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Use of a nutrient rich foods index to study the effect of Seattle's Minimum Wage Ordinance on supermarket food prices by nutrient quality

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Abstract

Use of a nutrient rich foods index to study the effect of Seattle's Minimum Wage Ordinance on supermarket food prices by nutrient quality

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Minimum wage policies may increase the capacity of low wage workers to achieve higher quality diets through greater food purchasing power. However, limited evidence is available on the effect of minimum wage policies on consumer food prices and even fewer studies perform cost analyses that include measures of food quality. One hypothesis is that the Seattle Minimum Wage Ordinance (SMWO) may result in changes in food prices differentially by food quality such that higher quality foods (i.e., more nutrient dense foods) have a higher increase in prices than lower quality foods. The present study tested: a) whether there is a change in food prices in response to the SMWO 2-years post-implementation, and b) whether there is a differential change in food prices by food quality such that nutrient dense foods had a higher increase than nutrient poor foods. Market basket data on 106 food and beverage items were collected at six supermarket chain stores affected by the SMWO (i.e., treatment) and at six same-chain supermarkets unaffected by the ordinance (i.e., control) at four time points between March 2015 and May 2017 (i.e., 1-month pre-policy implementation and at 1-month post, 1-year post, and 2-years post-policy implementation). The present study applied a nutrient density metric to the SMWO market basket to test these hypotheses. Item-level nutrient density scores were calculated and categorized by quartile using the Nutrient Rich Foods 9.3 index. A series of statistical

analyses were conducted to examine price differences attributable to SMWO overall and of foods by nutrient density quartile: a) between treatment and control supermarket chains, b) across treatment and control supermarkets over time, and c) price differences attributable to SMWO. First, there were no overall market basket price changes over time or attributable to SMWO. Second, food prices by nutrient density quartile did not differ significantly between treatment and control supermarkets at any time point. Third, there were no significant price changes for any nutrient density quartile at affected or unaffected locations over time (baseline and 3 follow up time points). Fourth, there were no significant average item price changes over time for any of the nutrient density quartiles attributable to SMWO. In conclusion, no evidence was found of a pass-through effect on supermarket food prices in response to an increased city-wide minimum wage overall or differentially by food quality.

Introduction

Disparities in diet quality tend to parallel disparities in socioeconomic status (SES).[1 2 3 4] It is well known that lower SES groups tend to consume lower quality diets that are energy-dense and nutrient poor. Such diets are primarily characterized by refined grains, added sugars and fats that tend to cost less per calorie. In contrast, nutrient dense diets characterized by fruits and vegetables, fish and lean meats tend to cost much higher per calorie. [1-4, 5 6 7 8 9 10] These associations among SES, diet cost and diet quality have been consistently observed across all measures of diet quality indicators, including nutrient-based,[7 8 10] food-based [9 11 12] or composite indicators (dietary energy density [3 6 13], dietary nutrient density [11 14], and the Healthy Eating Index (HEI 2005, 2010). [2 15 16] The HEI-2010, composed of 12 dietary components, is a federal measure of diet quality, where scores are based on how well an individual's intake aligns with standards in the Dietary Guidelines for Americans (DGA). [17 18] Diets with higher HEI-2010 scores have been associated with significantly higher energy-adjusted diet costs. Such diets are characterized by higher intakes of fruits, vegetables, whole grains and seafood. Dietary pattern-based analyses, utilizing supermarket data or national food price databases, also found consistent results. Higher quality patterns, such as the Mediterranean diet, characterized by higher intakes of nutrient rich foods cost more than low quality diets characterized by less healthy foods.[4 19 20 21 22] Food prices have been suggested as one of the mechanisms contributing to observed socioeconomic gradient in diet quality.

Pricing strategies to improve diet quality, such as vouchers or price reductions for healthier foods, demonstrate that food subsidies for nutritious foods can be one effective strategy to improve diet quality.[23] Monetary vouchers for nutritious foods, redeemable at supermarkets, farmers markets, or cafeterias encourage purchase of healthy foods. Vouchers exchangeable at supermarkets for fresh produce significantly increased fruit and vegetable consumption in low-income households.[24 25 26] Price discounts on fruits and vegetables offered at a web-based supermarket prompted a 25% increase in the number of fruits and vegetables purchased by individuals on a fixed weekly budget.[27]

Food assistance programs, such the USDA SNAP, is one approach to aid low income families to afford nutrient dense foods. Among individuals with marginal, low, or very low food security, SNAP participation has been shown to improve diet quality, demonstrated through

higher HEI-2010 scores.[28] A 40% fruit and vegetable bonus ($2 extra for every $5 spent on fruits and vegetables) available to Supplemental Nutrition Assistance Program (SNAP) EBT card users at farmers markets coupled with attendance frequency-based financial incentives was associated with significantly increased vegetable consumption and decreased soda consumption of participants.[29] A study of the USDA Healthy Incentives Pilot (HIP), found SNAP households that received a 30% rebate on targeted fruits and vegetables (fresh, canned, frozen and dried) purchased using SNAP benefits significantly increased intake of fruit (23% increase) and vegetables (30% increase). [30] Providing families an extra $60/month on SNAP EBT cards or cash-value vouchers for food during the summer both improved the healthfulness of children's diets (with higher consumption of fruits, vegetables, and whole grains) as compared to children in families not receiving extra benefits.[31] Modeling a per capita increase on SNAP benefits by $30/month predicted significant increases in diet quality, including higher consumption of vegetables and legumes, and a significant decrease in fast food consumption.[32] Such studies suggest that even a small increase in food budget may expand healthful food purchasing power of low wage workers and improve their diet quality.

Social policies, such as minimum wage policies, may be another means to improve purchasing power of low-income populations and improve the health of low wage workers, in part through increasing financial resources for healthier food purchases. One such policy that recently came into effect is Seattle's Minimum Wage Ordinance (SMWO).[33] The purpose of this ordinance was to improve low income communities through a multiple phase increase to $15 an hour for all workers employed within the city of Seattle. However, one hypothesis is that in response to wage legislation, businesses who employ large numbers of low wage workers may raise consumer prices to offset higher labor costs.[34] [35] In general, labor accounts for one-third of operating costs for a business.[36] The question is whether food retailers will increase the prices of food and specifically of healthy foods to offset their increased cost in response to minimum wage policy. The present study attempted to address this question by studying prices of a representative basket of 106 foods and beverage items before and after SMWO implementation.

The potential pass-through effect of minimum wage policy on supermarket food prices based on a nutrient quality measure can be insightful in determining whether minimum wage policies can help people afford more nutritious foods. While prior studies have assessed fast food

and restaurant prices in response to minimum wage legislation, no studies have yet examined the impact of minimum wage increase on food prices of nutrient dense foods. It is necessary to study the impact of minimum wage policies on supermarket food prices given that SNAP benefits are overwhelmingly used at larger food retails stores over smaller markets.[37] Worth exploring is whether increases in supermarket food prices in response to SMWO will offset the SNAP benefits offered to low income families.

Differential price changes at supermarkets based on food quality attributable to minimum wage increases remained unexplored in earlier phase-in periods of Seattle's Minimum Wage Ordinance (SMWO).[38 39] SMWO went into effect on April 1, 2015, designed as a progressive increase to $15.00 an hour over the course of 3-6 years, dependent on employer size and employer-paid medical benefits.[33] Prior to implementation of SMWO, 66% of Seattle workers in the food preparation/service sector and 43% of employees in the sales sector earned less than $15.00 an hour.[40] The present paper adds to the analysis of overall market basket price data the January 1, 2017 phase-in period of the SMWO to $15.00/hr for large employers that do not provide medical benefits within the city of Seattle.

The overarching goal of the present study is to test the hypothesis whether implementation of SMWO increased supermarket food prices by food quality. The specific aims are as follows: assess price differences of foods by nutrient density quartile a) between treatment and control supermarkets at each data collection time point, b) across treatment and control supermarkets over time, and c) study whether price differences are attributable to SMWO. This analysis examines whether differential impact on food prices based on an objective measure of food quality could be attributed to a city-level minimum wage policy. Assessing a food's quality necessitates the use of an objective measure, or score, which can provide a nutritional profile for a wide variety of food and beverage items. This study utilizes a nutrient rich foods index to differentiate foods for analysis based on food quality, providing a more detailed approach to understanding potential nutritional health impacts in response to minimum wage legislation.

