistically significantly so for 5/18 items). No significant pricing "halo effect" was seen in terms of supermarket position (proximal or distal) relative to adjacency to FVOMs.

Conclusions: The findings of this study indicate that FVOMs selling fruit and vegetables are providing produce to New Zealanders at lower cost than are supermarkets. This finding has implications for future public health and social welfare policies in terms of favouring the introduction of markets into areas of high deprivation where cost is a major barrier to maintaining a balanced healthy diet. Future studies to investigate other factors that promote or discourage market use by people from more deprived communities could also be conducted, so that interventions to increase fruit and vegetable consumption can be effectively implemented and targeted to the most vulnerable populations as well as to the wider New Zealand population.

Introduction

The Global Burden of Disease 2010 study highlighted nutrition as an important risk factor for disease burden globally as well as in the Australasian region.⁽¹⁾ In 2010, a diet low in fruit was found to cause 4.9 million deaths and 4.2 % of global disability adjusted life years (DALYs),⁽¹⁾ resulting in the largest attributable burden of all individual dietary risk factors, and the 5th greatest risk factor worldwide for disability and disease.⁽¹⁾ A diet low in vegetables was ranked 17th of the global risk factors.⁽¹⁾

Social, cultural, and environmental factors are important in determining food choices.(2) The presence of farmers' markets (where the produce is predominantly grown by the vendors themselves) and fruit and vegetable only markets (FVOMs) (where the majority is not grown by the vendors) in communities has been shown to increase the consumption of fruit and vegetables in several countries.(3-9) There are several theories as to why this phenomenon occurs: they may increase accessibility to produce, decrease the cost of produce, promote a change in attitudes towards fruit and vegetable consumption, and / or offer produce of higher quality compared with supermarkets.(3, 5, 6, 8, 9)

A number of barriers related to accessibility may be why a large percentage of developed country populations is failing to meet recommended daily intakes of fruit and vegetables.(3, 5, 6, 8, 9) In the United States of America (USA), several areas have been identified as food desert, places with little or no access to full grocery stores. Ruelas et al. 2012 examined the effect introducing farmers' markets into food deserts had on fruit and vegetable consumption.(3) 98 % of study participants reported increased fruit and vegetable intake after the farmers' markets were introduced;(3) here it is important to note that associations between location access and individual dietary behaviour are sensitive to the methods by which the food environment was studied.(10) Of relevance, food deserts do not appear to exist in New Zealand, and a recent New Zealand-based study has found little evidence to support the claim that poor locational access decreased fruit and vegetable consumption.(11) These results are supported by data from Smith et al. 2010, who found no effect of shop location on fruit and vegetable consumption in the urban United Kingdom setting.(2) However, it is still possible that the commonsense notion that distance to fruit and vegetable produce may influence food choices: research investigating fruit and vegetable access more precisely and directly is required.(11)

The cost of food has repeatedly been shown to influence food choices.(2) It is thought that cost is a major barrier to promoting healthy eating as high energy dense, high fat foods are often cheaper than healthier fresh fruit and vegetable alternatives.(2, 12) Ni Mhurchu et al. (2007) provide evidence to suggest cost is a significant barrier that prevents people from consuming a healthy diet in New Zealand.(13) This study considered the difference in cost and nutrient value of foods categorised as either "regular" (commonly bought by the study population) or "healthy"

(a healthier alternative matched to each regular food choice). Their results showed that “healthy” options were more expensive than food categorised as “regular”, and concluded that because “healthy” food is more expensive price indeed appears to be a barrier for people – especially low income shoppers – wishing to access healthy food(13). This conclusion is supported by other New Zealand data from Blakely et al. (2011), who found that a 12.5 % discount on healthy food increased healthy food purchasing by 11 % or 0.79 kg (95 % CI 0.43 to 1.16) per week during the intervention period.(14)

In support of the hypothesis that food prices influence food purchasing, households of lower socioeconomic status (SES) purchase smaller volumes of fruit and vegetables less regularly when compared to those with a higher socioeconomic background.(13, 15) An analysis of data from Canada, Australia and the USA demonstrating that healthier diets are associated with SES corroborate these findings.(16) Food prices and diet costs were investigated to look for causal mechanisms for the identified SES gradient; the results consistently demonstrated that energy-dense, unhealthy diets were associated with a lower cost.(16) Furthermore, several studies emphasise that the food budget of the lower SES population is inadequate to fund the recommended balanced diet.(17-19) These data are particularly relevant to the New Zealand setting, where key results of the 2002 National Children’s Nutrition Survey showed that the proportion of households unable to always afford to consume a healthy diet was markedly higher in more deprived areas.(20) Data also reveals that there is a much higher percentage of Māori living in the most deprived areas than non-Māori(21) and that Māori and Pacific people are much less likely to be able to afford to consume a healthy diet than those of New Zealand European ethnicity,(20) perhaps contributing to the higher rates of non-communicable diseases seen in these populations.

Drewnowski et al. (2012) found there was a three-fold difference in obesity rates in areas with lower priced supermarkets compared to higher priced supermarkets, and observed that those shopping at lower price supermarkets were more likely to be from lower income and education groups.(22) These data emphasised the extent to which income and education determine supermarket choice, and how this choice may influence health outcomes. Although quality of food in lower priced supermarkets was not explored in this study, a modest association between

the higher cost of food and its greater nutritional value has been reported.(13) This could partially explain the greater obesity rates in the areas with cheaper supermarkets.

