


# An equity-oriented systematic review of online grocery shopping among low-income populations: implications for policy and research

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**Context:** Online grocery services are an emerging component of the food system with the potential to address disparities in access to healthy food. **Objective:** We assessed the barriers and facilitators of equitable access to healthy foods in the online grocery environment, and the psychosocial, purchasing, and dietary behaviors related to its use among low-income, diverse populations. **Data Sources:** Four electronic databases were searched to identify relevant literature; 16 studies were identified. **Results:** Barriers to equitable access to healthy food included cost and limited availability of online grocery services in food deserts and rural areas. The expansion of online grocery services and the ability to use nutrition assistance benefits online were equity-promoting factors. Perceived low control over food selection was a psychosocial factor that discouraged online grocery use, whereas convenience and lower perceived stress were facilitators. Findings were mixed regarding healthfulness of foods purchased online. Although few studies assessed diet, healthy food consumption was associated with online grocery use. **Conclusion:** Researchers should assess the impact of online grocery shopping on low-income families' food purchases and diet.

**Systematic Review Registration:** PROSPERO registration no. CRD: 42021240277

## INTRODUCTION

In the United States, noncommunicable diseases such as obesity, type 2 diabetes, and cardiovascular diseases disproportionately affect diverse racial and ethnic groups, including Black, Hispanic, and Native American populations.<sup>1,2</sup> Disparate access to and availability of healthy food, combined with economic inequality, have contributed to health disparities in

diverse communities in the United States,<sup>3–5</sup> which are more likely to be under-resourced, underserved, and at high risk for poor diet, food insecurity, and obesity.<sup>6</sup>

Of note, efforts to address income-related disparities in access to healthy food have focused on improving the availability of healthy foods at local food vendors, including the Healthy Food Financing Initiatives,<sup>7</sup> Staple Foods Ordinances,<sup>8</sup> and the Healthy Corner Stores Initiatives.<sup>9</sup> However, structural barriers

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**Key words:** diet, equity, food purchase, low income, online grocery, policy, Supplemental Nutrition Assistance Program.

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to food access remain because households in low-income communities may have limited access to reliable transportation and live disproportionately far from sources of healthy foods, compared with predominantly White and high-income neighborhoods.<sup>10</sup> In response, there has been an emerging focus on interventions aimed at addressing physical barriers to healthy food by bringing food to people, such as the green cart program in New York City<sup>11</sup> and a virtual supermarket in Baltimore, Maryland.<sup>12</sup> Nevertheless, there is a pressing need to expand and refine these approaches.

Online grocery shopping is a new and growing component of the food system that addresses barriers related to physical access to healthy foods. In 2018, 34% of US shoppers reported purchasing groceries online at least sometimes.<sup>13</sup> Of those, 30% were from low-income households (<\$40 000 annual household income) and 64% were parents with children.<sup>13</sup> In the United States, from January 2020 to January 2021, online retail sales increased by 39%.<sup>14</sup> Specifically for families living in low-income areas who may lack access to grocery stores and personal vehicles,<sup>15</sup> online grocery services have the potential to address barriers related to transportation. However, many underserved families have not been able to realize the benefits of online grocery shopping, due to disparities in technology access<sup>16</sup> and digital literacy,<sup>17</sup> limited delivery services,<sup>18</sup> delivery and membership fees, and minimum order policies.<sup>19</sup>

The 2014 Farm Bill mandated a pilot program with food retailers to test the feasibility of allowing the use of Supplemental Nutrition Assistance Program (SNAP) benefits as payment for online grocery orders.<sup>18</sup> The ability to use the SNAP Electronic Benefits Transfer card online may address barriers related to physical access to healthy foods and the card provides an alternative payment method for purchasing groceries online for low-income households. Additionally, during the COVID-19 pandemic, online purchasing became a safe, socially distanced option to purchase groceries, which motivated the rapid expansion of the SNAP Online Purchasing Pilot (OPP) to 48 states and additional retailers.<sup>20</sup> The SNAP OPP expansion marked an important change in online grocery access among low-income populations in the United States: redemption of government benefits online increased to 67 times the amount of prepandemic redemptions.<sup>21</sup> Although increasing use of online grocery services has the potential to improve access to healthy foods, understanding barriers to its use and possible unintended consequences of online grocery shopping on food purchases and dietary habits among low-income and diverse populations is critical for the development of health- and equity-promoting policies.

In a previous scoping review, Jilcott Pitts et al<sup>22</sup> described barriers and motivators to online grocery shopping. However, few studies included in the review focused on diverse populations from low-income backgrounds, which are at greatest risk for health and social disparities. Furthermore, the Jilcott Pitts et al<sup>22</sup> review was conducted before the implementation of the OPP and the COVID-19 pandemic. Since then, online grocery shopping has become more accessible and additional studies on the topic have been published. In the present systematic review, we aimed to synthesize the existing evidence of the perceptions about and impact of online grocery shopping on low-income and diverse populations and to identify opportunities to inform policy and promote equity in the online food retail space. Therefore, using an equity lens, we examined online grocery shopping behaviors among diverse, low-income populations and aimed to answer the following questions: (1) What are the barriers to and enablers of equitable access to healthy food in online grocery services? (2) What are the psychosocial, purchasing, and dietary behaviors associated with online grocery service use among families from low-income backgrounds?

## METHODS

This systematic review was registered with the Prospective Register for Systematic Reviews CRD: 42021240277.

### Data sources

Four electronic databases were searched for applicable articles: MEDLINE, PsycINFO, Web of Science, and Business Source Ultimate, spanning the public health, behavioral sciences, and business literature. The systematic search took place from September 2020 through October 2021 and included relevant studies on online grocery shopping targeting low-income families and diverse ethnic or racial populations.

### Search strategies

A search strategy was developed on the basis of Medical Subject Heading terms and information from key articles identified a priori.<sup>23–25</sup> Boolean operators were used to combine keywords and Medical Subject Heading terms for a more focused search. Three topics were developed on the basis of the study research question: online, grocery shopping, and low income. Search terms included: online, internet, grocery shopping, grocery purchasing, food, produce, food assistance, Supplemental Nutrition Assistance Program, Women Infants Children Program, low-income, racial, and

ethnic diverse groups. The complete search strategy is described in Appendix 1 in the Supporting Information online.

### Eligibility criteria

This review included interventional or observational studies implemented in real-world settings, that used quantitative and/or qualitative methods, and were conducted among low-income populations experiencing food insecurity, participating in supplemental nutrition assistance programs (SNAP or the Special Supplemental Nutrition Program for Women, Infants, and Children [WIC]), and/or racially or ethnically diverse groups. Outcomes of interest included psychosocial, purchasing, and dietary behaviors, or equity promotion of access to healthy food in the online grocery environment. No restrictions were placed on geographic location of studies or the date of publication. Systematic, scoping, or narrative reviews; conference or dissertation abstracts; and general information articles were excluded. Study selection was completed using Covidence (Melbourne, Victoria Australia), following the methods outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. The eligibility criteria are described in Table 1, using the PI(E)COS (population, intervention/exposure, comparison, outcome, and study design) criteria.