Methods

Data Collection

The full methodology of the Seattle Minimum Wage Study (SMWS) grocery price data collection has been described previously. [38 39 41] Briefly, the purpose of the SMWS study was to explore the impacts of local minimum wage ordinances in Seattle and other cities on employment and earnings, income, and health; provide insight into how firms and businesses respond to wage changes, and to further understanding of how minimum wage ordinances may impact low-wage workers and households. The current study is part of a larger price study to determine the consumer level effects of an increased minimum wage on retail food prices. This study leveraged the University of Washington's Center for Public Health Nutrition (CPHN) market basket survey, which collects and standardizes prices for 106 food and beverage items. Inclusion of food and beverages in this market basket was based on the consumer price index as well as the Thrifty Food Plan market baskets developed by the USDA.[42] Data were collected at six supermarket chain stores affected by the Seattle Minimum Wage Ordinance (SMWO) ("intervention"- Seattle) and at six same-chain supermarkets unaffected by the ordinance ("control" – King County) at four time points: 1-month pre-implementation of Seattle's Minimum Wage Ordinance (March 2015), 1-month post-implementation (May 2015), 1-year post-implementation (May 2016), and 2 years post-implementation (May 2017). The data collection timeline in relation to the policy implementation timeline of Seattle's $15/hour minimum wage for large businesses (501 or more employees) is shown in Table 1. Supermarket selection was drawn from a previous study identifying these six supermarkets as a main food source for 65% of Seattle residents.[34] The selected supermarkets also represented a range of affordability, including stores with low, medium, and high prices.[43]

Table 1. Timeline of Seattle's minimum wage increase during data collection			
Date of data collection	**Minimum wage**		**Time Point**
March 2015	$9.47/hr		1-month pre-implementation
May 2015	$11.00/hr (April 2015)		1-month post-implementation
May 2016	$13.00/hr * (Jan 2016)	$12.50/hr † (Jan 2016)	1-year post-implementation
May 2017	$15.00/hr* (Jan 2017)	$13.50/hr † (Jan 2017)	2 years post-implementation

Minimum wage is for employers with over 500 employees who (*) do not pay towards an employee's medical benefits and (†) employers that do pay towards medical benefits.[33]

SMWS data collection procedures

A standard set of protocols were developed in the beginning of the study to collect prices for CPHN market basket of 106 food items. The detailed methodology has been published previously and described here briefly.[38 39] For each item, the lowest non-sale price, ideally in the same purchasable form available the year prior, was recorded on-site by a trained field researcher. When multiple sizes were available for the same food item, a medium-sized item was selected. Following collection, price data were rechecked for anomalies, and missing market basket items were re-checked in-store.

Nutrient Density Score as an indicator of quality

A common and validated means to give objective nutrition rankings to foods and beverages is the use of a nutrient rich foods index, which can then be compared with other measures such as price. [44 45] A nutrient rich foods index is used to calculate a nutrient density score for a food item based on the proportion of certain positive and negative macro- and micronutrients within that food item. Addition of a nutrient density score to ongoing SMWO study was the unique contribution of this analysis. Nutrient scores were calculated for each food item using the Nutrient Rich Foods Index 9.3 ($NRF_{9.3}$). The CPHN market basket was linked with Minnesota Nutrition Composition database and USDA SR 28 database to obtain nutrient composition per gram for each of its food and beverage items. [46] This included total calories along with 4 macro-

and 9 micronutrients. $NRF_{9.3}$ score was computed for each item using nine nutrients to encourage and three nutrients to limit in a healthy diet (Table 2). This allows for a lower nutrient density score to be given to foods with high amounts of added sugars, sodium, or saturated fat compared to foods without. The $NRF_{9.3}$ is based on daily value reference amounts established by the Food and Drug Administration and the index has been validated against the USDA's Healthy Eating Index.[47,48] The $NRF_{9.3}$ score is represented in the following formula:

$$\mathbf{NRF_{9.3} = \sum_{n=9} (\%DV/100\ kcal) - \sum_{n=3} (\%DV/100\ kcal)}^{5} \quad (1)$$

The score is calculated by determining the amount of each of nine positive nutrients and three negative nutrients in 100 kcal of a food item. Dividing this amount by the recommended daily value or limit yields the percent daily value (%DV) of each nutrient in the food item. The %DVs of the three negative nutrients are summed and subtracted from the summed %DVs of the nine positive nutrients. This value is multiplied by 100% to yield the $NRF_{9.3}$ score.

Table 2. Nutrients included in the Nutrient Rich Foods Index 9.3 and recommended daily values[49]

Nutrients to Encourage	**Daily Value**
Protein	56 g
Fiber	25 g
Vitamin A	3000 IU
Vitamin C	90 mg
Vitamin D	20 mcg
Calcium	1300 mg
Iron	18 mg
Potassium	4700 mg
Magnesium	420 mg
Nutrients to Limit	**Daily Limit**
Added sugars	50 g*
Saturated fat	20 g*
Sodium	2,400 mg
*<10% of calories in 2,000 calorie diet	

For each nutrient, values were capped at 100% of the daily value (for positive nutrients) or recommended daily limit (for negative nutrients). This was done to avoid inflated scores for food items with extremely high relative amounts of a nutrient. Nutrient density scores were available for 83 items using a nutrient composition database accessible through the Fred Hutchison Research Center. For the remaining 23 items, nutrient density scores were calculated using nutrient reference data obtained from the publicly available USDA Nutrient Database and Equation 1 above.

Food items were then categorized into quartiles by nutrient density score. Quartile 1 contains food items with the lowest nutrient densities, including some items that have a negative $NRF_{9.3}$ score, indicating a high presence of added sugars, saturated fats, and/or sodium. Quartile 4 includes food items receiving the highest nutrient density scores, such as fresh produce. Details on $NRF_{9.3}$ scores and example foods for each nutrient density quartile are described in Table 3.

Table 3. Nutrient density quartiles based on $NRF_{9.3}$ score

Quartile	Mean NRF Score (± SD)	NRF Score Range	Example Foods
Quartile 1- *Least nutrient dense foods*	-12.9 (±17.2)	-51.6-8.8	Chocolate chip cookies, butter, bologna, cola, potato chips (n=27)
Quartile 2- *Moderately nutrient dense foods*	19.8 (±5.8)	9.3-30.3	Potatoes, spaghetti, rice, bread(n=26)
Quartile 3- *Nutrient dense foods*	56.9 (±22.5)	30.2- 113.5	Whole wheat flour, milk, tofu, apples, bananas, chicken, salmon, mushrooms(n=27)
Quartile 4- *Highly nutrient dense foods*	231.2 (±86.8)	117.8-479.5	Tomatoes, sweet potatoes, spinach, canned pumpkin, strawberries, whole grain cereal, coffee(n=26)

Food price variable

For each item, supermarket prices in purchasable form were converted into price per 100g to standardize comparison across all foods and beverages. Items with measurement units other than grams, such as fluid ounces, were converted into grams using established reference values in the USDA Nutrient Composition Database.[37]

Statistical Analyses

Descriptive statistics were conducted to calculate mean, median and range of cost for each nutrient density quartile at a fixed time for each time point. A complete case analysis was conducted to remove items that were inconsistently present across data collection time points. Exclusion of inconsistent item-level data is important, as price per item can vary substantially. For example, an expensive food item such as fresh salmon has potential to significantly sway total market basket price if included differentially in analyses year to year. Out of 1908 market basket items, 27 items were differentially missing at follow-up 3 data collection compared to

baseline. Missing items that did not have a within store or time comparison were dropped, totaling 26 items between follow-up 2 and follow-up 3, 10 items between follow-up 1 and follow-up 2, and 12 items between baseline and follow-up 2. No items were reported missing between baseline and follow-up 1.

