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Examining Colorectal Cancer Risk Awareness and Food Shelf Use among Health Center Patients

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Abstract

Objective.—To employ the Colorectal Cancer Risk Awareness for Public Health Prevention (CRC-PHP) survey to examine how food shelf use and other covariates predict awareness of colorectal cancer (CRC) risk factors among patients of a Federally Qualified Health Center in Minneapolis, Minnesota. Secondary aims included describing the demographic and chronic-disease characteristics of the patient population and assessing their general knowledge of additional CRC risk factors and intent to make healthy food selections in the near future.

Methods.—Measures included CRC risk awareness, food shelf use, chronic-disease status, and intent to select healthy food options. Regression models and Chi-square tests of independence were employed to examine differences among food shelf users and non-users.

Results.—Among the 103 patients surveyed, 29% reported using a food shelf in the last 12 months. 47% of food shelf users and 38% of non-users reported having at least 1 diet-related condition (e.g., type 2 diabetes mellitus). Food shelf users scored 1.2 points higher than non-users, on average, on the CRC risk-factor awareness scale. They also answered more survey questions correctly regarding fruit and vegetable intake and its effect on CRC risk ($p=0.035$). Most

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Authors' information (optional). At the time the study was conducted in 2017, the corresponding author was a Master's in Public Health Administration and Policy candidate at the University of Minnesota School of Public Health.

Compliance with Ethical Standards

This study was reviewed and approved by the University of Minnesota's Institutional Review Board (IRB #1611E00901). *Informed consent.* Verbal informed consent was obtained from all study participants.

Consent for publication. Not applicable.

Availability of data and material. The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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participants reported being likely to purchase health-promoting foods in the future. In addition, participants reported being likely to select foods that were labeled as protective against CRC.

Conclusions.—Behavioral interventions exist that are focused on preventing and managing type II diabetes among food shelf users. Building off such interventions and incorporating behavioral economics components (such as nudges and product labels) has the potential to reduce food shelf customers' heightened risk and management of CRC.

Keywords

colorectal cancer; colon cancer; food insecurity; minority health; community health centers; diabetes mellitus

Background

Colorectal cancer (CRC), also referred to as colon cancer, is the third most common cancer diagnosis in Minnesota among both men and women [1]. Between 2010 and 2014 there were 39 new CRC cases per 100,000 Minnesotans; between 2009 and 2013 the mortality rate from CRC was 13 per 100,000 [2]. Risk factors associated with CRC include age, family history, and lifestyle factors [3, 4]. For example, Doubeni and colleagues found that physical inactivity, an unhealthy diet, smoking, and excess body weight accounted for an increased risk of CRC among populations with low socioeconomic status [5].

Additional CRC risk factors include heart disease, type 2 diabetes (T2DM), high blood pressure, and obesity [6, 7]. Diabetes and obesity disproportionately affect racial/ethnic minorities and populations with limited incomes or education, such as customers of the hunger-relief system [8, 9]. People who are food insecure have limited access to an adequate food supply due to financial and other resource constraints [10].

The hunger-relief system, which includes food shelves (sometimes referred to as food pantries), improves food access by providing free groceries to populations that are generally food insecure or low income [8–9, 11–12]. Provisions come from a variety of sources, such as wholesale retailers and the food service industry [8–9, 12–13]. Research shows that food shelves vary in their capacity to offer provisions supportive of a healthy diet [7, 9, 11–15]. Unlike federal food-assistance programs, food shelves are not required to meet nutritional standards [9].

Although the prevention and control of diabetes and some cancers have been studied among food shelf populations [16–19], to the authors' knowledge, CRC prevention efforts have not. Research focused on health outcomes among hunger-relief customers is important, as research confirms that the nutritional quality of food shelves is in need of improvement (particularly in key food groups that are protective against CRC) [9, 20–21]. Further, based on the prevalence of obesity and diabetes among customers of the nation's largest hunger-relief organization [8], many food shelf customers may already have an increased risk of developing CRC.

The primary purpose of the current study was to examine whether a relationship exists between awareness of CRC risk factors and food shelf use. We hypothesized that, due to

potential differences in socioeconomic status, non-food shelf users would be more knowledgeable about such risk factors compared with those who use these entities. The study also aimed to examine whether factors such as demographic characteristics and health status predicted knowledge of CRC risk factors. We strove to further describe the sample population with additional research questions, such as those related to purchasing intentions.

Methods

Study Design & Sample Criteria

The current study utilized the Colorectal Cancer Risk Awareness for Public Health Prevention (CRC-PHP) survey to examine the relationship between food shelf use and awareness of CRC risk factors among patients at a Federally Qualified Health Center (FQHC) in Minneapolis, Minnesota. From January to February 2017, a cross-sectional study was conducted using convenience sampling to recruit patients who (1) were aged 40–74, (2) received primary care from the study site, and (3) could speak and understand English or Somali (the primary languages of the patient population).