### Data extraction

Title, abstract, and full-text extraction were conducted by 2 research assistants independently using Covidence with a random agreement of 90%. Two reviewers (C.M.L., G.M.V.) analyzed each study independently. A third author (A.C.B.T.) was available to resolve disagreements. Backward reference searching of included articles was conducted to identify additional papers.

### Critical assessment

The methodological quality of each paper was assessed using JBI's critical appraisal tools,<sup>26</sup> which have published checklists for most study types (eg, analytical cross-sectional studies, randomized control trials, qualitative research). No checklist was available from JBI for mixed-methods studies and case studies. Thus, the Mixed Methods Appraisal Tool was used for critical appraisal of studies using mixed-methods designs<sup>27</sup> and the Center for Evidence-Based Management's critical appraisal of a case study was used for case studies.<sup>28</sup>

The checklists included questions to determine the extent to which a study addressed the possibility of bias

in its design, conduct, and analysis, and required the following responses for the JBI tool: "yes," "no," "unclear," "not applicable"; and, for the Mixed Methods Appraisal Tool and Center for Evidence-Based Management's too, "yes," "no," "can't tell." The answer "yes" means that a given appraisal criterion for satisfactory quality was met. The quality threshold was set by the research team a priori, in which studies scoring between 60% and 100% were deemed of moderate to high quality and were included in the review.

### Evidence synthesis

An adjudication approach informed by the theory of planned behavior (TPB)<sup>29</sup> and health equity framework<sup>30</sup> was used for evidence synthesis. Domains for extraction included methods and findings related to the 4 pillars of the health equity framework (ie, reduce deterrents, build community capacity, improve social and economic resources, and increase healthy options) and psychosocial constructs of the theory of planned behavior (ie, perceived barriers, attitudes, social norms, and perceived behavioral control), in addition to purchasing and diet assessment and outcomes. Additional data extracted included target population, model or theory, study aims, target foods and food groups, diet and purchase measures, sample size, study design, methods, results, equity considerations, quality of research, study limitations, and study recommendations. Meta-analysis was not possible owing to the heterogeneity of the study designs, exposures or interventions, and outcomes.

## RESULTS

### Search results

The search criteria returned a total of 1612 citations, which dropped to 466 citations after the removal of duplicates (Figure 1). Two additional articles were included from the bibliographic review. All titles and abstracts were screened and a total of 43 full-text articles were reviewed for eligibility. Overall, 16 articles were included for evidence synthesis, including 4 cross-sectional studies,<sup>18,31–33</sup> 5 mixed-methods studies,<sup>12,19,24,34,35</sup> 3 qualitative studies,<sup>36–38</sup> 2 case studies,<sup>39,40</sup> and 2 experimental studies.<sup>23,41</sup> All studies were of moderate to high quality after the critical assessment.

### Study characteristics

Studies included in this review were published between 2013 and 2021, all conducted in the United States

Table 1 PICOS criteria for inclusion and exclusion of studies

Parameter	Inclusion criteria	Exclusion criteria
General	Published in English Peer-reviewed publication	
Study design	Experimental, cross-sectional, quasi-experimental, qualitative, natural experiments, mixed methods	Reviews, abstracts
Population	Low-income (defined as living in poverty, food insecure, participating in supplemental assistance nutrition programs [SNAP or WIC]) and/or racially or ethnically diverse populations	
Intervention/exposure	Online ordering of groceries (supermarkets, grocery stores, farmers' markets)	
Setting	Urban and rural settings	Not real-world setting (ie, ordering from laboratory that does not deliver the groceries selected)
Outcomes	Psychosocial, purchasing, diet behaviors, or equity promotion in online grocery environment	

Abbreviations: SNAP, Supplemental Nutrition Assistance Program; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children.

(Table 2). Nine studies targeted food insecure or low-income, racially diverse populations,<sup>12,19,23,31,32,35,39–41</sup> 5 were conducted among individuals participating in nutrition assistance programs (SNAP or WIC),<sup>24,34,36–38</sup> 1 targeted regions with low access to healthy foods or food retailers,<sup>18</sup> and 1 examined US states participating in the SNAP OPP expansion.<sup>33</sup> For most studies (n = 11), whether the work was informed by a theoretical model or theory was not reported. Of those articles in which that information was provided (n = 5), 2 studies were based on the theory of planned behavior,<sup>24,37</sup> 2 on the nudge theory,<sup>23,41</sup> and in 1 study, the authors used a service ecosystem framework.<sup>19</sup> Sample size varied across the studies depending on whether the study was targeted at the regional (eg, 1250 census tracts in the OPP states),<sup>18</sup> retailer (eg, 2 retailers<sup>34</sup> or 1 retailer<sup>39</sup>), or individual (eg, ranging from 7<sup>36</sup> to 206 adults<sup>19</sup>) levels. Among the studies reporting a nutrition outcome (n = 9), 3 focused on specific healthy and unhealthy food and beverage items,<sup>12,23,24</sup> 1 looked at fruits and vegetables only,<sup>35</sup> and 5 assessed all grocery items purchased.<sup>19,23,31,34,41</sup>

### Online grocery services

The types of online grocery ordering services varied across the studies. The majority of the studies (n = 9) were conducted in the context of a grocery store or food retailer that accepted orders online and offered grocery pick-up and/or delivery.<sup>18,19,23,24,36–40</sup> Of those, 3 studies were implemented with a pick-up option at a community location,<sup>12,19,35</sup> 3 with store pick-up only,<sup>32,34,36</sup> and 3 offered pick-up or delivery services.<sup>23,31,39</sup> Six studies examined topics related to the SNAP OPP.<sup>18,19,24,39,40</sup>

### Barriers and enablers of equitable access to healthy foods via online grocery services

Figure 2 summarizes the findings from this systematic review. This is an equity-oriented framework focused on health promotion in online grocery services building on the 4 domains of Kumanyika's framework for equity in obesity prevention (ie, reduce deterrents, build community capacity, social and economic resources, and increase healthy options).<sup>30</sup> Central to the present conceptual framework are the 4 equity domains that act as pillars for policy or systems interventions and community capacity to ensure that the online food environment supports equitable healthy food availability and access. In turn, the online food environment influences and is influenced by an individual's perception of barriers, attitudes, and intentions to purchase groceries online, in line with the theory of planned behavior.<sup>29</sup>