The analyses were conducted in three steps. First, we studied differences in prices of foods by NRF quartile across the treatment and control supermarkets at each of the four time points (baseline, 1-month post, 1-year post, and 2-years post) using unpaired t-tests with equal variances for each supermarket chain. For example: average item price for a nutrient density quartile at a Seattle supermarket was compared to average item price at the King County location. Second, we studied differences in prices across treatment and control supermarkets over time using paired t-tests. Average price differences by nutrient density quartile and location across all time points were computed. This would detect differences within a supermarket chain over time.

Third, to determine the change in average market basket item prices that can be attributed to the minimum wage policy, a multilevel, linear differences-in-differences model was used:

$$Price_{ijkt} = \alpha_j + \beta_k Seattle_k + \gamma_1 Post1_t + \gamma_2 Post2_t + \gamma_3 Post3_t + \delta_1 Post1_t \times Seattle_k + \delta_2 Post2_t \times Seattle_k + \delta_3 Post3_t \times Seattle_k + \varepsilon_{ijkt} \quad (2)$$

Where $Price_{ijkt}$ is the estimated mean price for item *i* at store *j* in region *k* (Seattle (affected) or King County (unaffected) stores), at time *t*. α_j is a store-level random effect. $Seattle_k$ is an indicator that equals 1 for Seattle stores and 0 for King County stores, and β_k captures differences in mean item-level prices across regions. *Post1* is an indicator variable equal to 1 for prices measured in the follow-up 1 period (May 2015) and 0 for baseline (March 2015), and γ_1, γ_2 and γ_3 are differences in mean item-level prices across time relative to the baseline period. *Post2* and *Post3* are indicator variables equal to 1 for prices in the follow-up 2 and follow-up 3 periods respectively. $\delta_1 Post1_t \times Seattle_k$ equals 1 only for Seattle stores in the follow-up 1 period, and δ_1 are the treatment effects (price difference in Seattle that cannot be explained by region and time effects and could thus be attributed to the minimum wage ordinance). The model follows this same pattern for follow-up 2 ($\delta_2 Post2t \times Seattle_k$) and follow-up 3 ($\delta 3Post3t \times Seattlek$). ε_{ijkt} is the idiosyncratic error. Separate linear differences-in-differences models (Equation 2) were analyzed stratified by nutrient density score quartiles, again giving an estimate of mean

difference in item-level price but within a nutrient density category. Robust standard errors clustered at the store level and an α level of 0.05 was used to determine statistical significance.

Results

Prices of the overall market basket

Figure 1 displays the average total market basket cost for Seattle and King County locations at baseline (March 2015), follow-up 1 (May 2015), follow-up 2 (May 2016) and follow-up 3 (May 2017). While King County stores had a slightly lower average market basket cost compared to Seattle stores at baseline and each follow-up visit, there were no significant differences in total market basket or item-level costs cost at one-month (-\$0.01, SE = 0.05, P=0.884), one-year (-\$0.03, SE = 0.08, P=0.738), or two-years post-policy implementation (-\$0.01, SE = 0.12, P=0.923).

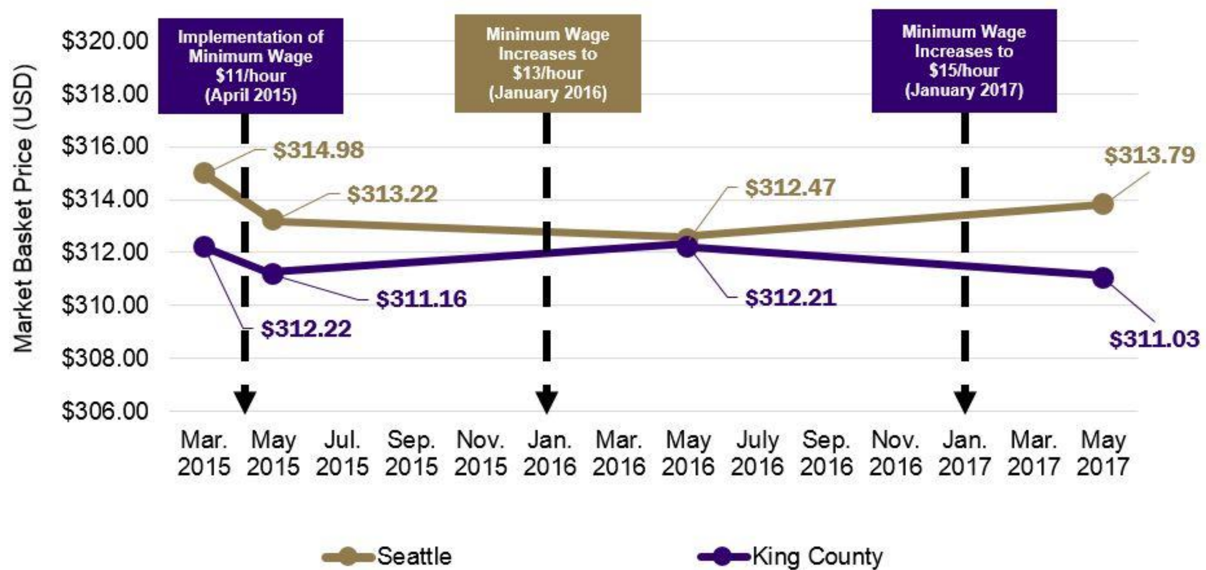


Figure 1. Average market basket cost before and after three phase-ins of the Seattle Minimum Wage ordinance in affected Seattle ("intervention") stores as compared with unaffected King County ("control") stores. Dashed vertical lines correspond to Seattle's Minimum Wage Ordinance phase-ins for businesses with more than 500 employees where the employee does not receive employer-paid medical benefit payments.

Trends in food prices between treatment and control supermarket at each time point

Table 4 shows differences in average item price between Seattle and King County stores for each supermarket chain by nutrient density quartile. Average item price within a nutrient density category did not differ significantly between same-chain supermarkets at any time point.

Table 4. Difference in average item price (per 100g) between treatment and control supermarket chains (Seattle vs. King County) by nutrient density quartile at baseline, follow-up 1, follow-up 2 and follow-up 3

Supermarket Chain	Mean price difference (NRF 1)	*P* value	Mean price difference (NRF 2)	*P* value	Mean price difference (NRF 3)	*P* value	Mean price difference (NRF 4)	*P* value
Baseline								
Supermarket Chain 1	$ 0.00	0.97	$ 0.04	0.79	$ -0.03	0.86	$ 0.04	0.52
Supermarket Chain 2	$ 0.01	0.96	$ 0.03	0.83	$ -0.07	0.73	$ 0.03	0.70
Supermarket Chain 3	$ 0.02	0.90	$ 0.01	0.94	$ 0.06	0.78	$ 0.01	0.91
Supermarket Chain 4	$ 0.01	0.94	$ -0.06	0.73	$ 0.04	0.85	$ -0.00	0.99
Supermarket Chain 5	$ 0.25	0.81	$ -0.03	0.86	$ 0.03	0.89	$ -0.00	0.95
Supermarket Chain 6	$ -0.01	0.95	$ -0.03	0.87	$ 0.00	0.99	$ 0.02	0.85
Follow-up 1								
Supermarket Chain 1	$ 0.06	0.06	$ 0.02	0.90	$ 0.01	0.95	$ 0.00	0.97
Supermarket Chain 2	$ 0.01	0.97	$ 0.01	0.93	$ -0.02	0.93	$ -0.03	0.73
Supermarket Chain 3	$ 0.04	0.76	$ -0.04	0.81	$ -0.03	0.90	$ 0.01	0.91
Supermarket Chain 4	$ 0.01	0.90	$ -0.02	0.89	$ 0.02	0.92	$ 0.05	0.70
Supermarket Chain 5	$ -0.01	0.94	$ -0.02	0.92	$ 0.03	0.87	$ -0.00	0.98
Supermarket Chain 6	$ 0.03	0.85	$ -0.03	0.89	$ 0.01	0.96	$ -0.02	0.87
Follow-up 2								
Supermarket Chain 1	$ 0.00	0.99	$ 0.02	0.86	$ 0.03	0.83	$ 0.03	0.72
Supermarket Chain 2	$ 0.02	0.85	$ -0.02	0.90	$ 0.07	0.75	$ 0.03	0.70
Supermarket Chain 3	$ -0.01	0.91	$ 0.00	1.00	$ 0.02	0.94	$ -0.02	0.77
Supermarket Chain 4	$ -0.06	0.56	$ -0.01	0.92	$ -0.01	0.97	$ -0.02	0.84
Supermarket Chain 5	$ -0.01	0.96	$ 0.02	0.89	$ 0.00	0.99	$ 0.01	0.86
Supermarket Chain 6	$ -0.01	0.95	$ 0.08	0.65	$ 0.03	0.88	$ 0.00	1.00
Follow-up 3								
Supermarket Chain 1	$ 0.06	0.53	$ 0.06	0.59	$ 0.07	0.61	$ -0.05	0.51
Supermarket Chain 2	$ -0.01	0.92	$ 0.03	0.86	$ 0.01	0.98	$ -0.00	0.96
Supermarket Chain 3	$ 0.08	0.51	$ -0.05	0.76	$ 0.05	0.86	$ -0.02	0.82
Supermarket Chain 4	$ 0.00	1.00	$ -0.02	0.90	$ -0.00	1.00	$ 0.02	0.82
Supermarket Chain 5	$ 0.02	0.85	$ -0.02	0.87	$ 0.03	0.89	$ 0.02	0.81
Supermarket Chain 6	$ 0.01	0.95	$ 0.01	0.97	$ 0.02	0.93	$ -0.04	0.74