Some international evidence indicates that markets improve access to fruit and vegetable, particularly for low-income groups. One reason for this may be lower price, although this may not always be so (in the USA, fruit and vegetables have been considered to be more expensive at farmers' markets than those found at supermarkets).(23) Further evidence to suggest that cost is a major barrier restricting fruit and vegetable consumption was derived following the introduction of coupons in various US jurisdictions: participants were 69.9 times as likely to purchase fruit and vegetables from a farmers' market if they were given a coupon incentive.(7, 9, 12) Wall et al. 2008 demonstrated that the coupon introduction increased fruit and vegetable consumption, and the increased consumption was maintained at a six-month follow up period following removal of the coupon intervention.(12) Importantly, it has been shown that coupons that can only be redeemed at farmers' markets result in a higher increase in fruit and vegetable consumption than coupons redeemable at supermarkets.(24) This finding may be due to the healthier options available at supermarkets.(24, 25)

While price was rated the most important inhibitor of more frequent visits or increased purchasing at farmers' markets in a New Zealand study, the importance rating was not statistically significant from the neutral rating in a sample of 252 shoppers at 11 markets, with over 30 % earning below the annual median income of NZ\$58,000.(26) This result may be explained by research that found that although price is an important factor in food choice, the roles of other influencing factors such as the satisfaction a food can produce, its image of healthiness and reliability, and in what situations it is consumed need to be considered.(27)

Significantly, local media in New Zealand recently reported that supermarkets buy produce from suppliers at cost price set by the supermarkets themselves and make an excessive profit by placing a disproportionately large mark-up value on the selling price. It was found that supermarkets place a higher mark-up value on food items bought in bulk, such as fruit, vegetables, meat and seafood. Food items which are pre-packaged and considered "well

branded” are given a lower mark-up price due to the competitive market which allows the suppliers to dictate the cost price of the items rather than the supermarkets.(28)

Other factors such as increased awareness and perception of quality at markets compared to supermarkets may improve fruit and vegetable intake. As well as increasing accessibility of fruit and vegetables to the community, farmers’ markets are also thought to influence consumption by changing behaviours related to food choices.(5) Specifically, a study by Evans et al. provided data to show that introducing farmers’ markets into neighbourhoods increased consumption of produce not sold at the farmers’ markets, suggesting an increased awareness of healthy food choices can lead to increased fruit and vegetable consumption.(5) Although not measured in this study, it is possible that consumption of fruit and vegetables not sold at the markets increased due to a competitor-induced reduction in food prices at local supermarkets. Specifically, the introduction of farmers’ markets into low income communities in the USA was shown to lower the price of produce sold at local supermarkets by approximately 12 % over a three year period.(4) Thus, as well as providing cheaper produce options, an additional potential benefit of markets might be that the potential cost reductions of fruits and vegetable at proximal supermarkets.

While some markets increase fruit and vegetable consumption by offering lower prices than nearby supermarkets, more expensive farmers’ markets may conceivably increase the population intake of fruit and vegetables through a less established mechanism.(8, 29) More affluent people tend to place a greater emphasis on quality and method of food production, rather than the cost and quantity of the purchasable items.(29) Farmers’ markets are often perceived by the middle and upper class to have better quality, organic produce than local supermarkets, and thus when introduced to an area act to increase fruit and vegetable consumption.(8)

While an overall increase in fruit and vegetable consumption is seen following the introduction of farmers’ markets to a community, disparities exist between the types of people who purchase the produce.(3, 9) Specifically, Ruelas et al. demonstrated that fruit and vegetable intake following a farmers’ market introduction only increased in Hispanic and White but not African American populations, even when all participants came from a low SES environment (which

traditionally shows an increase in consumption following the introduction of farmers' markets).(3) These data suggest that cultural or intrinsic factors may also play a role in determining fruit and vegetable intake(3).

To further explore some of these issues in the urban New Zealand setting, this project aimed to determine:

1. If markets typically offer price savings on fruit and vegetables relative to supermarkets in the Wellington region (including Lower Hutt and Porirua), and Christchurch regions.
2. If markets induce a halo effect by stimulating a reduction in fruit and vegetable prices in nearby supermarkets relative to supermarkets that are farther away.
3. If weekends are the best time to buy low-cost fruit and vegetables from supermarkets by comparing the same supermarkets on weekend versus mid-week days.
4. If there are price differences between farmers' markets and FVOMs.