Equity in online grocery shopping refers to the differential impact of policies and retailers' practices (ie, disparate cost of grocery items online vs in the store<sup>19</sup>) on online grocery shopping uptake and healthy food selection among rural and urban populations,<sup>18</sup> and groups of different ages, incomes, and races or ethnicities.<sup>39</sup> Five studies included in this review highlighted the importance of reducing deterrents to online grocery shopping to increase uptake and improve the quality of foods purchased by low-income, racially or ethnically diverse populations.<sup>18,19,32,39,40</sup> Disparate cost of equivalent grocery items at online retailers was reported in 1 study, in comparison with brick-and-mortar vendors in low-income neighborhoods in the United States.<sup>40</sup> In another study, authors motivated by the SNAP OPP found that grocery ordering and delivery services were rarely available in rural food deserts.<sup>18</sup> Researchers who

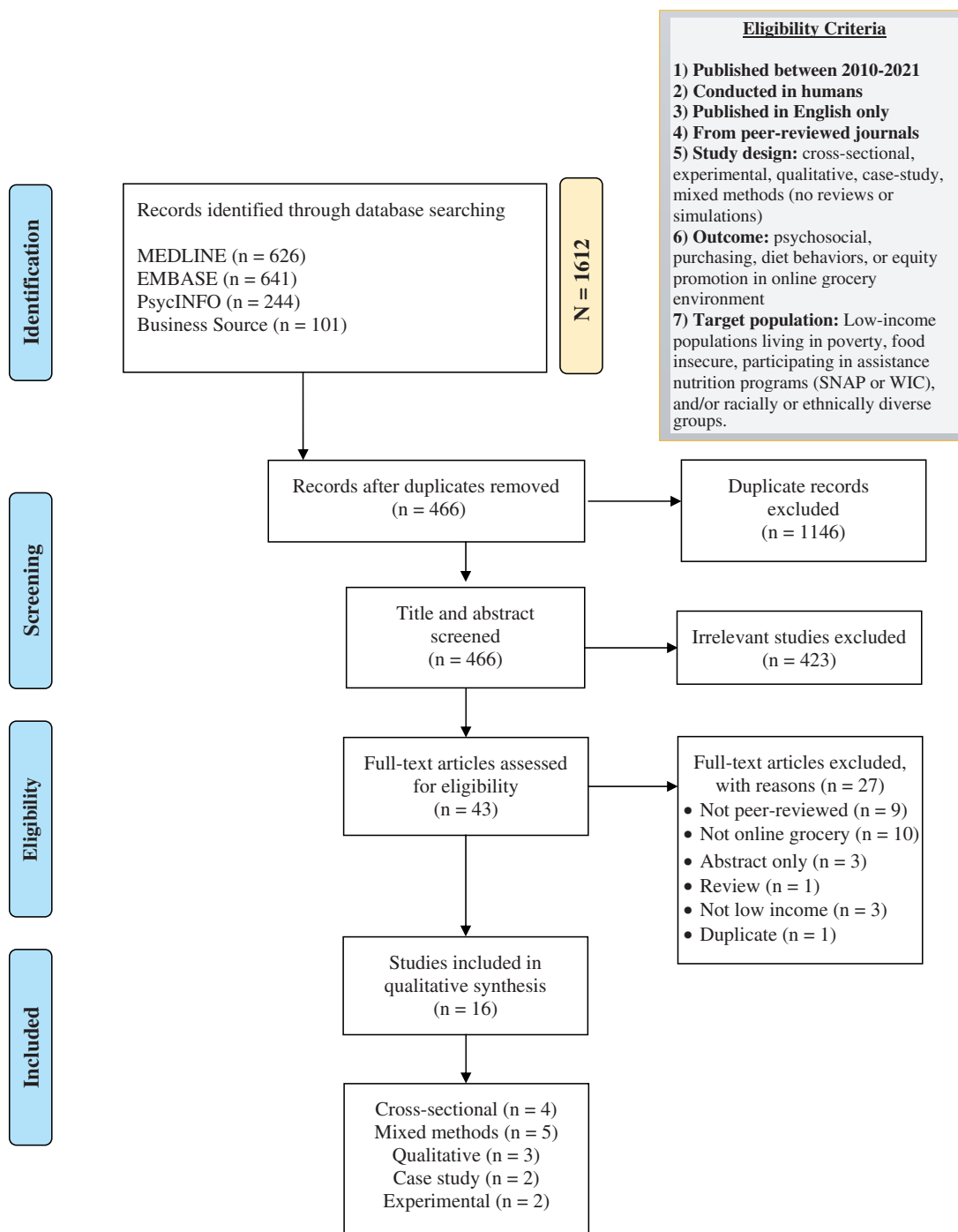


Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram of studies included in the systematic review.<sup>61</sup> Abbreviations: SNAP, Supplemental Nutrition Assistance Program; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children

examined receipts from 2 retailers serving primarily low-income communities in Maine found that shoppers with lower incomes and who enrolled in a nutrition assistance program were less likely to shop online than their higher-income counterparts.<sup>32</sup> Authors of an analytical essay examining neighborhood variation in SNAP enrollment in NYC highlighted the importance

of considering environmental and social barriers to SNAP participation, as well as disparate grocery costs and declining purchasing power of SNAP benefits.<sup>19</sup> In terms of uptake of online grocery services, a case study in Alabama reported that older, rural populations were not using SNAP online as frequently as younger shoppers were, and that online SNAP purchases made up a



**Table 2 Description of the studies included in the systematic review by domains of the equity-oriented framework to promote healthy food purchasing and diet in online grocery environments targeted at underserved populations**

Reference	Study design	Setting and population	Online retailer business model	Outcomes	Methods	Main findings <sup>a</sup>	Policy implications	Quality, %
Appelhans et al (2013) <sup>31</sup>	Increase healthy options Cross-sectional	Chicago, IL Adults with children in an urban food desert (n = 34)	Home delivery	Psychosocial: acceptability of online grocery services Purchase: items purchased while online grocery shopping (in office)	Psychosocial factors: perceived convenience, ease of use, and satisfaction; planned frequency of future use Online purchasing: receipts from groceries ordered at research center with study-provided voucher Equity: residents of food desert areas	Online grocery and inequities: higher SSB purchase online; food prices perceived to be high Online grocery and food assistance: most purchases composed of protein; F&V and caloric beverages also common OPP and online grocery: Ability to pay with SNAP would influence decision to buy groceries online.	Online grocery needs competitive prices, 1-d delivery, to accept SNAP, and to be available for home delivery	100 <sup>26</sup>
Burrington et al (2020) <sup>35</sup>	Mixed methods	New York (rural) Low-income families with children at risk of obesity who qualify for free or reduced school meals (n = 10)	Delivery to a community location	Psychosocial: improve knowledge and attitudes toward F&V consumption Purchase: order F&V from online produce market Diet: increase consumption of F&V	Psychosocial factors: self-efficacy for cooking, attitudes toward trying new foods Online purchasing: voucher redemption or online data monitoring Diet: daily servings of F&V consumed by child and parents Equity: rural communities, children's eligibility for free or reduced school meals; food-insecurity screener	Online grocery and inequities: increased children's F&V intake, household food security at post-online F&V ordering	Nutrition or cooking classes in combination with a F&V Rx program with online produce delivery increased F&V access and consumption by children.	73 <sup>27</sup>