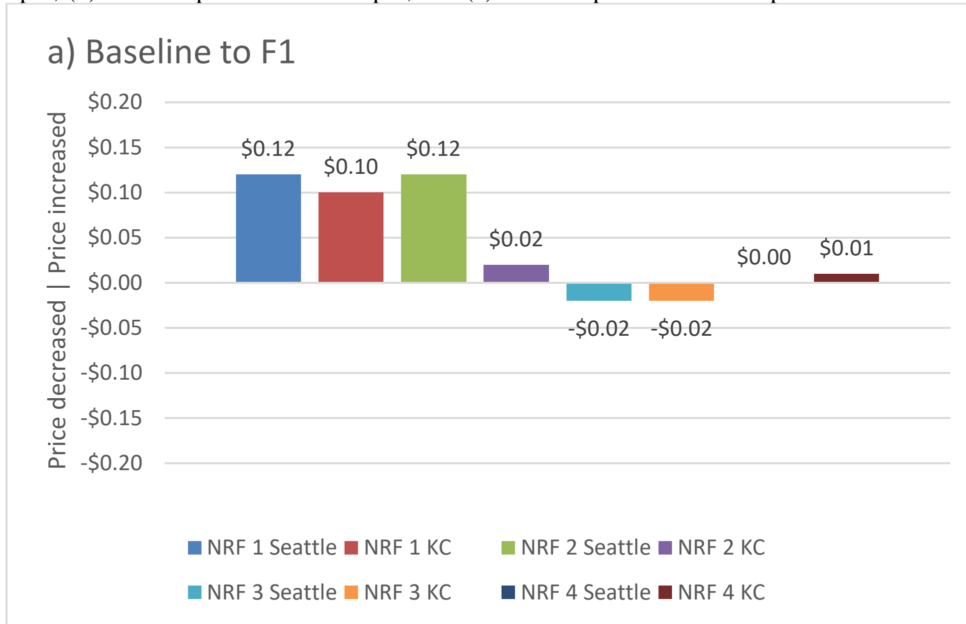
Paired t test with equal variances

Negative price differences indicate that King County stores had higher prices than Seattle stores. Positive price differences indicate that Seattle stores had higher average item prices than King County locations.

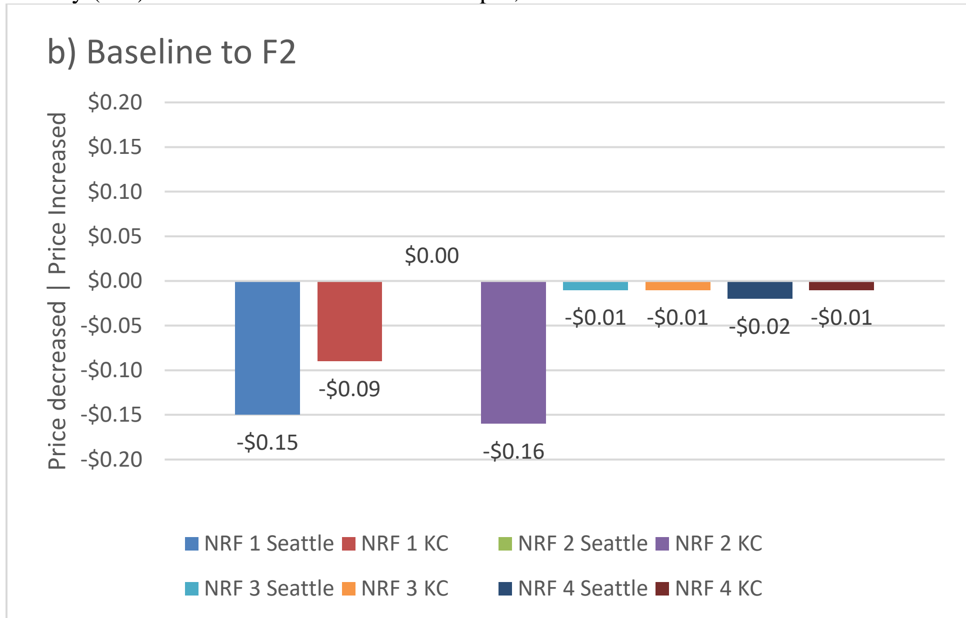
Trends in food prices between treatment and control supermarket across time points

Figure 2 shows the change in average item price per 100g within each nutrient density quartile by location (Seattle or King County) between time points. Between baseline and follow-up 1, baseline and follow-up 2, and baseline and follow-up 3 there were no significant price changes for any nutrient density category at either Seattle or King County stores. Between baseline and follow-up 3, foods with the lowest nutrient density (NRF 1) decreased in price across all supermarkets, in contrast to no change in prices for nutrient dense foods during the same time. Between follow-up 1 and follow-up 2, there was a significant price change (-\$0.03, P = 0.046) within the second nutrient density category (NRF2) at King County store locations. Between follow-up 2 and follow-up 3, there were significant price changes in nutrient density categories NRF1 and NRF4 at both locations. Within NRF1, the least nutrient dense food category, average prices at follow-up 3 in King County stores (-\$0.09, P = .0001) and Seattle stores (-\$0.05, P = 0.02) were significantly less than at follow-up 2. Within NRF4, the most nutrient dense food category, King County stores (\$0.05, P = 0.0008) and Seattle stores (\$0.03, P = 0.04) saw significantly higher prices at follow-up 3 compared to follow-up 2. A value of \$0.00 indicates that there was no price difference between Seattle and King County locations.

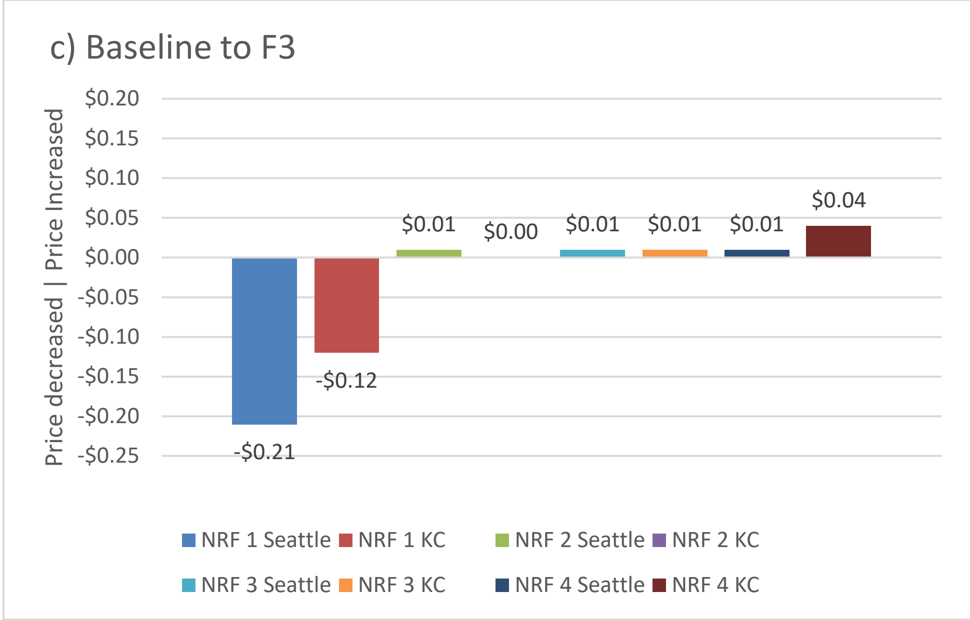
Figure 2a-e. Change in average price per 100g by nutrient density quartile (NRF1, NRF2, NRF3, NRF4) in Seattle and King County (KC) between (a) baseline and follow-up 1, (b) baseline and follow-up 2, (c) baseline and follow-up 3, (d) follow-up 1 and follow-up 2, and (e) follow-up 2 and follow-up 3.