Method

Selection of outlet sites

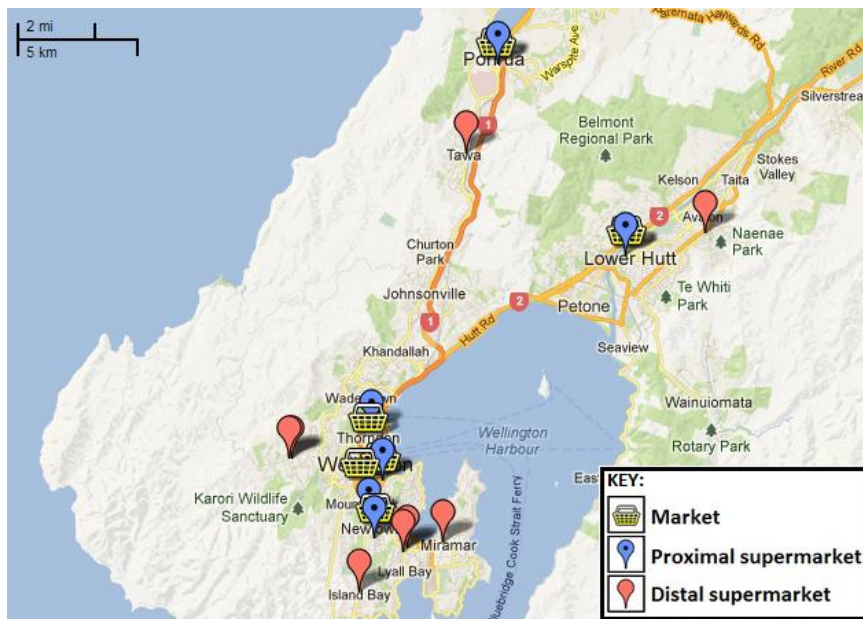
Market and supermarket locations

The main fruit and vegetable only markets (FVOMs) and farmers' markets were sampled in the Wellington (including Porirua and Lower Hutt) and Christchurch regions, and were identified by an internet search. These regions were selected for convenience, as researchers were available for data collection in both regions. The main supermarket branches were also sampled with at least two supermarkets sampled per market. Each market was matched with the closest proximal supermarket and a control distal supermarket which was the closest supermarket at least 2 km from the market sampled and was not being used as a comparison supermarket for another market. Small fruit and vegetable shops or specialty stores (e.g. organic shops) were not included in the sample frame. Table A and Map 1 show the FVOM and farmers' market locations in Wellington, the proximal and distal supermarkets selected, along with the distances from the

market to the corresponding supermarket. Table B and Map 2 show the similar locations in Christchurch. The online Countdown supermarket website was used as a general comparison to the other supermarkets.

Study period

Data were collected from the markets starting at 9.00 am for a duration of approximately 30 minutes on either a Saturday or Sunday. Data were collected from the supermarkets on the same day, at approximately 10.00 am for 15 minutes duration. Supermarket produce prices were also collected on the following Wednesdays in order to compare to the supermarket price on the day of the market. Data collection was carried out in both the Wellington and Christchurch regions in three consecutive weeks from the 2 - 20 of March 2013 (early autumn in New Zealand).

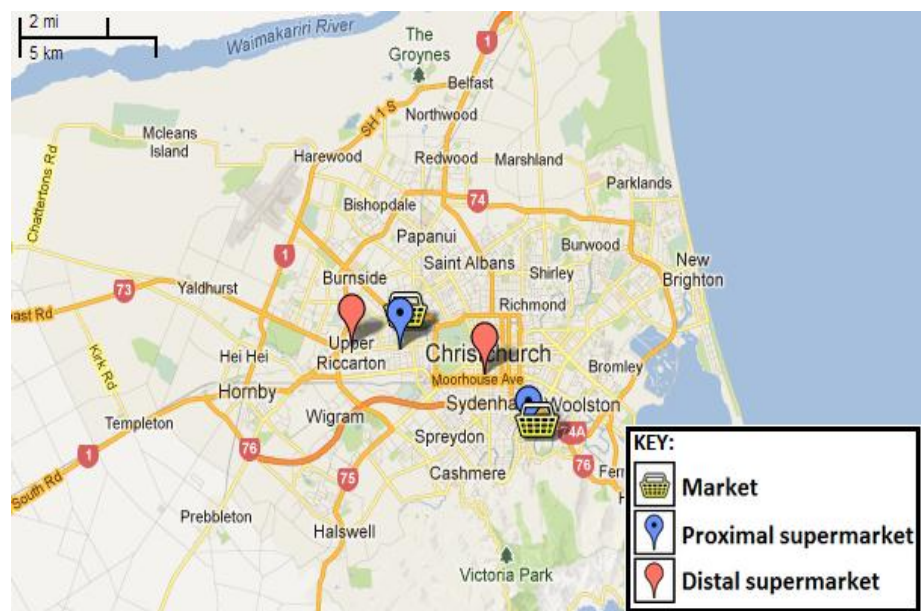


Map 1: Locations of the Wellington, Lower Hutt and Porirua supermarkets and markets included in the study sample

Table A: Distances between markets and comparison supermarkets in Wellington region included in the study sample

Market name and type	Proximal supermarket name	Proximal supermarket distance from market (km)*	Distal supermarket name	Distal supermarket distance from market (km)*
Newtown (FVOM)	Newtown New World	0.4	Miramar New World	3.7
Victoria Street (FVOM)	John Street Countdown	1.4	Island Bay	4.5
Hill Street (farmers' market)	Thorndon New World	0.9	Karori (New World and Countdown)	4.6
Te Papa/Waterfront (FVOM)	Chaffers New World	0.1	Kilbirnie (Countdown and Pak'n'Save)	4.3
Lower Hutt (FVOM)	High Street Countdown	0.4	Naenae New World	5.4
Porirua (FVOM)	Porirua New World	0.8	Tawa New World	2.9

*The distance in km is the distance (by road route) from each market to the corresponding supermarket as given by Google Maps.



Map 2: Locations of the Christchurch supermarkets and markets included in the study sample

Table B: Distances between markets and comparison supermarkets in Christchurch included in the study sample

Market name (and type)	Proximal supermarket name	Proximal supermarket distance from market (km)*	Distal supermarket name	Distal supermarket distance from market (km)*
Riccarton Bush Market (farmers' market)	Riccarton Pak'n'Save	1.1	Bush Inn Countdown	2.9
Opawa Market (farmers' market)	St Martins New World	0.7	South City New World	4.6

*The distance in km is the distance (by road route) from each market to the corresponding supermarket as given by Google Maps.

Price data collected

The price per kilogram (kg) of: apples, kiwi fruit, oranges, pears, broccoli, cabbage, cucumber, lettuce, cauliflower, mushrooms (field or button), onions, pumpkin, tomatoes, potatoes, carrots, and kumara along with the price of a bunch or bag of: Chinese cabbage (pak / bok choy, Shanghai bunch, wong bok), silverbeet, and spinach were collected and recorded. These fruit and vegetables were chosen because these are commonly grown in New Zealand, are popular and relatively low cost fruit and vegetable items in the average consumers shopping list, and some are included in the Food Price Index collated by Statistics New Zealand. Special pricing deals such as bulk discounts were also recorded.

