STRATEGIES TO SUPPORT HEALTHY FOOD CHOICES FOR ADULTS LIVING WITH LOW SOCIOECONOMIC STATUS AND TYPE 2 DIABETES MELLITUS: AN INTEGRATIVE LITERATURE REVIEW

by

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Abstract

Type 2 diabetes mellitus (T2DM) is an increasing concern in Canada, with low socioeconomic status being a major risk factor. This review explores strategies to improve food access that promote healthy food choices among people experiencing food insecurity and living with T2DM. Whittemore and Knalf's (2015) integrative literature review methodology was used to extract and analyse the evidence. Four key strategies emerged: 1) promoting healthy food affordability through incentives and disincentives, 2) understanding effective and ineffective food interventions, 3) enhancing nutritional education in the standard of care, and 4) manifesting empowerment through self-efficacy and diabetes management. These strategies can be applied by nurse practitioners within primary care. Aligned with a population health approach, they can direct practice, education, and research through healthy public policy focused on reducing the incidence of T2DM, particularly in people experiencing food insecurity.

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Chapter 1: Introduction

The incidence of diabetes is increasing rapidly and many patients in primary care live with low socioeconomic status and type 2 diabetes mellitus (T2DM) simultaneously. The literature points to low income or food insecurity as one factor contributing to the poor management or development of diabetes (Abdurahman et al., 2018; Anekwe & Rahkovsky, 2014). There are a growing number of people who are unable to afford the food that makes up a recommended diabetic diet. To address this concern, many innovative programs are being developed in communities throughout British Columbia (BC) to minimize food waste and improve local food security. These situations led to my interest in the evidence supporting how food access can be improved for adults with T2DM living in low socioeconomic circumstances to attain a medically recommended healthy diet. As a nurse practitioner (NP), there is greater opportunity to investigate this problem and to be involved in applying the evidence that results in change. The specific question developed to inquire into this situation was: how can improved food access promote healthy food choices among adults of low socioeconomic status (SES) living with T2DM in urban communities?

Background

According to Hosseini et al., (2019), 7.5% of the Canadian population aged 20-79 is living with T2DM. The prevalence of diabetes is growing in Canada and is expected to reach 12% by 2025 (Diabetes Canada Clinical Practice Guidelines Expert Committee [DCCPGEC] & Houlden, 2018). T2DM is a chronic metabolic disorder in which the body loses its ability to regulate blood sugar levels at a precise homeostasis, due to insufficient supply or action of insulin (DCCPGEC, Punthakee, et al., 2018). Screening for, and management of, T2DM is often measured through fasting plasma glucose (FPG), a value of current blood sugar levels or glycated hemoglobin (A1C), which provides a percentage of the average blood sugar levels over

a period of two to three months. T2DM increases the risks for the development of other chronic diseases in small vessel organs such as the eye and kidney, as well as large vessel organs like the heart and brain (DCCPGEC, Imran, et al., 2018). One of many risk factors for developing diabetes is obesity (DCCPGEC, Ekoe, et al., 2018; Public Health Agency of Canada [PHAC] & Canadian Institute for Health Information [CIHI], 2011). According to the Obesity in Canada report, measurements between 2007-2009 revealed that one in four Canadians were obese, a number which has been steadily increasing over the last decade (PHAC & CIHI, 2011). Risk factors identified for obesity parallel risk factors for the development of T2DM, such as poor diet, low socioeconomic status (SES), low levels of physical activity, and immigration, to exemplify a few (Health Canada, 2011). These risk factors potentially play out as an inexpensive, calorie-dense, high carbohydrates diet, which contribute to obesity leading to insulin resistance and eventual development of T2DM. A therapeutic diet is recommended by Diabetes Canada to manage and prevent T2DM, by promoting weight loss to improve insulin sensitivity and reducing insulin requirements through a lowered consumption of refined carbohydrates (DCCPGEC, Prebtani, et al., 2018; Hemmingsen et al., 2017). This diet is balanced with protein, healthy fats, and complex carbohydrates from fruits, vegetables, and whole grains. T2DM is a growing concern in Canada, bringing attention to addressing risk factors, such as low SES which is linked to a poor diet and obesity.