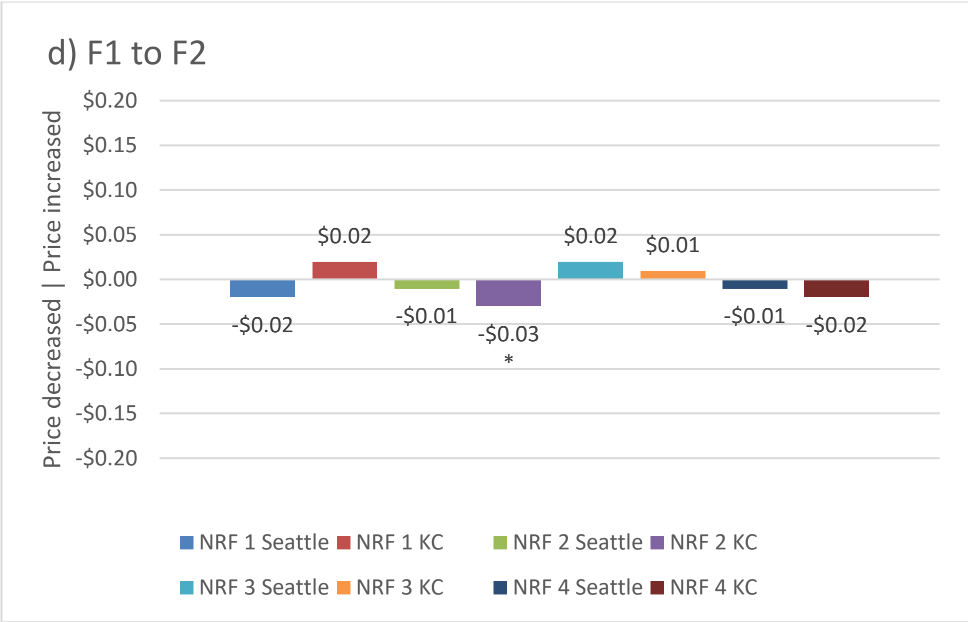
2a. Change in average price per 100g by nutrient density quartile (NRF1, NRF2, NRF3, NRF4) in Seattle and King County (KC) between baseline and follow-up 1, * = $P < 0.05$



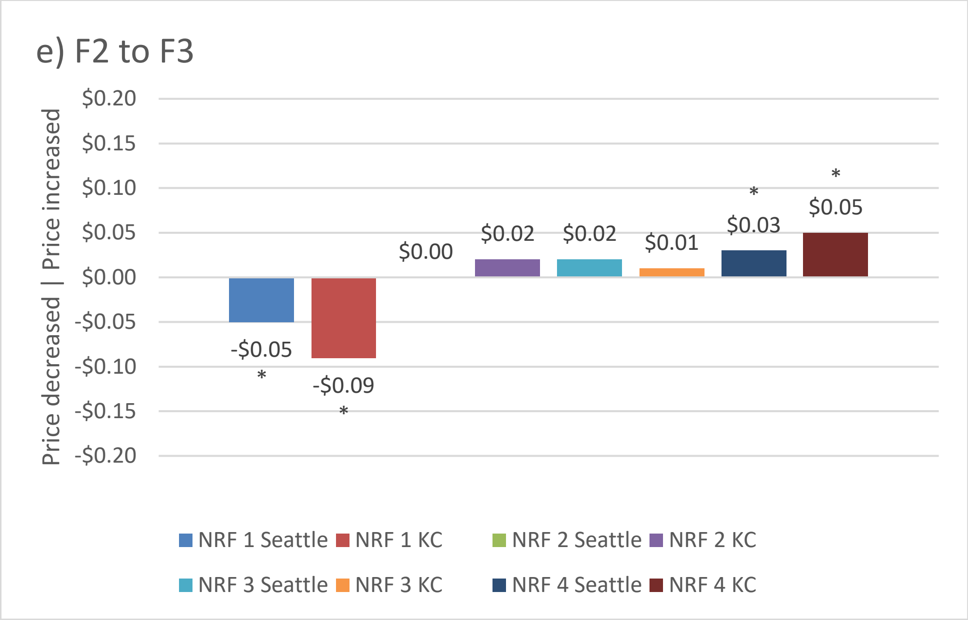
2b. Change in average price per 100g by nutrient density quartile (NRF1, NRF2, NRF3, NRF4) in Seattle and King County (KC) between baseline and follow-up 2, * = $P < 0.05$



2c. Change in average price per 100g by nutrient density quartile (NRF1, NRF2, NRF3, NRF4) in Seattle and King County (KC) between baseline and follow-up 3, * = $P < 0.05$



2d. Change in average price per 100g by nutrient density quartile (NRF1, NRF2, NRF3, NRF4) in Seattle and King County (KC) between follow-up 1 and follow-up 2, * = $P < 0.05$



2e. Change in average price per 100g by nutrient density quartile (NRF1, NRF2, NRF3, NRF4) in Seattle and King County (KC) between follow-up 2 and follow-up 3, * = $P < 0.05$

Difference-in-difference analyses

The results of the multilevel, difference-in-differences model are shown in **Table 5**. Differences in average item-level price per 100g did not change significantly over time for any of the nutrient density quartiles or overall. The largest observed price changes attributable to the SMWO by nutrient density quartile between any two time points in Seattle chain supermarkets, compared to King County supermarkets, was an increase of $0.15 (SE = 0.26) within NRF3 between baseline and follow-up 2 and a decrease of $0.12 (SE = 0.08) within NRF4 between baseline and follow-up 3.

Table 5. Nutrient density stratified linear difference-in-differences model results for the mean change in item-level price across Seattle ("intervention") and King County ("control") stores and time, from March 2015 to May 2017, following Seattle's Minimum Wage Ordinance					
		Nutrient density quartile			
	Overall	**NRF 1: Least nutrient dense foods**	**NRF 2: Somewhat nutrient dense foods**	**NRF 3: Nutrient dense foods**	**NRF 4: Highly nutrient dense foods**
Seattle (relative to King County)					
Mean	$ 0.03	$ 0.03	$ -0.01	$ 0.02	$ 0.07
SE	(0.35)	(0.58)	(0.31)	(0.34)	(0.23)
Follow-up 1 (relative toaseline period)					
Mean	$ -0.01	$ -0.09*	$ 0.07	$ -0.07	$ 0.06
SE	(0.02)	(0.05)	(0.04)	(0.07)	(0.04)
Follow-up 2 (relative to baseline period)					
Mean	$ -0.00	$ 0.12	$ -0.05	$ -0.08	$ -0.02
SE	(0.06)	(0.10)	(0.08)	(0.11)	(0.02)
Follow-up 3 (relative to baseline period)					
Mean	$ -0.02	$ -0.18	$ -0.00	$ -0.06	$ 0.17***
SE	(0.09)	(0.10)	(0.12)	(0.20)	(0.04)
Seattle x follow-up 1					
Mean	$ -0.01	$ 0.08	$ -0.05	$ -0.00	$ -0.06
SE	(0.05)	(0.08)	(0.05)	(0.10)	(0.07)
Seattle x follow-up 2					
Mean	$ -0.03	$ -0.09	$ 0.07	$ -0.04	$ -0.03
SE	(0.08)	(0.14)	(0.15)	(0.18)	(0.04)
Seattle x follow-up 3					
Mean	$ 0.01	$ -0.01	$ 0.02	$ 0.15	$ -0.12
SE	(0.12)	(0.16)	(0.16)	(0.26)	(0.08)
Observations	5,013	1,284	1,242	1,266	1,221
Stores (n)	12	12	12	12	12
R^2 within	0.0000	0.00287	0.000175	0.000419	0.00247
R^2 between	0.0003	0.0169	0.00414	0.00169	0.00161
R^2 overall	0.0000	0.00287	0.000154	0.000448	0.00238

