





Short Communication

Comparing shopper characteristics by online grocery ordering use among households in low-income communities in Maine

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Abstract

Objective: Online grocery shopping could improve access to healthy food, but it may not be equally accessible to all populations – especially those at higher risk for food insecurity. The current study aimed to compare the socio-demographic characteristics of families who ordered groceries online *v.* those who only shopped in-store.

Design: We analysed enrollment survey and 44 weeks of individually linked grocery transaction data. We used univariate χ^2 and *t*-tests and logistic regression to assess differences in socio-demographic characteristics between households that only shopped in-store and those that shopped online with curbside pickup (online only or online and in-store).

Setting: Two Maine supermarkets.

Participants: 863 parents or caregivers of children under 18 years old enrolled in two fruit and vegetable incentive trials.

Results: Participants had a total of 32 757 transactions. In univariate assessments, online shoppers had higher incomes ($P < 0.0001$), were less likely to participate in Special Supplemental Nutrition Program for Women, Infants, and Children or Supplemental Nutrition Assistance Program (SNAP; $P < 0.0001$) and were more likely to be female ($P = 0.04$). Most online shoppers were 30–39 years old, and few were 50 years or older ($P = 0.003$). After controlling for age, gender, race/ethnicity, number of children, number of adults, income and SNAP participation, female primary shoppers (OR = 2.75, $P = 0.003$), number of children (OR = 1.27, $P = 0.04$) and income (OR = 3.91 for 186–300% federal poverty line (FPL) and OR = 6.92 for >300% FPL, $P < 0.0001$) were significantly associated with likelihood of shopping online.

Conclusions: In the current study of Maine families, low-income shoppers were significantly less likely to utilise online grocery ordering with curbside pickup. Future studies could focus on elucidating barriers and developing strategies to improve access.

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In 2019, 44 % of American households purchased groceries online⁽¹⁾. In 2020, this number increased as shoppers sought to reduce their exposure to the coronavirus causing COVID-19⁽²⁾. Compared with grocery shopping in-store, shopping online offers customers several advantages that could improve access to healthy food.

Online grocery shopping may be more convenient for some shoppers: saving time, offering expanded shopping hours, allowing caregivers to shop without children and reducing obstacles for individuals for physical limitations⁽³⁾. Shopping online could also help shoppers save money by facilitating price comparisons, showing cart totals in real time and saving on transportation costs with delivery services. Lastly, online grocery shopping could improve the healthfulness of purchases by increasing healthy product availability, allowing real-time inventory of foods at home and reducing unhealthy, impulse purchases such as candy and desserts^(3–7).

Unfortunately, these benefits might not be equally accessible to all socio-demographic groups. Minimum order requirements and fees for membership, service or delivery can deter lower-income households^(3,8–10). United States Department of Agriculture (USDA) regulations require that Supplemental Nutrition Assistance Program (SNAP) and Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) transactions occur when the foods are received^(11,12). This effectively prevented online payment and grocery delivery for SNAP transactions until 2019 when USDA waived this requirement for select states and retailers in its SNAP Online Purchasing Pilot^(13–15). Technological and logistical challenges deter many retailers from accepting SNAP or WIC benefits for curbside or in-store pickup^(16,17).

Beyond these barriers to access, several qualitative studies with SNAP and WIC participants suggest that low-income shoppers may perceive other barriers to grocery shopping online^(3,6,9). Participants expressed concerns about inadequate substitutions, the quality and freshness of perishable goods (e.g., fruit, meat), challenges comparing items, difficulty locating deals, higher prices, delays receiving the order and hassles with returns^(3,6,9).

Few peer-reviewed studies have compared the characteristics of online grocery shoppers with in-store shoppers using sales data^(18–21). The only prior US study is 15 years old. It found that online shoppers had higher incomes but did not differ in gender, age or education⁽²²⁾.

The rapid expansion of online grocery shopping requires a better understanding of utilisation patterns to facilitate equitable use. The current study compared the socio-demographic characteristics of households that grocery shop in-store only with those that order groceries online at two supermarkets offering in-store shopping and online ordering options.

Methods

The current study was a secondary analysis of 863 households with at least one child under age 18. Primary household shoppers were enrolled in two separate randomised trials of a fruit and vegetable double-dollar incentive in two large supermarkets from the same chain in low-income Maine communities^(23,24). The supermarkets belong to a chain with close to 200 stores in the Northeast. The current study used 44 weeks of data from each trial: November 2015 to September 2016 and November 2016 to September 2017.