People in low-middle income brackets with lower levels of education are at higher risk for developing T2DM (Dinca-Panaitescu et al., 2011; Hosseini et al., 2019). Low SES contributes to food insecurity, which then leads to obesity and an increased prevalence of T2DM (Abdurahman et al., 2018). In Canada food insecurity is described in three categories, marginal, moderate or severe, which are measured over a one-year period per household (Tarasuk &

Mitchell, 2020). Marginal food insecurity is understood as worrying about being able to afford food or having a limited selection of food because of financial constraints. A household having to compromise on the quality or quantity of food consumed would be experiencing moderate food insecurity. And finally, severe food insecurity is the experience of having to reduce one's food intake or having disrupted eating patterns, such as skipping meals. It is reported that 8.8% of households in Canada experienced moderate or severe food insecurity in the 2017/2018 survey year (Tarasuk & Mitchell, 2020).

A systematic review completed by Abdurahman et al., (2018) found that food insecurity resulted in a decline in the consumption of fruits, vegetables, dairy products, and whole grains in favour of inexpensive, energy-dense foods, which contribute to obesity. Abdurahman et al., (2018) also reported that the stress of food insecurity leads to obesity and T2DM, due to alterations in physiological metabolic processes. The findings from Anekwe and Rahkovsky (2014) further support this hypothesis, by demonstrating that high food prices impact blood sugar management in low income groups to a greater degree than in higher income groups.

Due to food insecurity many individuals living in low socioeconomic situations are relying on food assistance programs to obtain an adequate quantity of food (Chaufan et al., 2011). Food assistance can include, but is not limited to, food banks, government assistance programs, food incentive programs, or food subsidy programs. Some families are forced to rely on more than one avenue of food assistance (Chaufan et al., 2011). Food assistance programs attempt to improve food access for those experiencing food insecurity by addressing the complex factors of access, themselves. A multidimensional concept of access as described by Penchansky and Thomas (1981) can be applied to the complexities of food access. According to their theory, access is defined through five dimensions: availability, accessibility, accommodation,

affordability, and acceptability (Penchansky & Thomas, 1981). Availability of food refers to the number of food distributors, which can include but is not limited to, grocery stores, restaurants, food banks, or farmers' markets. If there are enough food distributors, they must also be physically accessible, meaning that they are within a reasonable distance and have adequate means of transportation to and from the food distributor, in order for people to access their food. Accommodation of food access can be described as the hours of operation of grocery stores or food programs. Hours must be reasonable for the people utilizing the service to address accommodation. The price of food explains the concept of affordability, which can be a significant barrier or incentive for food purchasing. And finally, the acceptability of food is the attitude and knowledge people have about food, which includes the perception of accessing any form of food distributor. Food access strategies are analysed and discussed throughout the literature review through the lens of these five access dimensions (availability, accessibility, accommodation, affordability, and acceptability).

Improving food access takes a variety of forms including government financial subsidies, healthy food incentive programs, grocery store placement, charitable donations, and poverty reduction strategies. Currently in British Columbia, people who are on social assistance can apply for a diet income supplementation of $35 per month if they require a therapeutic diet for a chronic disease, such as T2DM (Government of B.C., 2017). As can be imagined, this meager addition does not necessarily match the difference in cost for healthy food versus calorie-dense, low nutrient food (Chaufan et al., 2011). Research completed by Heflin et al., (2017) revealed that the size of government financial assistance correlates with blood sugar management in people with T2DM, therefore it may prove to be beneficial to increase the amount of assistance received from government programs for specific chronic diseases. The Supplemental Nutrition