Setting & Recruitment

Patients were recruited from an FQHC located in a predominately Somali neighborhood in Minneapolis, Minnesota. Approximately half of the clinic's patients are of Somali descent. The FQHC is a nationally recognized community health center located a half mile from a food shelf, thus making it an ideal site for data collection.

A former Somali translator and teaching specialist assisted with translation of the survey and consent form. Forward-and-back translation was used and research materials were written in formal language to minimize differences across dialects. To assist with recruitment, study posters and double-sided flyers written in both English and Somali were created by a professional marketing consultant. The University of Minnesota Institutional Review Board (IRB# 1611E00901) approved all study materials prior to data collection.

Data Collection

The research team consisted of the first author and three undergraduate research assistants. Approximately 3 to 4 times per week, the team reviewed providers clinic schedules and approached patients who were eligible for the study based on their age. The research team liaised with physicians' medical assistants to facilitate patient contact and minimize workflow interruptions. Patients were recruited in clinic exam rooms while they waited to meet with their provider.

After providing verbal informed consent, eligible patients were offered the choice to complete the CRC-PHP survey either on their own or with the assistance of a research team member who read the survey questions aloud. Participants' verbal consent was obtained as the nature of the study met the criterion of 'exempt category 2 research' under the IRB's rules. Additionally, the research team provided a 'consent information sheet' disclosing information about study procedures, confidentiality, the voluntary nature of participation, and contact information for the primary researchers.

Somali-speaking members of the research team were primarily in contact with Somali-speaking patients. Most of these patients were accompanied by a family member or interpreter who assisted with translation. The research team meticulously sought to ensure that participants were asked survey questions in a culturally sensitive manner.

Using name and facial recognition as well as verbal notification from patients, the research team ensured that each participant completed 1 survey only. Survey completion time ranged from 7 to 20 minutes depending on how the survey was completed. For example, English-speaking patients either asked for survey questions to be read aloud or completed the survey on their own; most Somali-speaking patients completed the survey with the research team in a more conversational manner. Each patient received a copy of the consent form, along with a study flyer to encourage snowball sampling.

After patients completed the survey, they had the opportunity to provide a phone number or email address to enter a random prize drawing. Each patient was assigned a study identification number. The study team randomly selected 8 of these numbers for the drawings, and mailed each winner a \$50 gift card to a local grocery store by certified U.S. mail in April 2017.

Measures

The CRC-PHP survey consisted of 33 questions and the following 6 variables: (1) awareness of CRC risk factors; (2) food shelf use; (3) chronic-disease status; (4) general knowledge of CRC and recommended screening practices; (5) intent to make healthy food shelf selections; and (6) demographic characteristics.

Awareness of CRC Risk Factors

Awareness of risk factors associated with CRC was the primary outcome variable of interest. Scale items were adapted from the Bowel Cancer Awareness Measure (Bowel CAM), developed by University College London and Cancer Research United Kingdom [22]. The original scale consists of 26 items and 6 topics (e.g., warning signs, detecting bowel symptoms) [22]. However, the present study used 10 items from the Bowel CAM's prompted risk-factor scale and modified question wording, in addition to adding examples in an attempt to increase patient comprehension. For example, "fibre" was changed to "fiber," and pictorial examples of a "portion" size and a "standard drink" were included. Risk awareness scale items were assessed in their original format on a 5-point Likert scale from strongly disagree (1) to strongly agree (5). Responses of *strongly agree* and *agree* received a score of 1 point, whereas the responses *not sure*, *disagree*, and *strongly disagree* received a score of 0. The maximum score a patient could receive was 10 points. In a psychometric study by Power and colleagues [23], the original scale had satisfactory internal and test-retest reliability. The coefficient alpha (Cronbach) for the full scale and specifically for the prompted risk-factor subscale were 0.84 and 0.79, respectively.

Food Shelf Use

The primary predictor variable was dichotomous and assessed food shelf use. Patients were asked if they had been to a food shelf in the last 12 months. A *yes* response was followed by an open-ended request for the name(s) of their primary food shelf or shelves.

Additional questions were asked to assess the patients' level of use of food shelves. Two of these questions derived from a pilot study by Caspi et al to examine the frequency of patients' food shelf use [24]. The first question asked, "In the last month, about what portion of all your food was obtained from food shelves?" The second question was the same, but referenced the last 6 months. Response categories were *none*, *less than half*, *about half*, *more than half*, and *all or almost all*.

The remaining items asked food shelf clients about their food preferences. One question, adapted from the Hunger Task Force 2009 Food Pantry Survey, asked, "How important would it be for you to receive fresh fruits and vegetables?" [25]. This was modified to "How important would it be for you to receive fresh vegetables at your primary food shelf?" An additional question was created asking, "How important would it be for you to receive bakery items at your primary food shelf?" Responses were categorized on a 5-point Likert scale from most (1) to least important (5).

Chronic Disease Status

Two questions examined chronic-disease status. One open-ended question asked patients to write in their height and weight. This information was used to determine body mass index (BMI). The second question read: "Please check if a doctor has ever diagnosed you with any of the following: type II diabetes, cardiovascular disease, high blood pressure, colon cancer."