(continued)

Table 2 Continued

Reference	Study design	Setting and population	Online retailer business model	Outcomes	Methods	Main findings <sup>a</sup>	Policy implications	Quality, %
Lagisetty et al (2017) <sup>12</sup>	Mixed methods	Baltimore, MD Primarily Black women aged $\geq 60$ and stakeholders from Virtual Supermarket Program (n = 93 customers; n = 14 key stakeholders)	Store pickup and delivery to community location	Psychosocial: to evaluate barriers to program implementation Purchase: self-reported change due to the program Diet: perception of eating more healthfully due to the program	Psychosocial factors: satisfaction with program, barriers to healthy food access Online purchased: self-reported change Equity: participants living in low-income neighborhoods (food deserts)	Online grocery and inequities: Ability to have community drop-off/pickup locations and pay with cash or EBT was key to participation. Online grocery and food assistance: higher purchases of F&V and fewer snacks and desserts, but more juices and sodas OPP and online grocery: Participants were satisfied with the ability to pay with SNAP at delivery.	Allow payment with SNAP for online grocery delivery (using hand-held devices at delivery).	73 <sup>27</sup>
Brandt et al (2019) <sup>18</sup>	Cross-sectional	Reduce deterrents Rural and urban food deserts in 8 US states (n = 1250; 13 134 census tracts)	Store pickup or home delivery.	Equity in geographic reach of the SNAP OPP	Online purchasing: Nielsen TD-Linx Database to identify SNAP retailers; Google to identify OPP participation and delivery area Equity: rural and urban food desert census tracts	Online grocery and inequities: Online grocery purchasing and delivery were rarely available in rural food deserts.	Ability to use SNAP online may improve food availability for those in urban food deserts, although access is limited in rural areas.	75 <sup>26</sup>
Cohen et al (2019) <sup>40</sup>	Analytic essay	NYC, NY Individuals with low income (eligible but not enrolled in SNAP) living in 3 Public Use Microdata Areas	Not specified	Equity: to examine city and neighborhood characteristics that affect SNAP participation	Equity: measuring SNAP at the community scale: Program Access Index for Public Use Microdata Area	Online grocery and inequities: disparate grocery costs (high costs in gentrifying neighborhoods) OPP and online grocery: Geographic variation in food prices can be reduced through increased use of online grocers.	Consideration of environmental and social barriers to SNAP participation, disparate grocery costs and SNAP benefits not adjusted for higher cost of living	80 <sup>26</sup>

(continued)

Table 2 Continued

Reference	Study design	Setting and population	Online retailer business model	Outcomes	Methods	Main findings <sup>a</sup>	Policy implications	Quality, %
Cohen et al (2020) <sup>19</sup>	Mixed methods	NYC, NY Low-income, predominantly Black adults (n = 466 registered in the pilot; survey, n = 206; focus group, n = 6)	Delivery to a community location	Psychosocial: shopping practices, and perceptions of online shopping Purchase: grocery purchases before and after the pilot Equity: uptake of online grocery shopping	Psychosocial factors: barriers to buying healthy and affordable food online, logistics of grocery delivery Online purchasing: grocery receipt analysis (pre- and post-pilot) Equity: price comparison of in-store vs online prices; low-income residents in food desert; pilot design with input from community	Online grocery and inequities: prices online higher than in store Online grocery and food assistance: potential cost savings online; more promotions or discounts in store; positive experiences online OPP and online grocery: Participants wanted online stores to have the same sales and circulars as local stores.	Low-income individuals are unlikely to fully switch to online shopping unless grocers offer deals comparable to those in store. Community input and buy-in were key to identifying and addressing barriers to online shopping.	73 <sup>27</sup>
Hingle et al (2020) <sup>39</sup>	Case study	Low-income, older adults in rural Alabama (n = 1 grocery store chain) and low-income Hispanic adults in urban California (Double Up SNAP Incentive Program)	Home delivery, delivery to a community location, curbside pickup	Equity: to identify barriers and opportunities to improve equitable online access to nutrition programs	Online purchasing: stakeholder interviews and document review (proportion of purchases online and in store with SNAP/EBT) Equity: proportion of online purchases and program enrollment	Online grocery and food assistance: Majority of online purchases were non-SNAP. Older rural populations were not using SNAP online as frequently as younger customers who lived in town.	Maintain support for EBT online post-COVID and expand online access to other food assistance programs. Work with grocers and local partners to create grocery drop-off/pick-up centers in hard-to-reach rural areas	70 <sup>28</sup>
Zatz et al (2021) <sup>32</sup>	Cross-sectional	Maine Low-income families with children, predominantly non-Hispanic White (n = 863) grocery shopping at 2 supermarkets	Store pickup	Equity: sociodemographic differences between families who shopped online vs in-store	Online purchasing: retail scanner data (specific code for online orders) Equity: Sociodemographic determinants of online and in-store purchases at supermarkets serving low-income communities	Online grocery and inequities: Only shoppers were more likely to have higher incomes and less likely to participate in SNAP or WIC.	Expand the SNAP OPP to other regions and retailers; retailers to reduce or waive fees for low-income consumers; marketing campaigns to increase awareness of the SNAP OPP	100 <sup>26</sup>

(continued)