Assistance Program (SNAP) is the government program in the U.S.A. that distributes assistance via “food stamps”, which has evolved into a preloaded card that is indistinguishable from a bank or credit card (Cohen et al., 2017b; Harnack et al., 2016). Incentive programs have been utilized and proposed for SNAP to increase the consumption of healthy food (Cohen et al., 2017b; Harnack et al., 2016). Food deserts have also been a concern in addressing food access in low income neighbourhoods (Camp, 2015). Government assistance, such as those described, often come up short, and charitable organizations fill in when many families and individuals continue to experience food insecurity (Chaufan et al., 2013; Galli et al., 2018). There has been a lack of research to demonstrate the impact of charitable organization food assistance for people living with chronic disease (Galli et al., 2018). Poverty reduction strategies at federal levels have been adopted as a more comprehensive long term strategy to address food insecurity, leaving gaps in where charitable organizations address individual food assistance (Chaufan et al., 2013). Many governments have been hesitant to distribute funds for food assistance programs, arguing that poverty reduction strategies are aiming at a solution (Galli et al., 2018). However, poverty is a complex individual and social concern that is further complicated by chronic disease. It will not be solved through a single approach, yet the immediate need of individuals cannot be ignored. With the increasing burden of disease for patients and on health care systems (Diabetes Canada, 2020), T2DM cannot wait for poverty reduction to come to fruition. To manage T2DM now, it is imperative to explore the evidence for effective food access strategies that promote healthy food choices and support the prevention and management of T2DM among high risk groups and populations.

Due to the insidious increase in obesity and T2DM incidence rates, targeting risk factors for the development of T2DM is a worthy endeavor of primary health care providers and public

health agencies, alike. The goals and interventions often translate into short and long term strategies, respectively. Rose (1985) developed a theory that differentiates and identifies the advantages versus the disadvantages of disease prevention from a 'high risk strategy', which targets individual risk; as well as from a 'population risk strategy', which targets the broad effect of environmental determinants of risk within a population. An understanding of the basic difference in these approaches is in the question asked, why does this person have T2DM versus why is there an increase incidence of T2DM in North America (Rose, 1985)? There is a normal distribution of disease in a group of people, but the level of the distribution is different depending on specific exposures of a population. For a nurse practitioner in primary practice, there is a focus on a "high risk strategy" through identifying high risk groups and screening for the development of T2DM to prevent and reduce the disease burden of the same (Rose, 1985). Individual risk reduction is the traditional approach of primary care; however, it does not address the why of increasing incidence of T2DM in Canada. There is speculation about what has changed in the environment that has impacted T2DM risk factors, such as physical activity, diet, obesity, and income. Building healthy public policy has the potential to address what has changed in the environment, a dynamic context in which nurse practitioners can also implement needed strategies (DCCPGEC, Clement et al., 2018). Interventions that address food access improve T2DM on an individual level, but poverty reduction strategies, as discussed earlier, may reduce the risk of T2DM within a population. Both individual risk reduction and population risk reduction strategies must be employed in the management of increasing diagnoses of T2DM. The evidence presents novel approaches to addressing food insecurity for people living with T2DM through government assistance and charitable organizations. Further investigation is needed to

understand the relationship between food assistance and T2DM among individuals of low SES (Abdurahman et al., 2018). Through this integrative review I contribute to this investigation.

Chapter 2: Method

The purpose of an integrative review is to connect a variety of methodological studies in a systematic way to contribute to a body of knowledge surrounding a specific topic (Whittemore & Knafl, 2005). The Whittemore and Knafl (2005) process has been utilized for this integrative review, contributing in a meaningful way to the same standard of rigor as any scientific review. To accomplish such rigor, I identified a research question to guide and focus the literature search (Whittemore & Knafl, 2005). The question is: How can improved food access promote healthy food choices among adults with low socioeconomic status living with T2DM in urban communities? It was developed by employing the Population, Intervention, Context, Outcome (PICO) method. This question focused the literature search, and multiple search strategies were used to guard against potential bias, a process suggested by (Whittemore & Knafl, 2005). The steps taken to procure, sort, and analyse the set of articles are discussed, next.