General CRC Knowledge: Disease & Screening

Two true-or-false questions from the Male Role Norms, Knowledge, Attitudes, and Perceptions Associated with Colorectal Cancer Screening survey developed by Rogers and Goodson [26] were adapted to measure general knowledge of disease and recommendations regarding CRC screening practices. "Colorectal cancer is a cancer of the colon or rectum" was adapted to "Colorectal cancer is a cancer of the colon or rectum, located at the lower end of the digestive tract." "Men and women should begin screening for colorectal cancer soon after turning 50 years of age," was modified to "Men and women at average risk should begin screening for colorectal cancer soon after turning 50 years of age" [26]. The last true-or-false question, developed by the first author using CRC early-detection facts from the American Cancer Society [27], read: "If you have a family history of colon cancer, screening for colon cancer should start before age 50."

Intent to Make Healthy Food Shelf Selections

Two survey questions measured patients' intent to make healthy food choices. The first asked, "If you could identify foods that protect against cancer, how likely would you regularly select these foods as opposed to unhealthy foods?" The second question was modified from a client survey developed by a local hunger-relief agency, The Food Group [28]. It was originally intended to assess client demand for a range of staple and culturally

specific foods that promote cooking meals. We used this question to measure how likely patients were to purchase a list of foods in the next 3 months.

Demographic Characteristics

The following patient characteristics were assessed: (1) gender, (2) age, (3) ages of adult relatives living in the household, (4) race, (5) ethnicity, (6) zip code, (7) highest level of education, and (8) household income.

Data Analyses

To assess differences in group scores, we conducted a regression model of risk-factor awareness on food shelf use. A multivariate regression model was used to control for demographic characteristics and chronic-disease status. Differences in awareness scores by food shelf use were reported. A Chi-square test analyzed differences in group responses for 3 measures (awareness of CRC risk factors, general CRC knowledge, and intent to make healthy food selections) by food shelf status. Significance was defined as $p < 0.05$ and standard errors were constructed using the Taylor series. All analyses were conducted using Stata Version 14 (StataCorp LP, College Station, Texas).

Results

Sample Characteristics and Chronic Disease Status

The CRC-PHP survey was administered to 103 patients receiving care at a local FQHC. The research team approached a total of 112 patients (9 of whom declined participation), thus making our survey response rate 92%. As seen in Table 1, among the 103 patients, 73 reported not having used a food shelf in the last 12 months while 30 had. Most patients regardless of whether they used a food shelf were at least 50 years of age, female, and lived in Minneapolis, Minnesota. Half of the patients reporting food shelf use identified as White, while others identified as Black (20%), Somali (13%) and Other (17%). Among the non-food shelf users, 40% of patients identified as Somali, 23% White, 21% Black, and 16% Other. Approximately 60% of patients in both groups reported completing high-school, their GED, or less than a high school education. Among patients who responded, the majority of food shelf users (86%) made an annual income of less than \$15,000 compared to 59% of non-food shelf users.

Using the National Heart, Lung, and Blood Institute's BMI calculator [29], both groups had similar profiles, with most patients or 68% of all patients being overweight/obese. In regard to chronic- disease status, high blood pressure and Type II diabetes were common among both food shelf users and non-users. 47% of food shelf users reported having at least 1 diet-related condition (e.g., T2DM, high blood pressure, cardiovascular disease), compared with 38% of non-users; in addition, 23% of food shelf users, compared with 18% of non-users, reported having a comorbidity. One patient who reported using food shelves had recently been diagnosed with CRC.

Food Shelf Use

Twenty-nine percent of all participants reported using a food shelf in the last 12 months (predictor variable). Considering all sources where one might acquire food, 23% and 20% of participants reported obtaining at least half of all their food from a food shelf during the last 1 and 6 months, respectively. When asked about the presence of specific food groups at their primary food shelf, 87% reported that it would be *very important* to receive fresh vegetables and 63% indicated that it would be *very* or *somewhat important* to receive baked goods.

Reliability Analysis

Internal consistency of the 10-item CRC risk-awareness scale was tested using reliability analysis. A strong reliability coefficient was produced (Cronbach's alpha = 0.84), consistent with the results ($\alpha = 0.74$) of the original psychometric study [18].

Associations between CRC Risk Awareness, Food Shelf Use, and Covariates

Results from the unadjusted logistic regression ($N=103$) model suggested no statistically significant difference between food shelf users and non-users in awareness of CRC risk factors ($p\text{-value}=0.21$). After adjusting for covariates and conducting a multivariate regression ($n=91$), no significant differences emerged. However, food shelf users produced higher scores by 1.2 points, on average. The adjusted regression model is reported in Table 2. With mean scores of 6.0 ($sd=2.6$) for food shelf users and 5.3 ($sd=2.6$) for non-users out of a total of 10 points, both groups had similar levels of awareness. Food shelf users were more aware than non-users when asked whether "Eating less than 5 portions of fruit and vegetables a day (e.g., 1 portion is 1 apple, a handful of grapes, etc.)" would increase one's risk for CRC" ($X^2(1, N=103) = 4.46, p=0.035$), a statistically significant difference.