Robust standard errors in parentheses; *P* values come from Wald tests
*** $P < 0.001$, ** $P < 0.01$, * $P < 0.05$
Baseline, March 2015 (1-month pre-policy implementation); follow-up 1, May 2015 (1-month post-policy implementation); follow-up 2, May 2016 (1-year post-policy implementation); follow-up 3, May 2017 (2-years post policy implementation)

Discussion

Studies have consistently shown that higher quality diets cost more than less nutritious diets and that low-income individuals tend to have lower quality diets.[1-4] The impact of a

minimum wage policy on supermarket food prices based on diet quality is important in understanding how wage policies may influence the ability of low income shoppers to afford a highly nutritious diet rich in fresh fruits and vegetables. This study assessed the effect of Seattle's minimum wage policy on supermarket food prices overall and by nutrient density before and after three SMWO policy phase-ins (i.e., to a minimum wage of $11/hour, $13/hour, and $15/hour). We found no evidence of supermarket food price changes related to the SMWO after an increase to a $15.00 an hour minimum wage overall or based on a food's nutrient density.

There are several possible explanations for the null results observed in this study. First, supermarkets may be offsetting increased labor costs through a channel other than food price increases, such a reduction in employee overtime. [50] A report on the impact of SMWO on employment indicators showed that while wages increased, a reduction of 35-40 minutes per week per low-wage worker was observed following policy changes.[51] Second, supermarkets may be increasing the price of items not included in the market basket sample, such as bakery items, soups and salads, and other prepared foods available in many supermarkets. These food items are prepared in-house, and their price elasticity may behave more similarly to fast food prices than supermarket shelf items. Five out of six supermarket chains sampled in this study had extensive prepared foods sections, however, our market basket was not designed to collect these items systematically over time. Third, supermarket prices may be fixed at a national level, and thus less responsive to local policy changes. Many of the packaged food and beverage items sampled were the national-level store brands, which are likely to be price stable across a wide region. This price stability would apply to the foods with the highest nutrient density, often fresh fruits and vegetables, as these are frequently sourced from outside Washington state during the time of data collection. Fourth, employees at the supermarkets sampled may have been making at or above $15.00 an hour prior to the policy change. Four out of the six supermarkets sampled are unionized, and pre-policy wages may have already been at or above $15.00 an hour or unionized stores may provide benefits to workers that would place the $15.00 an hour benchmark after our most recent data collection time point. In the year prior to the SMWO, 14.3% of jobs in grocery stores in Seattle and 29.3% in King County earned less than $11 an hour based on administrative earnings and hours data from over 500 grocery establishments (NAICS Code 445110) provided

by the Washington Employment Security Department.[52] These proportions are higher when compared to all low-wage wage jobs in all industry sectors, 7.2% in Seattle and 9.9% in the rest of King County and suggests that SMWO would have a greater effect in grocery stores compared to other industries.

It is unclear what impact Washington state minimum wage increases had on supermarket prices in our fourth time point in May 2017. Between January 1, 2017 and January 1, 2018, Washington state employers were required to raise wages for all adult employees to a minimum of $11.00 an hour in preparation of future minimum wage increases.[53] It is possible that King County supermarkets increased wages to $11.00/hr prior to the January 1, 2018 deadline. Evidence from other low-wage sectors suggests that businesses may be unlikely to raise minimum wages in advance of mandated timelines.[12] In this case, we wouldn't expect to see wage increases related to Washington state minimum wage policy until 2018. Using employer-survey data, other research suggests large employers might be early responders.[54]

While studies of supermarket food prices in response to minimum wage changes are lacking, some comparisons can be made to prior research on fast food and restaurant prices. There is inconsistent evidence of a pass-through effect of state and federal minimum wage policies on fast food prices. Early research by Katz and Krueger found that price changes in the cost of a fast food meal were unrelated to a federal wage increase.[55] A follow-up study by Card and Krueger on a state-level minimum wage increase in New Jersey reported mixed evidence of a pass-through effect on fast food prices.[56] The cost of a fast food meal rose 3.2% higher in New Jersey compared to a meal Pennsylvania, which served as a control, however, when meal prices at individual stores, located in New Jersey, were compared, price increases did not correlate with the proportion of workers at the store affected by the minimum wage increase. MacDonald and Aaronson reported fast food price increases of 1.56% for a 10% increase in minimum wage, but also that item selection for price increases was related to other factors, such as a recent price reduction of the item.[57] Powers assessed the response of fast food prices to a 2004 state-level minimum wage increase in Illinois, finding mixed evidence of an impact on fast food prices, strongest for entrée prices.[58] Basker and Khan priced 3 menu items at New York City fast food restaurants throughout 1993-2014 to analyze price changes in response to 5 federal minimum wage increases that were implemented over the study period.[59] Their study found that a federal

minimum wage increase of 33% would be estimated to have a 3% increase in fast food prices in response to wage policy, an average increase of $0.10 per item.

City-wide minimum wage policies are a more recent area of legislation. The first cities to adopt local minimum wage increases, aside from the District of Columbia, were San Francisco and Santa Fe in 2003.[60] Food prices in Santa Fe were not studied in response to changes in minimum wage. An analysis of San Francisco menu prices of small and midsize fast food and table-service restaurants found a significant increase of 6.2% in fast food prices following a 26% increase in the minimum wage. Price increases were not related to the proportion of affected workers in the businesses, suggesting that price increases were related to competitive cost pressure among restaurants in the San Francisco area and not the policy change itself. This study only sampled a single menu item from each restaurant, which may not have captured where food price changes occurred. A 2016 study by Allegretto and Reich of a San Jose minimum wage increase analyzed restaurant prices obtained from online menus before and after a city-wide minimum wage increase of 25%, finding average prices increased 1.45% between restaurants within the city limits and adjoining urbanized areas of the same county.[61] No minimum wage studies of restaurant or fast food prices included a measure of food quality, which highlights the importance of the present study in matching price data to food quality measures.

This study had several strengths, including a 2-year seasonally-matched data collection that included multiple wage benchmarks during a progressive minimum wage increase. Additionally, this study utilized a validated nutrient rich foods index in calculating nutrient density scores for market basket items to provide an analysis of supermarket prices in relation to food quality. However, this study is limited in its ability to capture the impact of minimum wage policy on small, non-national grocery stores. Large supermarket chains benefit from centralized operations for much of the production, processing, and transportation costs of its products, which helps alleviate the burden of local wage increases. While the market basket used included commonly purchased items and a variety of nutritious and non-nutritious foods, a wider sampling of prepared foods would strengthen the analysis. Finally, recording specific brand names of food items would have allowed for more exact item comparisons when calculating nutrient density scores from nutrient composition databases.

Conclusions

This study found no evidence that supermarket food prices changed overall or differentially based on nutrient quality in response to Seattle's minimum wage ordinance. The lack of evidence of increased grocery prices in response to wage increases can provide support for livable wage advocates, as low-income workers may be able to afford higher quality diets if wages increase yet supermarket prices stay the same. While a minimum wage increase within the city of Seattle did not contribute to higher supermarket food prices at any level of nutrient quality, these findings cannot necessarily be applied to local wage policies in other cities or states. It is important for future studies to examine a greater variety of supermarket items, including items prepared in house, as well as other market types utilized by low income shoppers that may be less price stable than national chains, to more completely evaluate the impact minimum wage policies may have on the affordability of high quality diets.