Search Strategy

The research topic was first discussed with advanced practice nurses at the University of Northern British Columbia and the health sciences librarian of the same university, to guide the development of a research question. Following the development of the research question described above, key terms were brainstormed for use in order to begin the literature search within the university library databases. Due to the world pandemic of COVID 19, my search was limited to online databases. The aligned databases used for my research question included: CINAHL, Medline OVID, and PubMed. These databases are a repository of life science journals applicable to a multitude of health disciplines including nursing, health science, and medicine, which provide a broad lens to understand my research question. Journal hand searching of articles previously obtained was another search strategy employed, as I have been interested in

diabetes literature for some time during my professional education and have collected several articles related to the topic. The ‘snowball’ research strategy was also used by reviewing references cited by applicable articles. Combining these methods of searching promoted a saturation of the literature demonstrating thoroughness.

Preliminary Search

Key terms that had been mapped out were applied to the database searches, whereby MeSH headings were then discovered. In each of the aforementioned databases, the key terms and MeSH headings were searched and linked where appropriate using the Boolean terms “OR” and “AND”. The terms used are described and can be found in Table 2.1. To refine the population as applicable to the research question, MeSH headings and key terms used were “diabetes mellitus, type 2”, and “adults”, meaning individuals over the age of 18. To capture the meaning of “improved food access” and its many dimensions, the key terms and MeSH headings linked with “OR” were “food security/insecurity”, “food access”, “food programs”, “food assistance”, “food supply”, “food desert”, “health food”, “organic food”, and “community programs”. Where the search results were overwhelming (> 400), the search terms “low socioeconomic status” and/or “low income” were applied, in order to specify the context of the search. A comprehensive application of the context and outcome components of the research question, which include urban communities and healthy food choices, respectively, are discussed in the following section.

Table 2.1 MeSH Headings and Key Terms		
Population	**Intervention**	**Context**
Diabetes mellitus, type 2 Adults	Food security/insecurity Food access Food program Food assistance Food supply Food desert Health food Organic food Community programs	Low socioeconomic status Low income

Inclusion and Exclusion Criteria

The initial search of databases was purposefully left broad, in order to be more comprehensive and to guard against the exclusion of pertinent articles in error. Inclusion and exclusion criteria were utilized in a review of titles and abstracts, and during the full text review, in order to eliminate articles that did not address a component of the research question or were not applicable to nurse practitioner practice in Canada. Table 2.2 highlights the inclusion and exclusion criteria that is explained here.

To focus the research, samples were required to include participants 18 years of age or older who were living with T2DM or were at risk of developing T2DM. Children were excluded because they do not have the same incidence of T2DM, nor as much autonomy in regards to food choices when compared to adults. Other types of diabetes, such as type 1 diabetes mellitus (T1DM) or gestational diabetes mellitus (GDM), were also excluded from this review as they do not have the same casual relationship to socioeconomic status (SES) as T2DM (DCCPGEC, Punthakee et al., 2018). Using the search terms, food insecurity and food access programs, commonly produced articles that included a population experiencing low SES, which was another key inclusion component of the population.

Healthy food choices were the outcome that needed to be answered through the literature; however, key terms or MeSH headings related to healthy food choices were not applied in the database search, in order to prevent limiting the results. Healthy food choices were identified as an outcome in the title, abstract, and text review. Healthy food choices can be defined in a variety of ways, but is often not the primary or the specific outcome being studied in the research. The studies included were required to assess changes in the consumption of fruit and vegetables, sugar sweetened beverages, or calorie dense foods, which could be measured by change in body mass index (BMI), blood sugar values (A1C or FPG), food frequency questionnaire (FFQ) or healthy eating index (HEI), or food insecurity. Any research completed on animals was excluded, as the aim of this integrative review was to investigate the impacts of healthy food behaviours of people. Since the research question focused on a comprehensive diabetes diet, any studies discussing micronutrients in the management of T2DM was also not included.