Table 3 shows the proportion of questions answered correctly, broken down by food shelf status. Overall, food shelf users had more correct responses on the CRC risk-factor awareness scale than non-users. Regarding differences in awareness by demographic characteristics, individuals identifying as Other (e.g., mixed race, Ethiopian) or as a racial category with low representation (e.g., Native American, Asian) scored a significant 1.85 points lower than Whites ($p=0.04$).

General CRC Knowledge

Patients had a high level of understanding of CRC as a disease. More than half of all patients correctly responded *true* to the statement "Colorectal cancer is a cancer of the colon or rectum, located at the lower end of the digestive tract." Food shelf users were more likely than non-users to correctly respond *true* to the statement "Men and women at average risk should begin screening for colon cancer soon after turning 50 years of age" ($X^2(2, N=101) = 6.44, p=0.04$), whereas non-food shelf users were more likely to correctly respond *true* to the statement "If you have a family history of colon cancer, screening for colon cancer should start before age 50" ($X^2(2, N=100) = 12.36, p=0.002$).

Intent to Make Healthy Selections

Overall, 69% of patients responded positively (*extremely likely* or *likely*) when asked whether they would select foods protective against cancer if so labeled, while 16% reported that they would be *extremely unlikely* or *unlikely* to do so and 14% responded *neutral*. When purchasing certain foods in the next 3 months, 95% of patients said that they were likely to purchase fresh fruit and vegetables, compared with 41% who said that they were likely to purchase canned fruit and 37%, canned vegetables. More food shelf users than non-users said that they would be likely to purchase canned vegetables and pork ($\chi^2 (1, N = 99) = 4.38, p = 0.036$; $\chi^2 (1, N = 101) = 7.98, p = 0.005$) in the next 3 months.

Discussion

This study sought to determine the existence of a relationship between awareness of CRC risk factors and food shelf use by administering the CRC-PHP survey instrument to a convenience sample of 103 patients of an FQHC. We hypothesized that patients who had used food shelves in the last 12 months would have lower CRC risk-awareness scores compared with those who had not done so.

Results showed no statistically significant difference in scores between the 2 groups, but food shelf users had higher awareness scores than non-users by 1.2 points. In terms of accuracy, more food shelf users responded correctly to CRC risk-factor questions about fruit, vegetable, and fiber intake, as well as to items about the role of age, family history, and exercise in CRC risk. However, fewer food shelf users were aware of the link between alcohol consumption and CRC. Among both groups, the accuracy of survey responses deviated by no more than 2 percentage points for the remaining questions.

Forty-seven percent of food shelf users reported having at least 1 diet-related condition (e.g., T2DM, high blood pressure, cardiovascular disease), compared with 38% of non-users. Further, 23% of food shelf users, compared with 18% of non-users, reported having a comorbidity. According to Tsilidis and colleagues, patients with T2DM have a worse prognosis after a CRC diagnosis, in addition to having moderately increased CRC risk (20–40%), compared with those who do not have diabetes [30]. The underlying mechanisms explaining this association have yet to be elucidated, but in a recent meta-analysis of the relationship between diabetes and CRC prognosis, Zhu and colleagues [31] found that diabetes negatively affects overall CRC survival; survival for patients with diabetes was as much as 5 years shorter than for patients without diabetes. Additional research is warranted to better mitigate the potential impact of T2DM on CRC risk in food shelf-specific cohorts.

Obesity and behavioral risk factors such as physical activity have been found to be associated with CRC incidence. For example, in the prospective National Institutes of Health–AARP Diet and Health Study sample of 506,488 participants, Doubeni and colleagues found that, taken together, excess body weight, physical inactivity, unhealthy diet, and smoking accounted for 44% of the increased risk of CRC associated with lower educational attainment and 36% of the excess risk associated with neighborhood socioeconomic status [5].

The association of food shelf participation with low income was borne out in our study, in which 86% of food shelf users reported an annual income of less than \$15,000 and 63% reported having completed high school, a General Education Diploma, or less. Food shelves could be an important resource for improving nutrient intake among those facing food insecurity. As recommended by Dave and colleagues, barriers to healthy eating must be incorporated into future nutrition-education interventions and systematically addressed for food shelf users [32].

Food shelf interventions focused on disease prevention and management could benefit populations with demographics similar to those seen in our study. Because risk for T2DM is increased 2-fold among food insecure populations [33], there exists a need for intervention in hunger-relief settings. In a 6-month pilot intervention conducted by Seligman and colleagues in food banks in Texas, California, and Ohio [18], participants confirmed to be diabetic and food insecure received boxes of diabetes-appropriate foods. Prepacked boxes included lean meats, whole-grains, beans, low-sodium vegetables, no-sugar-added fruit, and dairy products [18]. Results showed improvements in participants' glucose control, fruit and vegetable intake, and diabetes self-management characteristics (e.g., fewer trade-offs between buying food and medication, increased self-efficacy in diabetes management, better medication adherence) [18].