Market prices were collected the first week by recording the prices from the first five fruit and vegetable stalls on the left from the ‘main’ market entrance (with this entrance used every visit). The method was changed slightly in week two to include price gathering until there were five prices recorded for each item (if possible). This was done in order to gather an average price for each item as some stalls did not have the required items needed making sampling only five stalls insufficient. The lowest price of each item from each stall was recorded. At each market the total number of stalls that sold fruit and vegetables was documented along with produce that was unlikely to be grown within 100 km. It was also noted whether EFTPOS was available, either as a mobile EFTPOS or the presence of at least one stall with EFTPOS. A total of 18 research team members, 12 from Wellington and 6 from Christchurch, were involved in the data collection (including repeat visits).

Additional information collection

The pricing data of the supermarket produce were collected in a similar fashion, with the cheapest New Zealand grown price, and the cheapest price overall (including imported produce), if this differed from the cheapest New Zealand grown price. It was also noted if the item was organic, or on special.

To provide a real world application of the results, a sample ‘shopping basket’ was compiled. This basket was designed using the optimal quantities for fruit and vegetables for minimising disease risk as used in the Global Burden of Disease Study,(1) (i.e., 300g/day per person for fruit and 400g/day per person for vegetables). As per the work by Lim et al, we excluded starchy vegetables (potatoes and kumara) from the basket, as these are not favoured for chronic disease risk reduction. The basket also tried to include a variety of vegetables to provide a range of nutrients. The basket was designed to feed a family of four: two adults and two children for one week. The total price of a selection of vegetables (1 broccoli, 1 cabbage, 1 cucumber, 1 lettuce, 1 cauliflower, 1 bunch each spinach and silverbeet, 1 kg carrots, 0.75 kg onions, 0.5 kg tomatoes, 0.3 kg mushrooms), equating to 8.4 kg, and a selection of fruit (2.1 kg each of apples, oranges and pears) equating to 6.3 kg, were compared using weekend supermarket mean prices as well as FVOM mean prices.

Semi-structured interview sampling and data instrument

Interviews were conducted to understand the organisational structure of one FVOM and one farmers’ market and the perspective of operators on the value of such markets. Interviews were conducted both in person and via telephone, with an average duration of 30 minutes. Attempts were made to contact four representatives of markets whose contact details were available, of which two responded and were subsequently interviewed. These were Fraser Ebbett, market manager of Harbourside (FVOM) market and Doug Hesp, market Organizer for Opawa Farmers’ market. Questions in the interview instrument included: “what is your perception of what a market offers to the community?” and “do you think it is cheaper to shop at a market for produce when compared to a supermarket?” A summation of the qualitative data collected by interview has been included in the Discussion Section of this Report.

Observational data collation and analysis

Price data were entered into a Google Drive document. Then the data were organised in Microsoft Excel. Analyses were conducted using a one-way ANOVA in STAT Plus version to compare mean prices for each food item between types of outlets. Market data excluded farmers' markets (the two Christchurch markets and the Hill Street market in Wellington); these were analysed separately as some farmers' markets produce tended to be quite different in nature (i.e., frequently organic produce).

Ethics approval

University of Otago ethics approval for this study was obtained on 9 January 2013.

Results

We obtained approximately 810 data items from farmers' markets, 1350 from FVOMs and 1296 from supermarkets, from a total of 111 outlet visits.

We found that the mean prices all of the 18 different fruit and vegetables assessed at the FVOMs were significantly cheaper than those from the proximal supermarket ($p < 0.001$) (Table 1). The largest difference in mean price was for kumara (sweet potato variety), which was \$2.31 per kg less at the FVOM, followed by mushrooms, which were \$2.15 per kg less at the FVOM than the proximal supermarkets. The prices of all assessed fruit and vegetables from the FVOMs were also lower than those at the distal supermarkets ($p < 0.001$, carrots $p < 0.002$) (Table 2).

There were no significant differences between proximal and distal supermarkets on the weekend for the price of fruit and vegetables except for Chinese cabbage, which was cheaper at the proximal supermarket ($p = 0.025$) (Table 3). It was not significantly cheaper to buy the majority of fruit and vegetables on the weekends except for broccoli and cauliflower, which were both significantly cheaper at the supermarkets on the weekend compared to mid-week, however pears were significantly more expensive mid-week ($p = 0.032$) (Table 4).

Results relating to the secondary aims of the study were that 15 out of 18 fruit and vegetables assessed were significantly cheaper at the FVOMs compared to the farmers' markets with locally grown produce (Table 5). The exceptions were: Chinese cabbage, cauliflower and pumpkin where no significant differences in prices were observed (Table 5).

Five out of the 18 fruit and vegetables analyzed were significantly cheaper at the Online Countdown compared to all supermarkets (Table 6). Mushrooms were \$3.60 cheaper at the online Countdown than the supermarkets that were analyzed in this study (Table 6) ($p < 0.05$ for pears, cabbage, silverbeet, kumara; and $p < 0.001$ for mushrooms). Bok choy was significantly more expensive online than it was at all the other supermarkets studied ($p < 0.001$) (Table 6).

Table 7 shows the median price differences for the fruit and vegetables sold per kg, whereas Table 8 shows the median price difference for the fruit and vegetables sold per item/bunch. Results showed a cheaper median price of \$1.37 and \$1.35 respectively for items sold per kg and items sold per bunch at the FVOM compared to the proximal supermarket on the weekend with a median price of \$3.21 and \$2.79 respectively. The price of fruit and vegetables at the FVOMs was lower, with a median price of \$1.51 and \$1.18 respectively for items sold per kg and per item compared to the distal supermarket on the weekend with median values of \$3.04 and \$2.73 respectively. The median weekend proximal supermarket price was 6 cents and 32 cents lower respectively for items sold per kg and items sold per item/bunch at the weekend proximal compared to the weekend distal supermarket. The fruit and vegetables purchased from the locally grown farmers' markets were \$2.08 and 95 cents more expensive respectively for fruit and vegetables sold per kg and for fruit and vegetables sold per item/bunch compared to the FVOMs. The median price of the Online Countdown was 50 cents cheaper and four cents cheaper respectively for items sold per kg and items sold individually, compared to all supermarkets that were assessed (Table 7 and 8).