Furthermore, inclusion criteria required that studies were performed in developed westernized countries, as this was the lens I have experience in and can apply to nurse practitioner practice in Canada. Research completed in rural communities was also excluded based on the theory that food access resources would be more frequent and comprehensive in an urban setting, allowing for more research with larger sample sizes. And finally, the articles had to be presented in English, as that is my only language and translation resources were not considered reasonable for the scope of this project.

Table 2.2 Inclusion and Exclusion Criteria	
Inclusion	**Exclusion**
Human studies Primary research Measuring health behaviour North America or high income countries Outcomes: fruit and vegetable, SSB, Calorie dense food intake; BMI; A1C; FPG; food security	Non-english Vitamins Children Homeless T1DM or GDM Low income countries

Search Results

Medline OVID produced 76 results. CINAHL and PubMed were broader searches and produced 250 and 163 articles, respectively. A total of 489 articles were retrieved from the database search. After removal of duplicates and addition of hand searched resources, there were 480 articles. A review of the titles and abstracts produced 24 articles for a full text review, with the above inclusion and exclusion criteria applied, resulting in 13 articles to be included in the integrative review. Among the 13 articles, there was one systematic review/meta analysis study design (Afshin et al., 2017), one qualitative study design (Berkowitz et al., 2020), and 11 quantitative studies that included cohort and quasi experimental designs (Afshin et al., 2017; Anekwe & Rahkovsky, 2014; Berkowitz et al., 2019, 2020; Cavanagh et al., 2016; Cheyne et al., 2020; Cohen et al., 2017a; Lawman et al., 2015; Mayer et al., 2016; Palar et al., 2017; Seligman et al., 2015; Weinstein et al., 2014; Zhang et al., 2017). Varied methodologies have been included to provide a broad lens of the literature. Each study was determined to be relevant in addressing at least one component of the research question. Although this integrative review was intended to contribute to the evidence for nurse practitioners in primary care practice in BC, no Canadian studies were found that met the inclusion criteria. All peer-reviewed research articles included in the review reported on studies conducted in the USA, with one exception being the systematic review/meta analysis which analysed data from the USA, New Zealand, Netherlands,

and South Africa. These 13 articles were examined and synthesized for themes and relationships that are discussed and presented in the following chapters, as they are relevant to nursing practitioner practice in primary care and to building healthy public policy in Canada. The search results are outlined in a PRISMA diagram that can be found in Appendix A. The next steps of analysing the literature and extracting the results are described in the following section.

Data Analysis and Extraction

Critical Appraisal Skills Programme (CASP, n.d.) checklists were used to evaluate each study included in this review. The CASP tools highlight the strengths and limitations of each study design and methodology. To facilitate comparing the data and determining relationships that answer the research question, the data was reduced and organized into a matrix which can be viewed in Appendix B (Whittemore & Knafl, 2005). Headings for the matrix were carefully selected, in order to code the data and ensure each article was analysed systematically (Whittemore & Knafl, 2005). The coding of the data was guided in part by the CASP checklist, in order to critique the quality of the literature, as well as determine how the results were relevant to the research question. The organization of the data is presented in the Matrix under the following headings: Title and Author, Date, Purpose/Hypothesis, Context, Method, Intervention, Strengths, Limitations, Results, and Relevance. With the data organized and displayed, the next steps of the integrative review are made possible (Whittemore & Knafl, 2005). Common themes, patterns, and connections were discovered in comparing the data results, which have been synthesized for discussion.

Chapter 3: Findings

The purpose of this integrative literature review was to answer the question: How can improving food access promote healthy food choices among adults living with low SES and T2DM? This chapter presents the four strategies I found in the research to be common and successful in improving healthy food choices. These strategies include: 1) promoting healthy food affordability through food incentives or disincentives, 2) understanding effective and ineffective food interventions 3) enhancing nutritional education in the standard of care, and 4) manifesting empowerment through self-efficacy and diabetes management. The research reviewed has been completed outside of Canada; however, regardless of the differences between countries, the integrative review of these food access interventions can guide innovative ways to address food insecurity within the Canadian context. The applicable knowledge components from the 13 articles are presented, next, and the details of each article can be found in the Matrix included as Appendix B.