Table 2 Continued

Reference	Study design	Setting and population	Online retailer business model	Outcomes	Methods	Main findings <sup>a</sup>	Policy implications	Quality, %
Coffino et al (2020) <sup>23</sup>	Build on Community Capacity Experimental	New York (urban) Adults with food insecurity who do not receive SNAP benefits (n = 50)	Home delivery	Purchase: feasibility and initial efficacy of default online shopping cart on quality of foods purchased (whole grains; F&V; calories; total fat; saturated fat; sodium; cholesterol; fiber)	Psychosocial factors: nutrition literacy, dietary preferences, impulsiveness Online purchasing: the Thrifty Food Plan Calculator for price, consumption, and nutrition data Equity: 6-item household food security screener	OPP and online shopping: increased healthfulness of food purchases using default cart options for food insecure individuals	Supports the use of “nudges” (ie, changing defaults) to promote healthier food purchases in online shopping	69 <sup>26</sup>
Coffino et al (2021) <sup>41</sup>	Experimental	New York Adults with low income (n = 38), food pantry patrons	Not specified	Purchase: effect of a default online shopping cart on quality of foods purchased	Online purchasing: Grocery items were matched with nutrient data and examined as HEI, total energy, and energy density. Equity: self-reported income, education, SNAP participation, food insecurity, and access to kitchen and computer	OPP and online shopping: Prefilled shopping cart arm had greater nutrition quality (HEI score) and fewer total calories and energy density compared with nutrition education arm	Nutrition education by itself may not be enough to support healthy food purchasing by SNAP online purchasers. Use of principles of nudges for healthy prefilled grocery carts may support healthful purchasing behaviors among consumers with low income.	75 <sup>26</sup>
Dunn et al (2021) <sup>33</sup>	Cross-sectional	United States: 46 states and Washington, DC, participating in the SNAP OPP 3 state-level information sources about the SNAP OPP	Store pickup or home delivery	Equity: nationwide assessment of official communication about SNAP OPP	Equity: program, retailer, health and nutrition, and communication accessibility about the SNAP OPP	OPP and online grocery. Most states had identified authorized retailers, half informed about pickup and delivery fees, and few included information about health and nutrition.	Need to improve state communication about the SNAP OPP, which mainly focused on basic program and retailer information and limited about nutrition and health.	100 <sup>26</sup>

(continued)

Table 2 Continued

Reference	Study design	Setting and population	Online retailer business model	Outcomes	Methods	Main findings <sup>a</sup>	Policy implications	Quality, %
Martinez et al (2018) <sup>24</sup>	Mixed methods	NYC, NY Adult SNAP recipients n = 148 individuals (purchase data); n = 35 (focus groups)	Store pickup and home delivery	Psychosocial: perceptions of and intentions toward online grocery shopping Purchase: online shopping and the use of SNAP online	Psychosocial factors: attitudes, behavioral control, barriers, motivators, and intentions toward online grocery shopping. Online purchasing: sales data from online grocery store; purchases from itemized receipts (planned, but were unable to analyze) Equity: SNAP recipients in low-income zip codes	Online grocery and inequities: online SNAP purchases higher in sweets, salty snacks, and lower in fruit than non-SNAP purchases Online grocery and food assistance: lack of control over food selection and sensorial experience; concerns about delivery, food quality, security, return policies OPP and online grocery: SNAP online acceptance was a motivator. Lack of awareness and information about OPP	Online grocers or USDA may need to use motivators (eg, increased transparency and customer control) to facilitate uptake of online shopping among SNAP recipients.	73 <sup>27</sup>
Rogus et al (2020) <sup>37</sup>	Qualitative	New Mexico (urban) Adult SNAP recipients with children (n = 18)	Store pickup and home delivery	Psychosocial: behaviors, knowledge, and attitudes of SNAP recipients toward online grocery	Psychosocial factors: attitudes, subjective norms, perceived behavioral control Equity: focus on SNAP participants from families with low income	Online grocery and inequities: perception that online shopping could benefit elderly or disabled people and those without a vehicle Online grocery and food assistance: low uptake of online grocery shopping. Barriers: cost, quality control, liking grocery shopping Motivators: online features, discounts, and delivery	Address negative attitudes to make online grocery more appealing to subgroups that could benefit from the service.	90 <sup>26</sup>

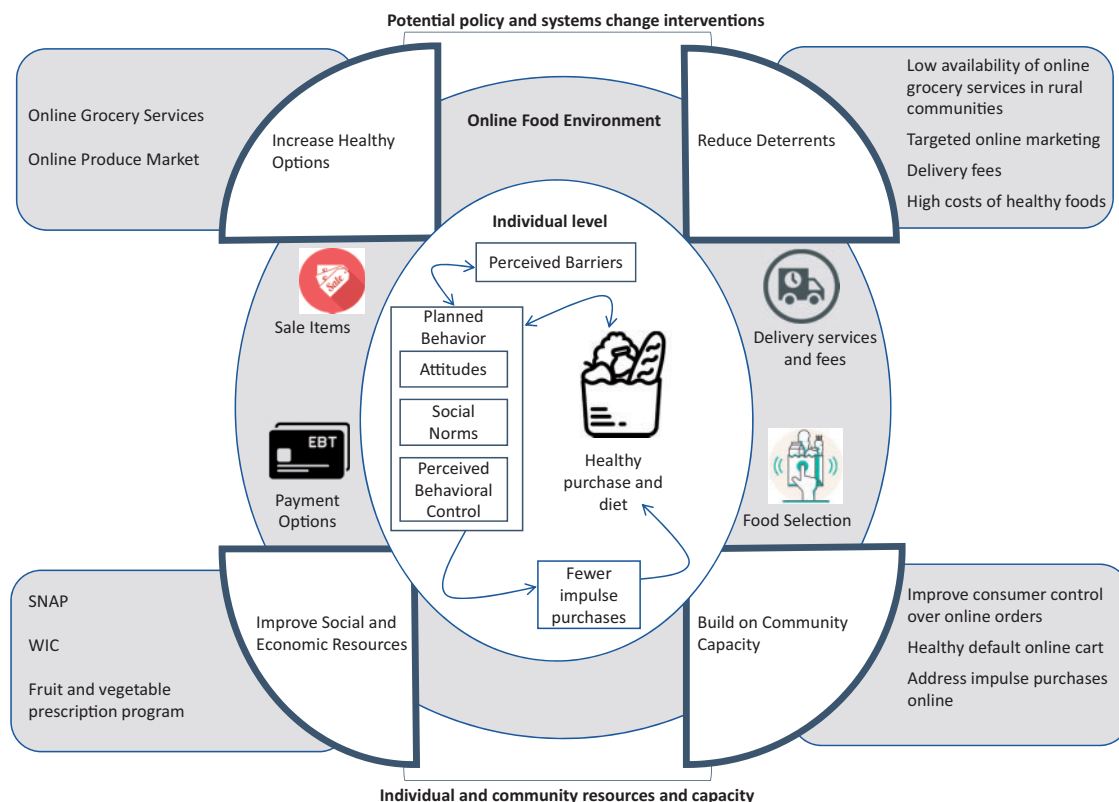
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Table 2 Continued