A sample 'shopping basket' compared the weekend mean prices for fruit and vegetables at supermarkets and FVOMs. Results showed the 'shopping basket' would cost \$49.13 from

supermarkets compared to \$29.83, resulting in a saving of \$19.30 (39.3%) by shopping at a FVOM (Table 9 and 10).

Table 1: A comparison of fruit and vegetable prices from FVOMs compared to proximal supermarkets (sorted by increasing price at the FVOM) (bolded values are the lowest price).

Item	Proximal supermarket weekend		FVOM		P-value comparing the means (ANOVA)
	(N)	Mean price per kg (NZ\$) or bunch if indicated	(N)	Mean price per kg (NZ\$) or bunch if indicated	
Fruit					
Apples§	17	3.08	68	1.68	<0.001*
Pears§	14	3.50	69	2.01	<0.001*
Oranges§	17	3.33	68	2.13	<0.001*
Leafy Vegetables					
Lettuce∞	14	2.66	70	1.34	<0.001*
Bok Choy∞	13	2.79	53	1.35	<0.001*
Silverbeet∞	15	3.00	60	1.44	<0.001*
Spinach∞	12	3.88	66	1.89	<0.001*
Cabbage∞	14	3.41	70	1.90	<0.001*
Starchy Vegetables					
Potatoes§	14	2.41	76	1.64	<0.001*
Kumara§	14	7.37	75	4.67	<0.001*
Other Vegetables					
Broccoli∞	15	1.71	74	1.21	<0.001*

Cucumber∞	14	2.21	74	1.38	<0.001*
Carrots§	13	1.96	73	1.55	<0.001*
Tomatoes§	14	2.41	84	1.58	<0.001*
Onions§	14	2.10	77	1.63	<0.001*
Cauliflower∞	17	2.53	80	1.69	0.002*
Pumpkin∞	14	4.01	70	2.75	<0.001*
Mushroom§	13	11.68	16	6.67	0.001*

*=statistically significant

§ = Price per kg,

∞ = price per individual item/per bunch

Table 2: A comparison of fruit and vegetable prices from FVOMs compared to distal supermarkets (sorted by increasing price at the FVOM) (bolded values are the lowest price).

Item	Distal supermarket		FVOM		P-value comparing the means (ANOVA)
	(N)	Mean price per kg (NZ\$) or bunch if indicated	(N)	Mean price per kg (NZ\$) or bunch if indicated	
Fruit					
Apples§	11	3.02	68	1.68	<0.001*
Pears§	11	4.00	30	1.94	<0.001*
Oranges§	11	3.40	68	2.13	<0.001*
Leafy Vegetables					
Bok Choy∞	13	3.12	31	1.29	<0.001*
Lettuce∞	13	2.68	70	1.48	<0.001*
Spinach∞	9	3.97	66	1.89	<0.001*
Cabbage∞	13	3.30	70	1.90	<0.001*
Silverbeet∞	13	3.25	61	2.40	<0.001*
Starchy Vegetables					
Potatoes§	13	2.29	47	1.64	<0.001*
Kumara§	13	6.99	46	4.68	<0.001*
Other Vegetables					
Broccoli∞	13	1.70	74	1.22	<0.001*

Cucumber∞	13	1.96	74	1.48	<0.001*
Carrots§	13	2.62	73	1.55	<0.002*
Tomatoes§	12	2.36	55	1.57	<0.001*
Onions§	12	2.06	77	1.63	<0.001*
Cauliflower∞	21	2.73	80	1.70	<0.001*
Pumpkin∞	12	3.86	41	2.76	<0.001*
Mushroom§	13	11.91	48	9.76	<0.001*

*=statistically significant

§ = price per kg

∞ = price per item/bunch

Table 3: A comparison of fruit and vegetable prices between proximal (n= 5) and distal (n= 6) supermarkets (sorted by increasing price at the distal supermarket weekend) (bolded values are the lowest price)

Item	Proximal supermarket weekend		Distal supermarket weekend		P-value comparing the means (ANOVA)
	<u>(N)</u>	Mean price per kg (NZ\$) or bunch if indicated	<u>(N)</u>	Mean price per kg (NZ\$) or bunch if indicated	
<i>Fruit</i>					
Apples§	17	3.08	11	3.02	0.839
Oranges§	17	3.33	11	3.39	0.816
Pears§	14	3.50	13	4.00	0.133
<i>Leafy vegetables</i>					
Lettuce∞	14	2.66	13	2.68	0.940
Cabbage∞	14	3.41	13	3.30	0.610
Bok Choy∞	13	2.79	13	3.11	0.025*
Silverbeet∞	15	3.00	13	3.24	0.262
Spinach∞	12	3.88	9	3.96	0.811
<i>Starchy vegetables</i>					
Potatoes§	14	2.41	13	2.29	0.551
Kumara§	14	7.37	13	6.96	0.163
<i>Other vegetables</i>					
Broccoli∞	15	1.71	13	1.69	0.916
Cucumber∞	14	2.21	13	1.95	0.357

Onions§	14	2.10	14	2.15	0.770
Carrots§	13	1.97	13	2.20	0.155
Tomatoes§	14	2.41	12	2.35	0.836
Cauliflower∞	17	2.53	21	2.72	0.357
Pumpkin∞	14	4.01	13	3.87	0.739
Mushroom§	13	11.68	13	11.91	0.767