Based on income alone, most participants in our study would likely qualify as food shelf clients (63 out of 94 participants reported an annual income of less than \$15,000). Further, most participants who reported having at least 1 chronic disease such as obesity or diabetes fell within this income bracket.

Given the results of the pilot study by Seligman and colleagues [18], an intervention incorporating both diabetes and CRC prevention and control characteristics could produce favorable outcomes in the food shelf using population in Minneapolis. This is particularly true as diabetes prevention and management could decrease CRC risk. The 2 diseases share risk factors such as obesity and a nutritionally deficient diet [4, 34–36]. Some studies also suggest that metformin, a blood-glucose-lowering medication widely prescribed to patients with T2DM, independently lowers CRC incidence [4]. As T2DM is a risk factor for CRC, diabetes-focused interventions may inherently reduce risk for developing CRC [37–39].

Based on the favorable results from the Seligman et al study, food shelf interventions have the potential to effectively increase awareness of diet-related risk factors associated with CRC among clientele. For this reason, utilizing behavioral economics approaches such as “nudging” to modify client behavior could increase awareness and assist food shelf clients in making more-healthful selections.

In a randomized controlled trial, product packaging and placement (nudging) significantly influenced the food choices of users of a food shelf in New York state [40]. Wilson and colleagues placed protein bars (a more nutrient-dense product than pastries) in the dessert section. The placement of protein bars at the start of the dessert section increased client selection by 46%. Moreover, keeping the protein bars in their original packaging increased selection by 59% [40]. Hunger-relief organizations in Minnesota have implemented similar

behavioral-economics strategies [28]. Food shelf clients may benefit from such nudging strategies such as labeling food products that reduce one's risk for T2DM and subsequently for CRC.

Limitations

Despite the contributions this study makes, several limitations must be considered. First, the sample size included in the multivariate logistic regression was small ($n=91$), particularly among food shelf users ($n=30$). Enrolling more patients into the study might have increased our ability to detect a true difference in CRC risk awareness between food shelf users and non-users. Further, we did not conduct a power analysis, as the study was exploratory in nature and used convenience-sampling techniques due to time constraints. Researchers interested in replicating this study should consider conducting a power analysis during the research-planning stage to identify the minimum number of participants required to identify a true difference in awareness of CRC risk factors between food shelf users and non-users.

Second, choosing to recruit patients from a health center rather than a food shelf may have increased survey bias. Recruiting at a food shelf would have reduced the effect of response and recall bias when asking patients if they had been to a food shelf in the past 12 months. However, conducting the study at the health center provided an appropriate comparison group to food shelf users, with similar demographic characteristics.

Third, since cognitive interviews were not conducted prior to data collection, the validity of responses may be of concern. This is particularly true as patients had the opportunity to take the survey either on their own or with the assistance of the research team. We attempted to lessen the severity of this issue by clarifying difficult or confusing questions for those who requested assistance. For example, some patients had difficulty comprehending the CRC risk-factor awareness scale and incorrectly interpreted some questions. To address this issue, we truncated and explicitly stated the original question for each scale item when confusion was established (e.g., "Do you think eating 5 portions of fruits and vegetables increases your risk for CRC?" was stated a second time as, "Do you think eating too few fruits and vegetables increases your risk for CRC?"). Additionally, some patients were not familiar with the term "fiber," but were swift to understand once provided with a brief example.

These same patients may have also been prone to response bias as they verbally answered sensitive questions and may have felt pressure to answer research questions in a more socially acceptable manner. For instance, 1 patient initially stated that she had not used a food shelf. However, upon recognizing that her partner had responded *yes* prior to her taking the survey, she quickly switched her answer.

Fourth, many patients, particularly older adults, indicated that they resided in a group home. Some of these patients stated they did not purchase all their food, but rather were able to select desired products from a list provided by their group home. Others reported having the option to select groceries offered by food distributors in their group home's parking lot. The CRC-PHP did not assess housing type as a demographic characteristic. Doing so in the future may provide insight into older or disabled patients' sources of food and could

potentially reveal, for example, that some individuals identified as non-food shelf users are in fact customers of the broader hunger relief system.

Conclusion

To promote positive health outcomes, nutrient-rich foods must be consumed and a healthy weight maintained. Such health-conscious activities may be difficult for low-income populations to achieve, particularly those dealing with food insecurity. As hunger-relief agencies continue to play a significant role in reducing hunger in the United States, their member populations face critical health issues. Food shelf interventions jointly focused on T2DM and CRC have the potential to help reduce risk for and improve management of both diseases in users of these services.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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List of Abbreviations

BMI	Body Mass Index
Bowel CAM	Bowel Cancer Awareness Measure
CRC	Colorectal cancer
CRC-PHP	Colorectal Cancer Risk Awareness for Public Health Prevention
FQHC	Federally Qualified Health Center
T2DM	Type 2 diabetes mellitus

Reference List

1. Minnesota Department of Health. Quick Facts Colorectal Cancer in Minnesota <https://www.health.state.mn.us/data/mcrs/data/qfcolorectal.html>. Accessed 9 March 2019.
2. Minnesota Department of Health, MN Public Health Data Access. Colorectal Cancer: Facts & Figures https://apps.health.state.mn.us/mndata/cancer_colorectal. Accessed 9 March 2019.
3. American Cancer Society. Cancer Facts and Figures for African Americans 2019–2021 <https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/cancer-facts-and->

[figures-for-african-americans/cancer-facts-and-figures-for-african-americans-2019-2021.pdf](#). Accessed 9 March 2019.