Reference	Study design	Setting and population	Online retailer business model	Outcomes	Methods	Main findings <sup>a</sup>	Policy implications	Quality, %
Jilcott Pitts et al (2020) <sup>36</sup>	Improve social and economic resources Qualitative	North Carolina Adult, female WIC participants (n = 7)	Store pickup	Psychosocial: advantages and disadvantages of online grocery shopping Purchase: impulse purchases	Psychosocial factors: perceived advantages and disadvantages of in-store vs online purchases; self-reported planned vs impulse buys Online purchasing: online grocery shopping experience (in the office) and annotated receipts from in-store and online purchases Equity: women with children enrolled in WIC	Online grocery and inequities: Inadequate substitutions, fees, lack of control over item selection, and inability to find deals were deterrents to using online grocery shopping. Participants made more impulse purchases online; most were chips and candy but sometimes consisted of fruit.	Ability to use WIC online could help with linkage to nutrition education programs, improve access for disadvantaged groups.	90 <sup>26</sup>
Zimmer et al (2020) <sup>38</sup>	Qualitative	East Tennessee Adult WIC recipients (n = 23)	Home delivery and store pickup	Psychosocial: WIC participants' perceptions about ordering groceries online	Psychosocial factors: perceptions about online ordering and WIC Online purchasing: food shopping experience (in-store and online) Equity: focus on WIC participants	Online grocery and inequities: Online shopping would address transportation issues and barriers related to shopping with children.	Pilot tests for WIC online ordering; facilitate WIC food retail operations	90 <sup>6</sup>
Zimmer et al (2021) <sup>34</sup>	Mixed methods	East Tennessee Adult WIC recipients (n = 24)	Store pickup	Psychosocial: acceptability and feasibility of WIC in online grocery service Purchase: online shopping (office) using WIC	Psychosocial factors: experience, barriers, and facilitators of using WIC for online order and pickup. Online purchasing: online order from WIC costumer and transaction receipts from WIC retailer Equity: feasibility trial of WIC as payment for online ordering	Online grocery and inequities: Challenges of locating WIC items and using the F&V cash value may reduce acquisition of produce online. Online grocery and food assistance: All participants placed an order with WIC and 96% picked up the order. Mean order total was \$30.60.	WIC online is feasible; need for consistent WIC labeling policies in store and online	73 <sup>27</sup>

Abbreviations: EBT, electronic benefits transfer; F&V, fruits and vegetables; HEI, Healthy Eating Index; NYC, New York City; OPP, Online Purchasing Pilot; SNAP, Supplemental Nutrition Assistance Program; Rx, prescription; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children; USDA, US Department of Agriculture.

<sup>a</sup>Online grocery and inequities refers to the potential of online grocery to promote or hinder equity in healthy food access; online grocery and food assistance refers to psychosocial and behavioral factors associated with online grocery shopping among families enrolled in federal food and nutrition assistance programs such as SNAP or WIC; OPP and online grocery refers to factors associated with the ability to pay for groceries online using nutrition assistance program benefits.



**Figure 2 Equity-oriented framework to promote healthy food purchasing and diet in online grocery environments targeted at underserved populations.** Abbreviations: SNAP, Supplemental Nutrition Assistance Program; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children

smaller share of all online purchases (20%) compared with in-store purchases (40%).<sup>39</sup> Four qualitative studies with SNAP and WIC families explored reasons for the low use of online grocery programs and all highlighted the perceived lack of control over grocery selection, especially of fresh produce and meats, as one of the major barriers, in addition to cost.<sup>24,36–38</sup>

Study authors recommended future programs and interventions build community capacity to order groceries online by improving customer control in the online environment,<sup>24</sup> and by improving state communication about the SNAP OPP to include nutrition and health information.<sup>33</sup> Two interventions intended to build community capacity to select healthier foods online tested nudges, using a healthy default shopping cart.<sup>23,41</sup> The pilot program was promising; participants in the intervention arm selected more healthier items than those in the control condition (receiving nutrition education materials).<sup>23,41</sup> Although provision of health and nutrition information is lacking in state communications about the online policy,<sup>33</sup> Coffino et al<sup>23,41</sup> empirically demonstrated that consumers benefit from a virtual food environment that is supportive of healthy food choices. Additionally, 3 studies recommended that the US Department of Agriculture allow the use of WIC benefits online as a

means to increase social and economic resources to improve food access for disadvantaged groups.<sup>34,36,38</sup>

In 3 studies, researchers pilot tested approaches to increase healthy options in the online grocery environment among socially disadvantaged communities.<sup>12,31,35</sup> One intervention (Virtual Supermarket Program) facilitated grocery delivery and SNAP payment at community hubs for low-income, urban older adults.<sup>12</sup> Participants placed and received grocery orders in designated hubs, including public libraries, schools, and senior housing centers.<sup>12</sup> The Internet Grocery Service tested the feasibility of a grocery delivery service to increase access to healthy foods in a low-income urban food desert by providing vouchers for groceries and delivery fees.<sup>31</sup> Last, an intervention in rural communities tested the feasibility of an online produce market where participants redeemed Fruit and Vegetable Prescription Program vouchers and picked up orders from a community site.<sup>35</sup>

### Psychosocial factors of the TPB related to online grocery shopping

In 10 studies included in this review, authors assessed psychosocial behaviors related to online grocery shopping. In most of these studies ( $n = 6$ ), psychosocial

domains were assessed qualitatively<sup>19,24,34,36–38</sup>; quantitative survey items were used in the other 4 studies.<sup>12,23,31,35</sup>

Overall, attitudes toward online shopping varied by study. Some authors reported a lack of interest in or low perceived benefit of online shopping.<sup>24,37</sup> In others, participants expressed interest in online grocery services, although most seemed to view it as an occasional convenience rather than a complete substitute for in-store shopping.<sup>31,36,38</sup> For example, after the Internet Grocery Service intervention, 54.5% of participants responded that they would use the service 1–6 times per year, 24.3% said they would use it at least monthly, and only 9.1% reported they would never use it in the future.<sup>31</sup>

Concerns about control over food selection emerged as a major barrier to uptake of online grocery services,<sup>19,24,36,37</sup> particularly with regard to the quality of fresh items<sup>37</sup> and the potential for losing money on unsatisfactory purchases.<sup>19</sup> Perceived high cost of online grocery shopping was another barrier to its uptake by underserved families. The potential for losing money on unsatisfactory purchases was a main concern<sup>19,36,37</sup>; participants cited fees and the relative paucity of deals online compared with in-store purchases as disincentives for online shopping.<sup>36</sup> Additionally, the lack of social interaction during grocery shopping was another reported deterrent to online shopping, although some participants felt that the benefits offset the loss.<sup>38</sup>

Online grocery ordering was perceived to be less stressful than in-store grocery shopping among women with children enrolled in WIC, because it eliminated the need for transportation and addressed the challenges of shopping in a store with children.<sup>38</sup> Although the evidence supporting reduced impulse purchases when shopping online is mixed,<sup>23,36</sup> participants also felt that online grocery shopping might result in fewer impulse buys of both unhealthy (eg, sweet snacks and chips) and sometimes healthy (eg, fruits) foods, compared with in-store purchases.<sup>38</sup> Additional benefits of online grocery services identified by participants included saving time and delivery of heavy or bulky items.<sup>19</sup>