Methods for recruitment, intervention, data access and online grocery services are described elsewhere^(23,24). Briefly, the retailer offered customers the option to order groceries online and pick up curbside at the store as soon as 4 h later; there was no delivery option. Customers paying with cash, credit, check or gift card paid curbside; customers paying with SNAP Electronic Benefits Transfer paid inside the store. There was a \$5 fee for online orders, which was waived for customers' first order and orders over \$100 or \$125 depending on the store. There was no minimum order amount.

At enrollment, participants completed a socio-demographic survey. The retailer provided item-level scanner data for all store locations in their chain, linked to participants via a loyalty card number. Transactions greater than \$1000 were excluded under the assumption that these purchases were not intended solely for that household.

Online orders were identified using a specific universal product code. Any shopper that completed at least one transaction online during the study period was classified as an online shopper; this group included shoppers that only shopped online and those that shopped both online and in-store. Shoppers that only completed transactions in-store were classified as in-store shoppers. See online supplementary, Supplemental Table 1 for the CONSORT flow diagram.

Analysis

Chi-squared and *t*-tests assessed differences in socio-demographic characteristics between households that shopped in-store only and those that shopped online (online only or both online and in-store). Mean imputation was used for missing or implausible values of number of children and number of adults. A logistic regression model estimated the association between socio-demographic characteristics (gender, number of children, number of adults, income, age, race/ethnicity and SNAP participation) and whether the participant shopped online at least once during the study. Complete case analysis was used because the two comparison groups were balanced on missingness of model covariates. WIC participation was not included in the multivariate analysis because only two participants reported WIC participation and shopped online, which would have resulted in many cells without observations.

**Table 1** Baseline characteristics of 863 participants enrolled in two fruit and vegetable incentive trials at separate Maine supermarkets stratified by online shopping use*

Variable	Overall (<i>n</i> 863)		Shopped in-store only (<i>n</i> 715)		Shopped online (online only or online and in-store)† (<i>n</i> 148)		<i>P</i> ‡
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Primary shopper characteristics							
Trial randomisation to intervention group	429	49.7	346	48.4	83	56.1	0.09
Age (years)							0.003
18–29	145	17.0	127	18.0	18	12.2	
30–39	362	42.5	282	40.1	80	54.4	
40–49	270	31.7	225	32.0	45	30.6	
50–59	58	6.8	56	8.0	2	1.4	
60 and older	16	1.9	14	2.0	2	1.4	
Female	717	84.1	585	82.9	132	89.8	0.04
Non-Hispanic white	791	92.8	651	92.2	140	95.9	0.12
BMI (kg/m ²)							0.33
Mean	28.1		28.2		27.6		
SD	6.5		6.6		6.2		
Household characteristics							
Number of children§							0.93
Mean	1.9		1.9		1.9		
SD	0.9		1.0		0.8		
Number of adults							0.31
Mean	2.0		2.1		2.0		
SD	0.5		0.8		0.5		
Income as percentage of federal poverty line¶							<.0001
≤100 %	176	22.7	167	26.1	9	6.7	
101–185 %	162	20.9	150	23.5	12	8.9	
186–300 %	238	30.8	186	29.1	52	38.5	
>300 %	198	25.6	136	21.3	62	45.9	
SNAP participation**	209	24.3	198	27.8	11	7.5	<.0001
WIC participation**	109	12.8	107	15.2	2	1.4	<.0001

*Responses were missing for the following characteristics: age (12); gender (10); race/ethnicity (11); BMI (132); SNAP participation (4); WIC participation (12); percentage of federal poverty level (89).

†Eleven shoppers shopped online only; 137 shopped both online and in-store.

‡*P*-values are from *t*-test for continuous measures and chi-squared or fisher's exact test for categorical variables (Satterthwaite for unequal variance).

§Mean imputation was used for missing or unrealistic values (*n* 1).

||Mean imputation was used for missing or unrealistic values (*n* 27).

¶If annual income was reported, percentage of poverty was calculated by dividing the median of the annual household income category by the annual federal poverty guideline for the household size in 2016; if only weekly income was reported, the median of the income category was multiplied by 4.35 to obtain monthly income, which was divided by the monthly federal poverty guideline for the household size in 2016.