*=statistically significant

§ = price per kg

∞ = price per item/bunch

Table 4: A comparison of fruit and vegetable prices between supermarkets on the weekend (n=11) compared to mid-week (n=11) (sorted by increasing price at the mid-week supermarket) (bolded values are the lowest price)

Item	Weekend supermarket		Mid-week supermarket		P-value comparing the means (ANOVA)
	<u>(N)</u>	Mean price per kg (NZ\$) or bunch if indicated	<u>(N)</u>	Mean price per kg (NZ\$) or bunch if indicated	
Fruit					
Oranges§	28	3.35	30	3.01	0.088
Apples§	28	3.06	32	3.02	0.875
Pears§	27	3.74	33	3.29	0.032*
Leafy vegetables					
Lettuce∞	27	2.67	33	2.65	0.877
Bok Choy∞	26	2.95	33	2.93	0.813
Silverbeet∞	30	3.10	35	3.27	0.352
Cabbage∞	27	3.35	33	3.54	0.132
Spinach∞	21	3.91	28	3.97	0.765
Starchy vegetables					
Potatoes§	27	2.35	32	2.34	0.935
Kumara§	27	7.19	32	7.02	0.427
Other vegetables					
Broccoli∞	28	1.70	33	1.85	0.040*
Onions§	26	2.08	31	2.05	0.762

Carrots§	26	2.07	33	2.11	0.630
Cucumber∞	27	2.09	33	2.17	0.634
Tomatoes§	26	2.28	32	2.54	0.434
Cauliflower∞	36	2.68	42	3.15	0.001*
Pumpkin∞	27	4.01	32	3.87	0.739
Mushroom§	26	11.79	33	11.64	0.772

*=statistically significant

§ = price per kg

∞ = price per item/bunch

Table 5: A comparison of fruit and vegetable prices at FVOMs (n=5) compared to locally grown farmers' markets (n=3) (sorted by increasing price at the farmers' markets) (bolded values are the lowest price)

Item	FVOM		Farmers' markets		P-value comparing the means (ANOVA)
	(N)	Mean price per kg (NZ\$) or bunch if indicated	(N)	Mean price per kg (NZ\$) or bunch if indicated	
Fruit					
Apples§	68	1.68	25	3.26	<0.001*
Pears§	69	2.01	24	3.54	<0.001*
Oranges§	68	2.13	16	5.00	<0.001*
Leafy vegetables					
Silverbeet≈	60	1.43	8	1.81	0.006*
Bok Choy≈	53	1.35	2	2.00	0.145
Spinach≈	66	1.91	7	2.36	0.010*
Lettuce∞	70	1.34	11	2.59	<0.001*
Cabbage∞	70	1.90	14	2.93	<0.001*
Starchy vegetables					
Potatoes§	76	1.64	26	3.45	<0.001*
Kumara§	75	4.67	3	6.99	<0.001*
Other vegetables					
Cauliflower∞	80	1.70	5	1.90	0.307
Pumpkin∞	70	2.79	15	2.76	0.970

Broccoli ∞	74	1.21	10	2.80	<0.001*
Carrots \S	73	1.54	27	3.39	<0.001*
Cucumber ∞	74	1.64	13	3.45	<0.001*
Onions \S	77	1.67	19	3.76	<0.001*
Tomatoes \S	84	1.57	37	3.83	<0.001*
Mushroom \S	16	9.67	4	12.00	<0.001*

*=statistically significant

\S = price per kg

∞ = price per item/bunch

Table 6: A comparison of fruit and vegetable prices from FVOMs compared to distal supermarkets (sorted by increasing price at the FVOM) (bolded values are the lowest price).

Item	Distal supermarket		FVOM		P-value comparing the means (ANOVA)
	(N)	Mean price per kg (NZ\$) or bunch if indicated	(N)	Mean price per kg (NZ\$) or bunch if indicated	
Fruit					
Apples§	11	3.02	68	1.68	<0.001*
Pears§	11	4.00	30	1.94	<0.001*
Oranges§	11	3.40	68	2.13	<0.001*
Leafy Vegetables					
Bok Choy∞	13	3.12	31	1.29	<0.001*
Lettuce∞	13	2.68	70	1.48	<0.001*
Spinach∞	9	3.97	66	1.89	<0.001*
Cabbage∞	13	3.30	70	1.90	<0.001*
Silverbeet∞	13	3.25	61	2.40	<0.001*
Starchy Vegetables					
Potatoes§	13	2.29	47	1.64	<0.001*
Kumara§	13	6.99	46	4.68	<0.001*
Other Vegetables					
Broccoli∞	13	1.70	74	1.22	<0.001*

Cucumber∞	13	1.96	74	1.48	<0.001*
Carrots§	13	2.62	73	1.55	<0.002*
Tomatoes§	12	2.36	55	1.57	<0.001*
Onions§	12	2.06	77	1.63	<0.001*
Cauliflower∞	21	2.73	80	1.70	<0.001*
Pumpkin∞	12	3.86	41	2.76	<0.001*
Mushroom§	13	11.91	48	9.76	<0.001*

*=statistically significant

§ = price per kg

∞ = price per item/bunch

Table 7: Summary table showing the median difference of fruit and vegetables sold per kg (n=9 items)^ (bolded values are the lowest price)

Key Comparison	Median price first outlet (NZ\$ per kg)	Median price second outlet (NZ\$ per kg)	Difference in favour of first outlet (NZ\$ per kg)	Number of items significantly different in price
FVOMs vs proximal supermarket on the weekend	1.84	3.21	1.37	9/9 significantly cheaper at the FVOM
FVOMs vs distal supermarket on the weekend	1.89	3.04	1.51	9/9 significantly cheaper at the FVOM
Proximal vs distal supermarket on weekends	3.08	3.02	-0.06	0/9
Weekend supermarket vs Mid-week supermarket	3.06	3.01	-0.05	1/9 significantly cheaper Mid-week
Farmers' markets vs FVOM	3.76	1.68	-2.08	9/9 significantly more expensive at the farmers' market
All Supermarkets vs online countdown	3.04	2.49	-0.55	3/9 significantly cheaper online

^ - includes apples, oranges, pears, carrots, mushrooms, onions, tomatoes, potatoes, and kumara.