REFERENCES

[1] Darmon, N., & Drewnowski, A. (2015). Contribution of food prices and diet cost to socioeconomic disparities in diet quality and health: A systematic review and analysis. Nutrition Reviews, 73(10), 643-660. doi:10.1017/s1368980010003642

[2] Rydén, P. J., & Hagfors, L. (2011). Diet cost, diet quality and socio-economic position: How are they related and what contributes to differences in diet costs? Public Health Nutrition, 14(09), 1680-1692.

[3] Monsivais, P., & Drewnowski, A. (2009). Lower-Energy-Density Diets Are Associated with Higher Monetary Costs per Kilocalorie and Are Consumed by Women of Higher Socioeconomic Status. Journal of the American Dietetic Association, 109(5), 814-822. doi:10.1016/j.jada.2009.02.002

[4] Schröder, H., Gomez, S. F., Ribas-Barba, L., Pérez-Rodrigo, C., Bawaked, R. A., Fíto, M., & Serra-Majem, L. (2016). Monetary Diet Cost, Diet Quality, and Parental Socioeconomic Status in Spanish Youth. Plos One, 11(9). doi:10.1371/journal.pone.0161422

[5] Drewnowski, A., & Specter, S. (2004). Poverty and obesity: The role of energy density and energy costs. The American Journal of Clinical Nutrition, 79(1), 6-16. doi:10.1093/ajcn/79.1.6

[6] Drewnowski, A., Monsivais, P., Maillot, M., & Darmon, N. (2007). Low-Energy-Density Diets Are Associated with Higher Diet Quality and Higher Diet Costs in French Adults. Journal of the American Dietetic Association, 107(6), 1028-1032. doi:10.1016/j.jada.2007.03.013

[7] Andrieu, E., Darmon, N., & Drewnowski, A. (2005). Low-cost diets: More energy, fewer nutrients. European Journal of Clinical Nutrition, 60(3), 434-436. doi:10.1038/sj.ejcn.1602331

[8] Townsend, M. S., Aaron, G. J., Monsivais, P., Keim, N. L., & Drewnowski, A. (2009). Less-energy-dense diets of low-income women in California are associated with higher energy-adjusted diet costs. The American Journal of Clinical Nutrition, 89(4), 1220-1226. doi:10.3945/ajcn.2008.26916

[9] Drewnowski, A., & Darmon, N. (2005). The economics of obesity: Dietary energy density and energy cost. The American Journal of Clinical Nutrition, 82(1). doi:10.1093/ajcn.82.1.265s

[10] Aggarwal, A., Monsivais, P., & Drewnowski, A. (2012). Nutrient Intakes Linked to Better Health Outcomes Are Associated with Higher Diet Costs in the US. PLoS ONE, 7(5). doi:10.1371/journal.pone.0037533

[11] Maillot, M., Darmon, N., Darmon, M., Lafay, L., & Drewnowski, A. (2007). Nutrient-Dense Food Groups Have High Energy Costs: An Econometric Approach to Nutrient Profiling. The Journal of Nutrition, 137(7), 1815-1820. doi:10.1093/jn/137.7.1815

[12] Drewnowski, A., Darmon, N., & Briend, A. (2004). Replacing Fats and Sweets With Vegetables and Fruits—A Question of Cost. American Journal of Public Health, 94(9), 1555-1559. doi:10.2105/ajph.94.9.1555

[13] Aggarwal, A., Monsivais, P., Cook, A. J., & Drewnowski, A. (2011). Does diet cost mediate the relation between socioeconomic position and diet quality? European Journal of Clinical Nutrition, 65(9), 1059-1066. doi:10.1038/ejcn.2011.72

[14] Monsivais, P., Aggarwal, A., & Drewnowski, A. (2011). Following Federal Guidelines To Increase Nutrient Consumption May Lead To Higher Food Costs For Consumers. Health Affairs, 30(8), 1471-1477. doi:10.1377/hlthaff.2010.1273

[15] Rehm, C. D., Monsivais, P., & Drewnowski, A. (2011). The quality and monetary value of diets consumed by adults in the United States. The American Journal of Clinical Nutrition, 94(5), 1333-1339. doi:10.1093/nutrit/nuv027

[16] Rehm, C. D., Monsivais, P., & Drewnowski, A. (2015). Relation between diet cost and Healthy Eating Index 2010 scores among adults in the United States 2007–2010. Preventive Medicine, 73, 70-75. doi:10.1016/j.ypmed.2015.01.019

[17] Guenther, P. M., Casavale, K. O., Kirkpatrick, S. I., Reedy, J., Hiza, H. A., Kuczynski, K. J., . . . Krebs-Smith, S. M. (2013). Update of the Healthy Eating Index: HEI-2010. Journal of the Academy of Nutrition and Dietetics, 113(4), 569-580. doi:10.1016/j.jand.2012.12.016.

[18] Guenther, P. M., Kirkpatrick, S. I., Reedy, J., Krebs-Smith, S. M., Buckman, D. W., Dodd, K. W., . . . Carroll, R. J. (2013). The Healthy Eating Index-2010 Is a Valid and Reliable Measure of Diet Quality According to the 2010 Dietary Guidelines for Americans. The Journal of Nutrition, 144(3), 399-407. doi:10.3945/jn.113.183079

[19] Schröder, H., Serra-Majem, L., Subirana, I., Izquierdo-Pulido, M., Fitó, M., & Elosua, R. (2016). Association of increased monetary cost of dietary intake, diet quality and weight management in Spanish adults. British Journal of Nutrition, 115(05), 817-822. doi:10.1017/s0007114515005048

[20] Morris, M. A., Hulme, C., Clarke, G. P., Edwards, K. L., & Cade, J. E. (2014). What is the cost of a healthy diet? Using diet data from the UK Womens Cohort Study. Journal of Epidemiology and Community Health, 68(11), 1043-1049. doi:10.1136/jech-2014-204039

[21] Lopez, C. N., Martinez-Gonzalez, M. A., Sanchez-Villegas, A., Alonso, A., Pimenta, A. M., & Bes-Rastrollo, M. (2009). Costs of Mediterranean and western dietary patterns in a Spanish cohort and their relationship with prospective weight change. Journal of Epidemiology & Community Health, 63(11), 920-927. doi:10.1136/jech.2008.081208

[22] Schroder H, Marrugat J, Covas MI. High monetary costs of dietary patterns associated with lower body mass index: a population-based study. Int J Obes. 2006;30:1574–1579.

[23] Gittelsohn, J., Trude, A. C., & Kim, H. (2017). Pricing Strategies to Encourage Availability, Purchase, and Consumption of Healthy Foods and Beverages: A Systematic Review. *Preventing Chronic Disease, 14*. doi:10.5888/pcd14.170213

[24] Herman, D. R., Harrison, G. G., Afifi, A. A., & Jenks, E. (2008). Effect of a Targeted Subsidy on Intake of Fruits and Vegetables Among Low-Income Women in the Special Supplemental Nutrition Program for Women, Infants, and Children. American Journal of Public Health, 98(1), 98-105. doi:10.2105/ajph.2005.079418

[25] Bihan, H., Méjean, C., Castetbon, K., Faure, H., Ducros, V., Sedeaud, A., . . . Hercberg, S. (2011). Impact of fruit and vegetable vouchers and dietary advice on fruit and vegetable intake in a low-income population. European Journal of Clinical Nutrition, 66(3), 369-375. doi:10.1038/ejcn.2011.173

[26] Herman, D. R., Harrison, G. G., & Jenks, E. (2006). Choices Made by Low-Income Women Provided with an Economic Supplement for Fresh Fruit and Vegetable Purchase. *Journal of the American Dietetic Association, 106*(5), 740-744. doi:10.1016/j.jada.2006.02.004

[27] Waterlander, W. E., Steenhuis, I. H., Boer, M. R., Schuit, A. J., & Seidell, J. C. (2012). The effects of a 25% discount on fruits and vegetables: Results of a randomized trial in a three-dimensional web-based supermarket. International Journal of Behavioral Nutrition and Physical Activity, 9(1), 11. doi:10.1186/1479-5868-9-11