**Based on self-reported participation at enrollment.

Analyses were completed in 2020 using SAS, version 9.4. The Harvard T.H. Chan School of Public Health's Institutional Review Board determined that this was not human subjects research.

Results

Eight hundred and sixty-three participants completed 32 757 transactions (96.4 % in-store, 3.6 % online). 82.9 % of participants (*n* 715) shopped in-store only. 17.1 % of participants (*n* 148) shopped online at least once, of which eleven shopped online only (Table 1).

Households that shopped in-store only and those that shopped online were balanced on assignment to intervention group in the trials. The two groups did not differ significantly with respect to BMI, race/ethnicity or household composition. Households that shopped online were more likely to have a female primary shopper than households that only shopped

in-store (89.8 % *v.* 82.9 %, *P* = 0.04). Age of the primary shopper differed significantly (*P* = 0.003). Among households that shopped online, 54.4 % of primary shoppers were 30–39 years old (*v.* 40.1 % for in-store only shoppers) and only 2.8 % of shoppers were aged 50 and older (*v.* 10 % for in-store only shoppers). Household income differed significantly between online households and in-store only households (*P* < 0.0001). Fewer households that shopped online had incomes less than 186 % of the federal poverty line (15.6 % *v.* 49.6 %); 45.9 % of households that shopped online had incomes greater than 300 % percent of the federal poverty line compared with 21.3 % of households that shopped in-store only. Households that shopped online were less likely to report participation in SNAP (7.5 % *v.* 27.8 %, *P* < 0.0001) or WIC (1.4 % *v.* 15.2 %, *P* < 0.0001) than households that shopped in-store only.

After controlling for age, gender, race/ethnicity, number of children, number of adults, income and SNAP participation, female primary shopper (OR = 2.75 *v.* male, *P* = 0.003), more

**Table 2** Odds of shopping online for socio-demographic characteristics among 764 families in Maine*

Variable	OR	95 % CI	P
Primary shopper characteristics			
Age			
18–29 years	Ref.		–
30–39 years	0.99	0.53, 1.86	0.97
≥ 40 years	0.58	0.30, 1.13	0.11
Gender			
Male	Ref.		–
Female	2.75	1.40, 5.41	0.003
Race/ethnicity			
Not non-Hispanic white	Ref.		–
Non-Hispanic white	1.62	0.60, 4.40	0.35
Household characteristics			
Number of children†	1.27	1.01, 1.61	0.04
Number of adults‡	0.88	0.62, 1.25	0.47
Income as percentage of federal poverty line§			
≤185 %	Ref.		–
186–300 %	3.91	2.06, 7.42	<.0001
>300 %	6.92	3.44, 13.89	<.0001
SNAP participation 			
Non-participant	Ref.		–
Participant	0.63	0.29, 1.4	0.26

*Responses were missing for the following characteristics which resulted in a sample of 764: age (12); gender (10); race/ethnicity (11); SNAP participation (4); percentage of federal poverty level (89).

†Mean imputation was used for missing or unrealistic values (*n* 1).

‡Mean imputation was used for missing or unrealistic values (*n* 27).

§If annual income was reported, percentage of poverty was calculated by dividing the median of the annual household income category by the annual federal poverty guideline for the household size in 2016; if only weekly income was reported, the median of the income category was multiplied by 4.35 to obtain monthly income, which was divided by the monthly federal poverty guideline for the household size in 2016.

||Based on self-reported participation at enrollment.

children in the household (OR = 1.27 per child, *P* = 0.04) and higher income (OR = 3.91 for 186–300 % federal poverty line and OR = 6.92 for >300 % federal poverty line *v.* <185 %, *P* < 0.0001) were significantly associated with shopping online (Table 2).

Discussion

Our results revealed key socio-demographic differences in participants who ordered groceries online at least once compared with in-store only shoppers. Online shoppers had more children in their household and were higher income, younger, less likely to participate in WIC or SNAP, and more likely to be female. After controlling for socio-demographic characteristics, number of children in the household, income and gender remained significant predictors of online shopping. This suggests that important barriers may prevent certain populations from accessing the potential benefits of online shopping.

Comparisons of our results to prior studies on this topic should be interpreted with caution given that our study is more recent than prior studies (2002–2011), differences in settings and variation in methodology. Studies varied widely with respect to which demographic characteristics

were analysed and how they were operationalised, with two studies including only one or no household characteristics^(19,22). Only two prior studies used multivariable analyses to assess characteristics predictive of grocery shopping online^(20,21). Race/ethnicity and federal nutrition programme participation were not considered in other studies.