4. American Cancer Society. Colorectal Cancer Facts & Figures 2017–2019 <https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/colorectal-cancer-facts-and-figures/colorectal-cancer-facts-and-figures-2017-2019.pdf>. Accessed 9 March 2019.
5. Doubeni CA, Major JM, Laiyemo AO, et al. Contribution of behavioral risk factors and obesity to socioeconomic differences in colorectal cancer incidence. *J Natl Cancer Inst* 2012;104(18):1353–62. [PubMed: 22952311]
6. Kendall A, Olson CM, Frongillo EA Jr. Relationship of hunger and food insecurity to food availability and consumption. *J Am Dietetic Assoc* 1996;96(10):1019–24.
7. Wetherill MS, Williams MB, White KC, Li J, Vidrine JI, Vidrine DJ. Food pantries as partners in population health: assessing organizational and personnel readiness for delivering nutrition-focused charitable food assistance. *J Hunger Environ Nutri* 2018:1–20.
8. Weinfeld NS, Mills G, Borger C, et al. Hunger in America 2014. National Report Prepared for Feeding America <http://help.feedingamerica.org/HungerInAmerica/hunger-in-america-2014-full-report.pdf>. Accessed 9 March 2019.
9. Nanney MS, Grannon KY, Cureton C, et al. Application of the Healthy Eating Index-2010 to the hunger relief system. *Public Health Nutri* 2016;19(16):2906–14.
10. Coleman-Jensen A, Gregory C, Singh A. Household food security in the United States in 2013. United States Department of Agriculture, Economic Research Service 2014 https://www.ers.usda.gov/webdocs/publications/45265/48787_err173.pdf. Accessed 9 March 2019.
11. Hoisington A, Manore MM, Raab C. Nutritional quality of emergency foods. *J Am Dietetic Assoc* 2011;111(4):573–6.
12. Akobundu UO, Cohen NL, Laus MJ, Schulte MJ, Soussloff MN. Vitamins A and C, calcium, fruit, and dairy products are limited in food pantries. *J Am Dietetic Assoc* 2004;104(5):811–3.
13. Simmet A, Depa J, Tinnemann P, Stroebele-Benschop N. The nutritional quality of food provided from food pantries: a systematic review of existing literature. *J Acad Nutri Dietetics* 2017;117(4):577–88.
14. Farmer B Overburdened food banks can't say no to junk. All Things Considered. 13 Jan 2011. Natl Public Radio <https://www.npr.org/2011/01/13/132864584/high-demand-nutritional-dilemma-vex-food-banks>. Accessed 9 Nov 2018.
15. Kantor LS, Lipton K, Manchester A, Oliveira V. Estimating and addressing America's food losses. *Food Rev* 1997;20(1): 2–12. <http://gleaningusa.com/PDFs/USDA-Jan97a.pdf>. Accessed 9 Nov 2018.
16. Higashi RT, Craddock LS, Leonard T, Cuate E, Pruitt SL. Charitable food distribution sites offer novel opportunities for cancer prevention research and intervention among vulnerable, hard-to-reach, and underserved populations. *Cancer Epidemiol Biomark Prev* 2015;24(4):764 <https://doi.org/10.1158/1055-9965.epi-15-0114>.
17. Bencivenga M, DeRubeis S, Leach P, Lotito L, Shoemaker C, Lengerich EJ. Community partnerships, food pantries, and an evidence-based intervention to increase mammography among rural women. *J Rural Health* 2008;24(1):91–5. 10.1111/j.1748-0361.2008.00142.x. [PubMed: 18257876]
18. Seligman HK, Jacobs EA, Lopez A, Tschann J, Fernandez A. Food insecurity and glycemic control among low-income patients with type 2 diabetes. *Diabetes Care* 2012;35(2):233–8. 10.2337/dc11-1627. [PubMed: 22210570]
19. Gany F, Lee T, Loeb R, et al. Use of hospital-based food pantries among low-income urban cancer patients. *J Community Health* 2015;40(6):1193–1200. <https://doi.org/10.1007/s10900-015-0048-7>. [PubMed: 26070869]
20. Aune D, Chan DS, Lau R, et al. Dietary fibre, whole grains, and risk of colorectal cancer: systematic review and dose-response meta-analysis of prospective studies. *BMJ* 2011;343:d6617. [PubMed: 22074852]
21. Song M, Garrett WS, Chan AT. Nutrients, foods, and colorectal cancer prevention. *Gastroenterol* 2015;148(6):1244–60.