[28] Nguyen, B. T., Shuval, K., Bertmann, F., & Yaroch, A. L. (2015). The Supplemental Nutrition Assistance Program, Food Insecurity, Dietary Quality, and Obesity Among US Adults. American Journal of Public Health, 105(7), 1453-1459. doi:10.2105/ajph.2015.302580

[29] Bowling, A. B., Moretti, M., Ringelheim, K., Tran, A., & Davison, K. (2016). Healthy Foods, Healthy Families: Combining incentives and exposure interventions at urban farmers' markets to improve nutrition among recipients of US federal food assistance. *Health Promotion Perspectives, 6*(1), 10-16. doi:10.15171/hpp.2016.02
[30] Olsho, L. E., Klerman, J. A., Wilde, P. E., & Bartlett, S. (2016). Financial incentives increase fruit and vegetable intake among Supplemental Nutrition Assistance Program participants: A randomized controlled trial of the USDA Healthy Incentives Pilot. *The American Journal of Clinical Nutrition, 104*(2), 423-435. doi:10.3945/ajcn.115.129320
[31] Gordon, A. R., Briefel, R. R., Collins, A. M., Rowe, G. M., & Klerman, J. A. (2017). Delivering Summer Electronic Benefit Transfers for Children through the Supplemental Nutrition Assistance Program or the Special Supplemental Nutrition Program for Women, Infants, and Children: Benefit Use and Impacts on Food Security and Foods Consumed. Journal of the Academy of Nutrition and Dietetics, 117(3). doi:10.1016/j.jand.2016.11.002
[32] Anderson, P. M., & Butcher, K. F. (2016). The Relationships Among SNAP Benefits, Grocery Spending, Diet Quality, and the Adequacy of LowIncome Families' Resources (Rep.). Washington DC: Center Budget and Policy Priorities.
[33] Ord. 124960 , § 45, 2015.
[34] Hirsch, B. T., Kaufman, B. E., & Zelenska, T. (2011). Minimum Wage Channels of Adjustment. SSRN Electronic Journal. doi:10.2139/ssrn.1967602
[35] Pollin, R., & Wicks-Lim, J. (2016). A $15 U.S. Minimum Wage: How the Fast-Food Industry Could Adjust Without Shedding Jobs. Journal of Economic Issues, 50(3), 716-744. doi:10.1080/00213624.2016.1210382
[36] Aaronson D, French E, MacDonald J. The minimum wage, restaurant prices, and labor market structure. Journal of Human Resources. 2008 Jul 1;43(3):688-720.
[37] SNAP Retailer Data. (n.d.). Retrieved from http://www.fns.usda.gov/snap-retailer-data
[38] Otten, J., Buszkiewicz, J., Tang, W., Aggarwal, A., Long, M., Vigdor, J., & Drewnowski, A. (2017). The Impact of a City-Level Minimum-Wage Policy on Supermarket Food Prices in Seattle-King County. International Journal of Environmental Research and Public Health, 14(9), 1039. doi:10.3390/ijerph14091039
[39] Spoden, A. L., Buszkiewicz, J. H., Drewnowski, A., Long, M. C., & Otten, J. J. (2018). Seattle's minimum wage ordinance did not affect supermarket food prices by food processing category. Public Health Nutrition, 1-9. doi:10.1017/s1368980017004037
[40] Report for the City of Seattle, Income Inequality Advisory Committee. Available online: http://murray.seattle.gov/wp-content/uploads/2014/03/Evans-report-3_21_14-+-appdx.pdf
[41] Buszkiewicz J, Otten J, Tang W et al. (2016) The effect of a city-level minimum-wage policy on food prices: a study of supermarket food prices in Seattle–King County. Presented at AcademyHealth Annual Research Meeting, Boston, MA, USA, 27 June 2016.
[42] Drewnowski A, Aggarwal A, Hurvitz PM, Monsivais P, Moudon AV. Obesity and supermarket access: proximity or price? Am J Public Health. 2012 Aug;102:e74-80.
[43] CPHN Public Health Research Brief. Available online: http://www.depts.washington.edu/uwcphn/reports/cphnbrf2.pdf (accessed April 2018)
[44] Fulgoni, V. L., Keast, D. R., & Drewnowski, A. (2009). Development and Validation of the Nutrient-Rich Foods Index: A Tool to Measure Nutritional Quality of Foods. The Journal of Nutrition, 139(8), 1549-1554. doi:10.3945/jn.108.101360
[45] Drewnowski, A. (2009). Defining Nutrient Density: Development and Validation of the Nutrient Rich Foods Index. Journal of the American College of Nutrition, 28(4). doi:10.1080/07315724.2009.10718106
[46] US Department of Agriculture, Agricultural Research Service, Nutrient Data Laboratory. USDA National Nutrient Database for Standard Reference, Legacy. Version Current: April 2018. Internet: /nea/bhnrc/ndl
[47] Drewnowski, A., & Fulgoni, V. (2008). Nutrient profiling of foods: Creating a nutrient-rich food index. Nutrition Reviews, 66(1), 23-39. doi:10.1111/j.1753-4887.2007.00003.x
[48] Fulgoni, V. L., Keast, D. R., & Drewnowski, A. (2009). Development and Validation of the Nutrient-Rich Foods Index: A Tool to Measure Nutritional Quality of Foods. The Journal of Nutrition, 139(8), 1549-1554. doi:10.3945/jn.108.101360
[49] Dietary Reference Intakes. (n.d.). Retrieved from https://www.nal.usda.gov/fnic/dietary-reference-intakes
[50] Ekaterina Jardim; Mark Long; Robert Plotnick; Emma van Inwegen; Jacob Vigdor and Hilary Wething, (2017), Minimum Wage Increases, Wages, and Low-Wage Employment: Evidence from Seattle, No 23532, NBER Working Papers, National Bureau of Economic Research, Inc
[51] The Seattle Minimum Wage Study Team. 2016. Report on the Impact of Seattle's Minimum Wage Ordinance on Wages, Workers, Jobs, and Establishments Through 2015. Seattle. University of Washington.

[52] *2011 Occupational Employment and Wage Estimates* (Publication). (2011). WA: Washington State Employment Security Department. Available online: https://www.esd.wa.gov/labormarketinfo/report-library
[53] Minimum Wage Requirements and Labor Standards RCW § 49.46, 2017.
[54] The Seattle Minimum Wage Study Team. 2016. Report on Baseline Employer Survey and Worker Interviews. Seattle. University of Washington.
[55] Katz, L., & Krueger, A. (1992). The Effect of the Minimum Wage on the Fast Food Industry. Industrial and Labor Relations Review, 46(1). doi:10.3386/w3997
[56] Card, D., & Krueger, A. (1994). Minimum Wages and Employment: A Case Study of the Fast Food Industry in New Jersey and Pennsylvania. The American Economic Review, 84(4). doi:10.3386/w4509
[57] Macdonald, J. M., & Aaronson, D. (2006). How Firms Construct Price Changes: Evidence from Restaurant Responses to Increased Minimum Wages. American Journal of Agricultural Economics, 88(2), 292-307. doi:10.1111/j.1467-8276.2006.00859.x
[58] Powers, E. T. (2009). The Impact of Minimum-Wage Increases: Evidence from Fast-food Establishments in Illinois and Indiana. Journal of Labor Research, 30(4), 365-394. doi:10.1007/s12122-009-9068-3
[59] Basker, E., & Khan, M. T. (2013). Does the Minimum Wage Bite into Fast-Food Prices? SSRN Electronic Journal. doi:10.2139/ssrn.2326659
[60] Dube, A., Naidu, S., & Reich, M. (2007). The Economic Effects of a Citywide Minimum Wage. ILR Review, 60(4), 522-543. doi:10.1177/001979390706000404
[61] Allegretto, S., & Reich, M. (2017). Are Local Minimum Wages Absorbed by Price Increases? Estimates from Internet-Based Restaurant Menus. ILR Review, 71(1), 35-63. doi:10.1177/0019793917713735