Table 8: Summary table showing the median difference of fruit and vegetables sold per item / bunch (n=9 items) \pm (bolded values are the lowest price)

Key Comparison	Median price first outlet	Median price second outlet	Difference in favour of first outlet	Number significantly different to outlet 1
FVOMs vs proximal supermarket on the weekend	1.44	2.79	1.35	9/9 significantly cheaper at the FVOM
FVOMs vs distal supermarket on the weekend	1.55	2.73	1.18	9/9 significantly cheaper at the FVOM
Proximal supermarkets vs distal supermarket on the weekend	2.79	3.11	0.32	1/9 significantly more expensive at the distal supermarket
Mid-week supermarket vs weekend supermarket	2.95	3.15	0.20	2/9 significantly cheaper on the weekend
Farmers' markets vs FVOMs	2.59	1.64	-0.95	6/9 significantly more expensive at the FM
All supermarkets vs Online countdown	2.94	2.90	-0.04	3/9 two significantly cheaper online and one significantly cheaper at the supermarket.

\pm = includes broccoli, cabbage, bok choy, cucumber, lettuce, silverbeet, spinach, cauliflower, pumpkin.

Table 9: A sample ‘shopping basket’ of fruit and vegetables using mean prices compiled from the data collected from FVOMs (n=5)

Item	Quantity (for a family of 2 adults, 2 children, for one week)	Price per kg	Price (\$NZD)
Apples	2.1kg	1.68	3.53
Oranges	2.1kg	2.13	4.47
Pears	2.1kg	2.01	4.22
Broccoli	1 (0.675kg)	1.21	1.21
Cabbage	1 (3kg)	1.90	1.90
Cucumber	1 (0.3kg)	1.64	1.64
Lettuce	1 (0.5kg)	1.34	1.34
Silverbeet	1 (0.4kg)	1.43	1.43
Spinach	1 (0.4kg)	1.91	1.91
Carrots	1 kg	1.54	1.54
Cauliflower	1 (0.6 kg)	1.70	1.70
Mushroom	0.3 kg	9.67	2.90
Onions	0.75 kg	1.67	1.25
Tomatoes	0.5 kg	1.57	0.79
Total:	6.3kg (fruit), 8.4kg (vegetables)*		\$29.83

*300g fruit/day per adult 150g/day per child, 400g vegetables/day per adult, 200g/day per child.

Table 10: A sample ‘shopping basket’ using mean fruit and vegetable prices from the data collected from supermarkets (n= 11)

Item	Quantity	Price per kg	Price (\$NZD)
Apples	2.1kg	3.06	6.43
Oranges	2.1kg	3.35	7.04
Pears	2.1kg	3.74	7.85
Broccoli	1 (0.675kg)	1.70	1.70
Cabbage	1 (3kg)	3.35	3.35
Cucumber	1 (0.3kg)	2.09	2.09
Lettuce	1 (0.5kg)	2.67	2.67
Silverbeet	1 (0.4kg)	3.10	3.10
Spinach	1 (0.4kg)	3.91	3.91
Carrots	1 kg	2.07	2.07
Cauliflower	1 (0.6 kg)	2.68	2.68
Mushroom	0.3 kg	11.79	3.54
Onions	0.75 kg	2.08	1.56
Tomatoes	0.5 kg	2.28	1.14
Total:	6.3kg (fruit), 8.45kg (vegetables)*		\$49.13

*300g fruit/day per adult 150g/day per child, 400g vegetables/day per adult, 200g/day per child.

Discussion

Main Results and Interpretation

Our analyses demonstrate that there is a difference in price of fruit and vegetables sold at FVOMs in comparison to supermarket prices. FVOMs typically offered higher savings on similar food items relative to supermarkets in the Wellington region. Products in FVOMs were on average \$1.35 cheaper than proximal supermarkets on the same fruit and vegetable items with the highest mean mark-up prices being \$2.31 for kumara and \$2.15 for mushrooms. Our comparisons of shopping baskets, based on adequate food quantity for a family of four, revealed a saving of \$19.30 by shopping at a FVOM as opposed to a supermarket. This equates to a saving of 3.4 % of income, for those on the median income in New Zealand, by shopping at fruit and vegetable markets as opposed to supermarkets. Our study compared FVOM prices, markets which only sell fruit and vegetables exclusively, with supermarket prices in Wellington. Our study did not compare the data obtained from the Christchurch markets as these were by definition farmers' markets who sell other items as well as fruit and vegetables. Upon comparison of Wellington FVOMs and the three farmers' markets (two in Christchurch and one in Wellington), we found that 15 out of 18 fruit and vegetables assessed were significantly cheaper at the FVOMs compared to the farmers' markets with the exceptions of bok choy, cauliflower and pumpkin for which there were no significant results. Interestingly, online supermarket shopping proved to be significantly cheaper than supermarkets in Wellington for the following items: pears, cabbage, silverbeet, kumara, and mushrooms.