Both perceived behavioral control and normative beliefs positively influenced use of online grocery shopping during an intervention that was co-created by residents of a low-income housing community and researchers.<sup>19</sup> Participants reported that ordering groceries online was easier than they had anticipated,<sup>19</sup> a finding that was echoed by mothers participating in WIC in another study.<sup>36</sup> Participants also noted that although they were generally wary of online shopping, they trusted residents of their community and were willing to try the online grocery pilot.<sup>19</sup>

## Purchasing and diet behaviors related to online grocery shopping

Of the 11 studies in which researchers assessed online food purchasing behaviors,<sup>12,19,23,24,31,32,34–36,39,41</sup> consumer purchasing data were collected from itemized store receipts in 7 studies,<sup>19,24,31,32,34,36,41</sup> from online data monitoring in 1 study,<sup>35</sup> from stakeholder interviews and document review from a retailer in 1 study,<sup>39</sup> and were self-reported in 2 studies,<sup>12,35</sup>

In 2 studies, authors quantitatively assessed impulse buying during online grocery shopping.<sup>23,36</sup> Participants in 1 study purchased more on impulse online than they did when shopping in a store, although not all impulse buys were unhealthy.<sup>36</sup> In another study, Coffino et al<sup>23</sup> did not find a difference in impulse purchases between consumers who received nutrition education (the control condition) and those who received the healthy-default shopping-cart intervention.<sup>23</sup>

The impact of online grocery shopping on nutritional quality of purchases was mixed. A healthy-default shopping cart increased the healthfulness of food purchases and decreased fat, sodium, and cholesterol from foods purchased,<sup>23</sup> and led to greater overall nutritional quality.<sup>41</sup> The most frequently purchased items in the Internet Grocery Service pilot were animal proteins, fruits and vegetables, and caloric beverages.<sup>31</sup> SNAP Electronic Benefits Transfer online purchases were higher in sweet and salty snacks and lower in fruits than non-SNAP online purchases in a study<sup>24</sup> and had greater nutritional quality. In other studies, researchers were limited in their ability to quantitatively assess the impact of online grocery services on the healthfulness of food purchases, because of low uptake of online grocery shopping. For example, after a planned randomized controlled trial of online ordering failed due to low uptake, Martinez et al<sup>24</sup> pivoted to a mixed-methods design to understand low use of online services. Cohen et al<sup>19</sup> did not report on the food types that were purchased but noted that online orders made up a small percentage of dollars spent on food (~3.1%).

Dietary intake was assessed in only 2 studies. In 1 study, authors assessed changes in daily servings of fruits and vegetables among children and their caregivers in response to an online food-market program.<sup>35</sup> The online program resulted in improved self-reported fruit and vegetable intake among children and decreased household food insecurity.<sup>35</sup> No dietary change was observed among caregivers. In the other study, self-reported intake data related to the Virtual Supermarket Program were collected.<sup>12</sup> Customers reported purchasing more fruits and vegetables and sugary drinks since the start of the virtual program. They also attributed



eating more healthfully and perceived having greater access to affordable foods due to the program.<sup>12</sup>

## DISCUSSION

In this systematic review, we examined the potential for online grocery services to promote equitable access to healthy foods among underserved populations. Interest in the topic has grown substantially over the past few years, as evidenced by the burgeoning research and the SNAP OPP. Perceived barriers and TPB constructs associated with online grocery shopping identified in this systematic review focusing on low-income, diverse populations are consistent with findings from a previous scoping review.<sup>22</sup> Furthermore, the perspective afforded by the equity-oriented framework advanced the understanding of the main deterrents to online grocery shopping among low-income and diverse populations (eg, perceived high cost) and identified promising strategies to build on community capacity (eg, improving customer control over online purchases), opportunities to improve social and economic resources for food access (eg, allowing use of government benefits online), and strategies to increase healthy grocery options (eg, expanding online ordering and delivery services of healthy food vendors).

This investigation identified low availability of online grocery services in rural communities, perceived high costs, and perceived low behavioral control over food selection as important barriers to uptake of online grocery services by disadvantaged groups, which could widen inequities in access to healthy food. The ability to pay for groceries online with SNAP benefits was a motivator,<sup>24,31</sup> making an important case for future research on the expansion of the US Department of Agriculture online purchase pilot to other programs such as WIC and the Fruit and Vegetable Prescription Program. Pilot interventions tested strategies to improve healthy-food purchasing that could be incorporated into existing online grocery programs, including the default healthy-food online grocery cart,<sup>23,41</sup> and centralized delivery locations like public libraries and schools in hard-to-reach communities.<sup>12,19,35</sup> More research is needed on the feasibility of the use of other government benefits (eg, WIC, Fruit and Vegetable Prescription Program) in the online grocery environment as a means to improve social and economic resources for access to healthy food. Furthermore, researchers should examine and compare the cost-effectiveness of creating hubs for community grocery pick-up, expanding delivery buffers, and/or creating more supermarkets, with a particular focus on rural communities. Partnership with community centers and retailers to create community

hubs and reduce delivery fees may be a promising strategy to improve access to healthy foods.

The few studies in which online food purchasing and dietary behaviors were examined among underserved populations reported potential increases in both healthier and healthier food choices. Fewer impulse purchases and reduced influence of children on parents' buying behavior (ie, "pester power") in the online environment are possible mechanisms to explain fewer unhealthy food purchases online. These findings are also supported by the multiple selves theory, because ordering groceries for delivery in the (relatively) distant future predicts more healthy food choices (should-self), whereas immediate purchases predicts more healthier food choices (want-self).<sup>42,43</sup> Conversely, the potential for targeted online marketing and personalized recommendations have been hypothesized to increase unhealthy food purchases online.<sup>44,45</sup> Although, to our knowledge, the effect of online marketing on unhealthy food selection has not been empirically tested, various simulated, online-grocery, experimental studies have demonstrated that targeted online marketing of healthy foods and provision of nutrition information were promising strategies to improve quality of foods purchased in the virtual environment.<sup>46–48</sup> On the other hand, there is plausible evidence that food and beverage industries have disproportionately targeted marketing of unhealthy items to low-income, diverse populations across media markets.<sup>49–51</sup> Authors of a 2013 study, which was outside the scope of the present review, assessed the nutritional quality of Bronx, NY–based grocery store circulars available online and found that >84% of products advertised on the first page were processed.<sup>52</sup> The influence of grocery store circulars on online grocery purchases merits further investigation. Given the potential for personalized online marketing of unhealthy foods in the online grocery environment, there is a need to better understand existing online marketing in the virtual grocery environment and to explore avenues for interventions to support selection of healthy foods online among underserved populations.