Our finding that online shoppers had higher incomes was consistent with the prior US study⁽²²⁾. In studies of other high-income countries, income was not considered^(18–20) or not significant⁽²¹⁾. Unlike the descriptive analyses of eastern US shoppers in 2002, our results showed significant differences by gender and age; we found that women and 30–39-year-olds were most likely to shop online.

Our finding that women were more likely to shop online was consistent with the study in Australia⁽²¹⁾. However, in Spain, men were more likely to shop online and gender was not a significant predictor of online shopping in France or Belgium^(18–20).

In other countries, age was associated with online grocery shopping; however, these associations were highly variable, in part because of differences in how age was operationalised^(18–21). In Spain and Australia, age was negatively associated with online grocery shopping^(18,21). In France and Belgium, shoppers aged 30–45 or 50 years old were most likely to grocery shop online^(19,20).

Consistent with studies in Belgium, Australia and Spain, we found no significant difference in grocery shopping setting by household size^(18,20,21). Similar to two prior studies that evaluated household composition in addition to size, we found that the number of children was a significant predictor of grocery shopping online. In Belgium, the presence of children younger than 11 years old was a significant predictor of shopping online⁽²⁰⁾. In Spain, online shoppers had fewer children than shoppers that tended to shop in-store⁽¹⁸⁾.

Further research should describe who grocery shops online and explore barriers for different populations, especially those at higher risk for food insecurity. The COVID-19 pandemic has heightened the urgency of such studies⁽²⁾. Prior literature suggests certain populations face some key impediments to online grocery shopping. Existing grocery delivery networks provide minimal coverage to rural food deserts⁽²⁵⁾. Shoppers who are less technologically savvy may be reluctant to shop online⁽²⁶⁾. Older, lower-income, less educated, racial/ethnic minority and rural residents are less likely to have broadband internet access⁽²⁷⁾. Concerns about the quality and freshness of perishable foods picked out by someone else may be particularly salient for lower income shoppers, who can least afford food waste^(8,9,28). Understanding these challenges in greater detail could inform targeted, equity-oriented solutions.

In the meantime, policymakers and retailers could reduce several barriers to online grocery shopping for under-resourced populations. USDA could continue expanding its online SNAP pilot, as it has in response to COVID-19⁽²⁹⁾, and evaluate the impact on food access for low-income



households. More retailers should allow SNAP participants to order online and pay with Electronic Benefits Transfer at pickup. To reduce financial barriers, USDA could permit the use of SNAP benefits for delivery and service fees; if additional funding could not be allocated for fees, it would be important to evaluate trade-offs for household budgets. Retailers could reduce or waive fees for lower-income customers. Lastly, marketing campaigns could raise awareness of online grocery services among low-income shoppers⁽⁸⁾.

Encouragingly, USDA recently announced that it will fund an online pilot for WIC in up to five states⁽³⁰⁾. WIC participants could especially benefit from locating WIC-eligible foods more easily, saving time shopping in-store and avoiding stigmatising interactions^(3,31,32).

Several limitations should be noted. The current study only measured participants' purchases at one grocery chain; some in-store only shoppers might have purchased groceries online from other retailers. Over half of participants reported doing all or almost all of their food shopping at the grocery store where they enrolled. Since participants were enrolled in store, shoppers who predominantly shopped online would be less likely to be in our sample. However, recruitment at one store location occurred before the online shopping service launched, so this is unlikely to bias our results substantially. Our data do not capture other factors that might influence decisions to shop online (e.g., employment, disability status, digital literacy)^(20,33). The small number of online-only shoppers prevented us from comparing them to participants who shopped both online and in-store. In the multivariate analysis, the confidence intervals were wide for some parameter estimates (e.g., SNAP participation) because of small cell sizes. The study population consisted of Maine households with children that were predominantly non-Hispanic White females aged 30–49 years old. The study's findings may not generalise to shoppers without children in the home, with different socio-demographic characteristics, residing in other regions or shopping online with delivery.

Conclusions

The current study of Maine households with children indicates that low-income shoppers were significantly less likely to order groceries online for curbside pickup. While online grocery shopping has the potential to improve food access, more research is needed to understand barriers by socio-demographic characteristics.

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Supplementary material

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