In view of these findings, FVOMs may bridge the barrier of cost associated with a diet low in fruit and vegetables. FVOMs provide a greater advantage to affordable healthy food options compared to Farmers' markets, while the online supermarket provide an even lower cost price for a select few items (relative to other supermarkets).(2, 12) This finding is consistent with local media reports in New Zealand which have highlighted the increased prices of fruit and vegetables in supermarkets. Also, an interview conducted with the Harbourside Market manager, Fraser Ebbett emphasised that "generally produce is cheaper at markets" relative to supermarkets and that "some produce may also be fresher as roughly 20 % is home grown" (Ebbett, F.

interviewed on 16 March 2013). The significant difference in price between FVOMs and supermarkets may be due to the effect of high mark-up values placed on items bought in bulk by the supermarkets. The apparent duopoly effect of the two major supermarket chains, Foodstuffs and Progressive, may allow these supermarkets to dictate cost price of produce from farmers and then re-sell them with a high mark-up value as there is no competitive market to bring their prices down.(28)

Our results suggested that the presence of FVOMs did not seem to induce a significant halo effect to reduce proximal and distal supermarket prices on weekends. Although supermarkets do have “sale days”, these do not seem to be influenced by the presence of markets as they often fall on week days (for example, “mid-week sales”), or that sale prices are not significantly lower than prices at FVOMs. It seems that FVOMs do not impose a great enough competitive effect on the produce market and therefore do not affect the prices set by the supermarkets. This differs from previous research conducted in the USA which found that the introduction of farmers’ markets into a neighbourhood decreased the prices of fruits and vegetables at neighbouring supermarkets by 12 % over 3 years. However, this American study investigated the effect of introducing markets over a period of time into a neighbourhood considered a “food desert”, amplifying the effects of farmers’ markets on the price of produce in the vicinity. Our method did not investigate the introduction of new FVOMs into an area, nor did it target an area considered a “food-desert”. However, it is possible that a drop in supermarket prices could be seen over a long period of time if a greater number of FVOMs were introduced across Wellington and Christchurch. The number of FVOMs will need to be large enough to compete with the current duopoly effect of Foodstuffs and Progressive supermarket branches. This will not be known until future studies investigate this effect.

Study Strengths and Limitations

The strengths of our study design include gathering quantitative data obtained from 40 different stalls from 8 different markets (FVOMs and farmers’ markets) and 19 different supermarkets (4112 data items in total) based in both the Wellington region and from Christchurch, and online.

Data were gathered from two different urban cities in New Zealand. Within Wellington we gathered data from all markets including those in Porirua and Lower Hutt. As such, this study may tend to reflect the true difference in fruit and vegetable prices between FVOMs and supermarkets in these areas. Data collection was conducted in a seasonal period for peak produce growth.

Limitations to this study include the fact that the data only provide a snapshot of prices (for three weeks in early autumn) and does not reflect seasonal variation or effects of price promotions. Also, data were only gathered on Saturdays and Wednesdays and does not reflect prices over the entire week. Furthermore, we compared the cost of food items across a limited 18 selected fruit and vegetables which were considered to be commonly purchased items. Food items that were not available at both markets and supermarkets or could not be grown in New Zealand's climate were excluded. This method allowed for easy comparison of these items across FVOMs and supermarkets, but may not fully reflect all fruits and vegetables commonly consumed. Also, unavailability of some food items, such as kiwifruit at FVOMs, led to exclusion of this item from analysis. Finally, quality (appearance and "shelf life") and size variation between produce sold at FVOMs compared to those sold at supermarkets were not assessed. The quality of produce sold at FVOMs may vary considerably. Food items with longer "shelf life" would also decrease wastage and thus decrease food costs. The geographical layout of Wellington may also have dampened any halo effect on prices as Wellington central have a tendency to be more expensive thus skewing the results between FVOMs and their proximal and distal counterparts.

Possible Implications for Future Research

Future research conductors could consider investigating produce variation such as availability and cost over a minimum period of 12 month, as well as the variability in quality of fruit and vegetables sold at FVOMs relative to supermarkets. Also, this study only looked at cost as being a barrier to access of fruit and vegetables. Further research should include identifying factors associated with different ethnicities of people currently using the FVOMs or factors causing barriers to access for those of low SES, for example, transport to FVOMs and education on

healthy diets, to place an equity lens on the issue.(30) Any new health policy needs to empower disadvantaged individuals and communities to have better control over the decisions affecting their lives, including which foods they purchase.(31)

Possible Implications for Policy Makers

Based on our findings in this study, the following public health strategies and government initiatives are suggested for further consideration:

- Central or local government support for increasing the number of FVOMs throughout New Zealand so as to increase access to low cost fruit and vegetables and with the potential to lower supermarket prices over time. For example, these governments could offer rent-free land and support promotional activities to increase the visibility of markets.
- Central or local government support for specifically increasing the introduction of FVOMs into isolated and low socioeconomic areas in New Zealand associated with limited access to fruit and vegetables.
- Development of public health policies such as FVOM coupons/vouchers for families in need of financial assistance to ensure an adequate fruit and vegetable intake on a low income.(12, 24, 25) If these coupons were only for food grown in New Zealand, then this would help support local growers as well.

Conclusion

The findings of this study indicate that FVOMs provide produce to New Zealanders at lower cost than are supermarkets. Thus, FVOMs have the potential to bridge the gap between cost and access to fruit and vegetables. The presence of FVOMs did not seem to create a halo effect, with proximal and distal supermarkets continuing to sell produce at higher prices relative to FVOMs in the area. This finding has implications for future public health and social welfare policies in terms of favouring the introduction of markets into areas of high deprivation where cost is a major barrier to maintaining a balanced healthy diet. Future studies to investigate other factors

that promote or discourage market use by people from more deprived communities could also be conducted, so that interventions to increase fruit and vegetable consumption can be effectively implemented and targeted to the most vulnerable populations as well as to the wider New Zealand population.(31)

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