One mechanism that could explain greater purchases of healthy items online is through future episodic thinking, which is required for planning grocery shopping,<sup>53</sup> and aligns with the premise of the TPB to understand behavioral intentions. However, no study in this systematic review tested the influence of meal planning on online grocery purchases of healthy items. In 1 study included in the present review, authors held community cooking classes as part of an intervention to improve access to fruits and vegetables.<sup>35</sup> They reported an increase in fruit and vegetable consumption by children.<sup>35</sup> In a recent study among a sample of majority non-Hispanic White women in Maine, researchers



reported that online purchases were associated with lower spending on sweet snacks and desserts compared with in-store purchases.<sup>54</sup> A potential explanation for the findings suggested by the authors included meal planning and the shopping lists built in to online grocery services.<sup>55</sup> Those authors also found that consumers spent more dollars per transaction online compared with in-store shopping.<sup>54</sup> Given that affordability of food is 1 of the main barriers to healthy diets among low-income populations<sup>56</sup> and that disparities in the cost of foods have been found between online and physical stores,<sup>19</sup> studies should be conducted to examine the financial impact of online purchases compared with in-store grocery purchases on low-income consumers' spending. Most studies in which the influence of online grocery shopping on nutrition outcomes was evaluated relied on self-reported measures of purchase and diet. Therefore, the impact of online grocery shopping on supporting healthy eating practices should be further examined. Investigation of how the ability to use national food and nutrition assistance benefits online affects healthiness of food selection and dietary behaviors is another area that warrants more investigation.

### Policy and research implications

Studies included in this review highlighted the importance of research to inform, develop, and evaluate policy and program efforts in the online grocery environment to promote the purchase and consumption of healthy foods among underserved populations. Findings from various studies underscored the need to make online grocery services more attractive to low-income groups through improving consumers' perception of control over grocery selection<sup>24,36–38</sup> and addressing financial barriers by offering deals comparable to those in-store.<sup>19,37</sup>

Environmental and social barriers to SNAP participation exist, especially for low-income populations in areas with a high cost of living.<sup>40</sup> In 6 studies, researchers explored perceptions and attitudes toward online grocery shopping among SNAP participants. Researchers identified barriers to online grocery services and suggested strategies to promote more equitable food access for low-income populations, including increased transparency and customer control,<sup>24</sup> competitive prices, 1-day delivery, SNAP Electronic Benefits Transfer online payment acceptance,<sup>31</sup> and use of handheld devices to allow for payment at delivery,<sup>12</sup> some of which have already been included in the OPP expansion. Nonetheless, the low availability of grocery delivery service in the US Department of Agriculture–defined food deserts and rural areas is still a deterrent to equitable access to healthy foods.<sup>18,39</sup> It is crucial to

maintain support for SNAP online post-pandemic and to expand online access to other food assistance programs, like WIC.<sup>39</sup> Zimmer et al<sup>38</sup> highlighted the potential benefits of online ordering to facilitate WIC food retail operations, and Jilcott Pitts et al<sup>36</sup> noted that the ability to use WIC online could help with linkage to nutrition education programs, improving access and food literacy for disadvantaged groups.

All but 2 studies<sup>33</sup> included in this systematic review collected data before the COVID-19 pandemic, which has affected the food system and families' purchasing and dietary habits.<sup>57–59</sup> The pandemic also prompted the US Department of Agriculture OPP's rapid expansion to most US states and the inclusion of additional authorized retailers, thus increasing access to online grocery services among underserved populations.<sup>21</sup> However, most studies included in this review were conducted prior to the roll out and expansion of the OPP when online grocery purchasing surged.<sup>60</sup> Therefore, interest in and uptake of online grocery shopping among low-income diverse populations presented in this systematic review are likely underestimated. Because of the increase in online grocery shopping uptake, social norms, attitudes, and barriers may have shifted, thus necessitating evaluations to examine changes among underserved populations due to the pandemic.

### Limitations

This systematic review has some limitations. First, although information on online grocery shopping may be available in gray literature reports, websites, or other unexamined documents, we focused exclusively on peer-reviewed literature. The exclusive use of peer-reviewed literature helps ensure reasonable quality of the research reported. Second, the use of only peer-reviewed literature may lead to publication bias because studies with negative or null outcomes are less likely to be published. Third, the tools used to assess quality of study varied by study design and may not be comparable with each other, although all the tools are widely used and were selected to enhance comparability with other reviews. Fourth, studies included in this review varied methodologically in terms of study design, sample size, and locale. Only 2 studies had randomized controlled design; most studies had small and convenient sample sizes. Thus, findings should be interpreted with caution and may not be generalizable. Yet, the inclusive search strategy of a wide array of disciplines using both quantitative and qualitative designs is a strength of this review. Fifth, all studies included in this systematic review were conducted in the United States, despite the extensive literature on online grocery shopping in

European countries. Given the focus of this study on low-income, diverse populations, the European-based studies did not meet the eligibility criteria for this review. More research examining online grocery shopping behaviors among underserved populations is needed outside of the United States. Last, given the variability in outcomes reported in the studies, it was not possible to conduct a meta-analysis to evaluate the pooled effect of online grocery shopping on health equity, healthy food purchasing, and diet among low-income, diverse populations.

## CONCLUSIONS

Barriers to equitable access to healthy foods in online grocery services included higher cost and scarcity of delivery services in rural and food desert areas. The expansion of online grocery services and other grocery delivery programs paired with nutrition assistance programs were enablers of equitable access to food through online grocery shopping. Most studies included in this review assessed psychosocial factors associated with online grocery shopping uptake, which acted as deterrents to online grocery shopping (ie, lack of control, concerns around food selection, perceived high cost, lack of social interaction) or facilitators (ie, perception of less stress, less impulse buying, convenience, time-saving). Studies included in this review reported mixed findings related to healthiness of foods purchased online; in the few studies in which dietary behaviors were assessed, authors reported increases in consumption of healthy foods associated with online grocery uptake. Future research should examine the effects of online grocery shopping on purchasing and diet using validated, empirical measures, including itemized grocery receipts and food frequency questionnaires or multiple 24-hour dietary recalls. In light of the OPP expansion and emerging studies on the feasibility of accepting WIC online, more research is needed to test interventions to improve equitable access to healthy food via online grocery services and assess its impact on food purchases and dietary behaviors of low-income families.

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drafted and critically revised the manuscript, and approved the final version of the manuscript.

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## Supporting Information

The following Supporting Information is available through the online version of this article at the publisher's website.

## Appendix S1 Systematic Review Search Strategies

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