22. Cancer Research UK, University College London, Kings College London, and University of Oxford. Cancer Research UK Cancer Awareness Measure (CAM), Toolkit (version 2.1). Cancer Research UK https://www.cancerresearchuk.org/sites/default/files/health_professional_cancer_awareness_measure_toolkit_version_2.1_09.02.11.pdf. 2017 Accessed 9 Nov 2018.
23. Power E, Simon A, Juszczuk D, Hiom S, Wardle J. Assessing awareness of colorectal cancer symptoms: measure development and results from a population survey in the UK. *BMC Cancer* 2011;11(1):366 10.1186/1471-2407-11-366. [PubMed: 21859500]
24. Caspi CE, Grannon KY, Wang Q, Nanney MS, King RP. Refining and implementing the Food Assortment Scoring Tool (FAST) in food pantries. *Public Health Nutrition* 2018; 21(14):2548–2557. 10.1017/S1368980018001362. [PubMed: 29808784]
25. Askew T, Hunger Task Force. In perspective: an assessment of Milwaukee county food pantry clients. Alliance to End Hunger 2010 http://alliancetoendhunger.org/wp-content/uploads/2018/03/HFCR_Tasha.pdf. Accessed 9 Nov 2018.
26. Rogers CR, Goodson P. Male role norms, knowledge, attitudes, and perceptions of colorectal cancer screening among young adult African American men. *Front Public Health* 2014;2:252 10.3389/fpubh.2014.00252 [PubMed: 25506049]
27. American Cancer Society. American Cancer Society Recommendations for Colorectal Cancer Early Detection 2016 <http://www.cancer.org/cancer/colonandrectumcancer/moreinformation/colonandrectumcancerearlydetection/colorectal-cancer-early-detection-ac-s-recommendations>. Accessed 9 Nov 2018.
28. Caspi CE, Hikaru P, Grannon K, Carlson S. Super shelf pilot: the impact of a behavioral economics intervention on the nutritional quality of food selected by clients at food pantries. University of Minnesota Program, Health Disparities Research 2016 <https://www.healthdisparities.umn.edu/research-studies/super-shelf-pilot>. Accessed 9 Nov 2018.
29. U.S. Department of Health & Human Services, National Institutes of Health. Calculate your body mass index. National Heart, Lung, and Blood Institute https://www.nhlbi.nih.gov/health/educational/lose_wt/BMI/bmi-m.htm. Accessed 9 Nov 2018.
30. Tsilidis KK, Kasimis JC, Lopez DS, Ntzani EE, Ioannidis JP. Type 2 diabetes and cancer: umbrella review of meta-analyses of observational studies. *BMJ* 2015;350:g7607. [PubMed: 25555821]
31. Zhu B, Wu X, Wu B, Pei D, Zhang L, Wei L. The relationship between diabetes and colorectal cancer prognosis: a meta-analysis based on the cohort studies. *PloS one* 2017;12(4):e0176068 10.1371/journal.pone.0176068. [PubMed: 28423026]
32. Dave JM, Thompson DI, Svendsen-Sanchez A, Cullen KW. Perspectives on barriers to eating healthy among food pantry clients. *Health Equity* 2017;1(1):28–34. [PubMed: 30283833]
33. American Diabetes Association. 1. Improving care and promoting health in populations: standards of medical care in diabetes—2019. *Diabetes Care* 2019;42(Supplement 1), S7–S12. 10.2337/dc19-S001. [PubMed: 30559227]
34. Bayo J, Molina R, Pérez J, et al. SEOM clinical guidelines to primary prevention of cancer (2018). *Clin Transl Oncol* 2019;21(1):106–13. [PubMed: 30607789]
35. Mokdad AH, Ford ES, Bowman BA, et al. Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. *JAMA* 2003;289(1):76–9. [PubMed: 12503980]
36. Liu PH, Wu K, Ng K, Zauber AG, et al. Association of obesity with risk of early-onset colorectal cancer among women. *JAMA Oncol* 2019;5(1):37–44. [PubMed: 30326010]
37. Hu FB, Manson JE, Liu S, et al. Prospective study of adult onset diabetes mellitus (type 2) and risk of colorectal cancer in women. *J Natl Cancer Inst* 1999;91(6):542–7. [PubMed: 10088625]
38. Limburg PJ, Anderson KE, Johnson TW, et al. Diabetes mellitus and subsite-specific colorectal cancer risks in the Iowa Women's Health Study. *Cancer Epidemiol Prev Biomark* 2005;14(1):133–7.
39. González N, Prieto I, Del Puerto-Nevado L, et al. 2017 update on the relationship between diabetes and colorectal cancer: epidemiology, potential molecular mechanisms and therapeutic implications. *Oncotarget* 2017;8(11):18456–85. [PubMed: 28060743]

40. Wilson NLW, Just DR, Swigert J, Wansink B. Food pantry selection solutions: a randomized controlled trial in client-choice food pantries to nudge clients to targeted foods. *J Public Health* 2017;39(2):366–72. 10.1093/pubmed/fdw043.

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Table 1.

Sample Characteristics of Federally Qualified Health Center Patients (N=103).

	Non-Food Shelf User	Food Shelf User
Age		
40–49	18 (25%)	10 (33%)
≥ 50	<u>55 (75%)</u>	<u>20 (67%)</u>
Total	73 (100%)	30 (100%)
Gender		
Male	32 (44%)	13 (43%)
Female	<u>41 (56%)</u>	<u>17 (57%)</u>
Total	73 (100%)	30 (100%)
Race		
Somali	29 (40%)	4 (13%)
White	17 (23%)	15 (50%)
Black	15 (21%)	6 (20%)
Other	<u>12 (16%)</u>	<u>5 (17%)</u>
Total	73(100%)	30 (100%)
Minnesota Residence		
Minneapolis	61 (85%)	26 (90%)
Other	<u>11 (15%)</u>	<u>3 (10%)</u>
Total	72 (100%)	29 (100%)
Highest Level of Education		
Less than high school	21 (29%)	6 (20%)
High-school or GED	22 (30%)	13 (43%)
Some college	14 (19%)	7 (23%)
College degree or higher	<u>16 (22%)</u>	<u>4 (13%)</u>
Total	73 (100%)	30 (100%)
Annual Household Income		
< \$15,000	39 (59%)	24 (86%)
≥ \$15,000	<u>27 (41%)</u>	<u>4 (14%)</u>
Total	66 (100%)	28 (100%)
BMI		
Underweight/Normal	23 (33%)	9 (30%)
Overweight/Obese	<u>46 (67%)</u>	<u>21 (70%)</u>
Total	69 (100%)	30 (100%)
Disease Diagnosis (count of positive diagnosis) *		
Type II diabetes	16	7
High blood pressure	36	18
Cardiovascular disease	2	3
Colon cancer	0	1
Total	54	29
Risk Factor Awareness Score		

	Non-Food Shelf User	Food Shelf User
Mean (SD)	5.4 ($\pm$ 2.5)	6.0 ($\pm$ 2.6)

* Study participants may have reported having at least one condition.

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Table 2.

Adjusted Multivariate Logistic Regression Model of Patient Colorectal Cancer Risk Awareness Score by Food Shelf Status and Covariates (N=91).

Predictor	Coefficient	SE	p-value	95% CI ^I
Food Shelf Use				
Non-user	(Ref)	(Ref)	(Ref)	(Ref)
User	1.20	0.63	0.06	(-0.05, 2.50)
Gender				
Male	(Ref)	(Ref)	(Ref)	(Ref)
Female	-0.66	0.56	0.24	(-1.77, 0.45)
Age				
40 – 49	(Ref)	(Ref)	(Ref)	(Ref)
≥ 50	-0.02	0.62	0.97	(-1.25, 1.21)
Income				
< \$15,000	(Ref)	(Ref)	(Ref)	(Ref)
≥ \$15,000	0.22	0.78	0.78	(-0.81, 1.75)
Education				
Less than high school	(Ref)	(Ref)	(Ref)	(Ref)
High school or GED	-1.59	0.80	0.05	(-3.12, 0.00)
Some college	-1.08	0.98	0.28	(-3.04, 0.88)
College degree or higher	0.55	0.96	0.57	(-1.37, 2.47)
Race				
White	(Ref)	(Ref)	(Ref)	(Ref)
Black	-0.61	0.81	0.45	(-2.21, 0.10)
Somali	0.24	0.81	0.76	(-1.37, 1.86)
Other	-1.85	0.87	0.04*	(-3.58, -0.12)
BMI				
Underweight/Normal	(Ref)	(Ref)	(Ref)	(Ref)
Overweight/Obese	-0.99	0.57	0.09	(-2.13, 0.15)
High Blood Pressure				
Negative Diagnosis	(Ref)	(Ref)	(Ref)	(Ref)
Positive Diagnosis	-0.50	0.55	0.36	(-1.60, 0.60)
Type II Diabetes				
Negative Diagnosis	(Ref)	(Ref)	(Ref)	(Ref)
Positive Diagnosis	0.22	0.65	0.74	(-1.07, 1.51)

^I CI, confidence interval

* p<0.05

Table 3.

Colorectal Cancer Risk Factor Awareness Scale – Correct Responses by Food Shelf Status

Risk Factor Scale Items	Food Shelf Status		
	Non-user (%)	User (%)	Total (%)
Drinking more than 1 standard drink of alcohol a day.	42%	30%	39%
Eating less than 5 portions of fruit and vegetables a day	51% *	73% *	57%
Eating red or processed meat once a day or more.	63%	62%	63%
Having a diet low in fiber	45%	62%	49%
Being overweight	69%	69%	69%
Being 70 years old.	49%	69%	55%
Having a close relative with colon cancer.	53%	73%	59%
Doing less than 30 minutes of moderate physical activity 5 times a week.	51%	65%	55%
Having a bowel disease (e.g. Crohn's disease, ulcerative colitis).	67%	67%	66%
Having diabetes	45%	43%	44%

*
P<0.05