Promoting Healthy Food Affordability Through Food Incentives or Disincentives

One of the encompassing themes derived from the integrated review was that incentives and/or disincentives improved food access through the dimension of affordability, promoting healthy food choices among a varied population (Afshin et al., 2017; Anekwe & Rahkovsky, 2014; Cavanagh et al., 2016; Cohen et al., 2017a; Weinstein et al., 2014). Decreased food prices can incentivise purchasing, while increased food price is a disincentive for food purchasing (Afshin et al., 2017; Anekwe & Rahkovsky, 2014). State wide incentive programs, in addition to standard food assistance, is another form of incentive to promote healthy food consumption (Cohen et al., 2017a). Incentive programs that promote healthy food choices can be a strategy targeting high risk groups through a food bank or clinic, or through public policies, in order to

target specific populations (Afshin et al., 2017; Cavanagh et al., 2016; Weinstein et al., 2014). These interventions are important for people who are food insecure, but not necessarily accessing emergency food assistance programs.

The Connection Between Food Price and Healthy Food Choices

Afshin et al., (2017) completed a systematic review and meta-analysis of the impact of food price on food purchasing and BMI. As the cost of healthy food decreases by 10%, the purchasing of such food increases by 12% (95%CI: 10-15%) (Afshin et al., 2017). In this study healthy food included low calorie/low fat foods and fruits and vegetables, which aligns well with the definition of a healthy diet outlined by Diabetes Canada. The price of food can be subsidized at the point of purchase, with coupons or with a cash-back rebate (Afshin et al., 2017). The most commonly subsidized foods were fruits and vegetables, resulting in a 14% (95% CI: 11-17%) increase in purchasing for every 10% reduction in cost (Afshin et al., 2017). Low calorie/low fat food (excluding low fat milk and zero calorie beverages) consumption also increased by 16% with every 10% reduction in cost of these food items (95%CI: 10-23%). Less robust evidence pointed to a reduction in BMI of 0.04 kg/m2 for every 10% reduction in price of healthy food (Afshin et al., 2017). Alternatively, as food prices increased, the researchers found reduced consumption (Afshin et al., 2017; Anekwe & Rahkovsky, 2014). What was further revealed by Afshin et al.'s (2017) systematic review, was that a 10% increase in unhealthy food price decreased consumption by 6%. Anekwe and Rahkovsky (2014) was similarly interested in how increased food price impacted food security and disease management in people with low SES and T2DM. Anekwe and Rahkovsky (2014) noted that increased price of fruits and vegetables, lean proteins, and low fat milk resulted in increased fasting plasma glucose (FPG) and other blood sugars, which is likely thought to correlate with decreased consumption due to barriers in

access. The investigation did measure outcomes with more definitive measurement tools but the results of Anekwe and Rahkovsky's (2014) are limited by its retrospective nature and ability to account for only food consumed at home. The authors also had to exclude sugar sweetened beverages (SSB) from the analysis (Anekwe & Rahkovsky, 2014). Afshin et al., (2017) addressed these gaps as the most commonly targeted food items for increased price in their research, which was fast food and (SSB), noting that an increase in price trended to a reduction in BMI; however, it was not statistically significant. The opposite effect was true for increased prices of healthy food, especially for low income women and women with children, meaning that an increased price of healthy food demonstrated an increase in BMI (Afshin et al., 2017). However, the authors noted that the quality of the data supporting impacts of food price on BMI had many limits (Afshin et al., 2017). Lower priced healthy food promotes healthy food choices for those with or without T2DM, and to a lesser degree, disincentives discourage the purchasing of unhealthy food. There is somewhat compelling evidence to support implementing a strategy of affordability by subsidizing healthy food and increasing the price of unhealthy food at the purchaser level, in order to target larger populations in the entire spectrum of food security.

The Use of Food Coupons to Leverage Healthy Food Purchasing

Food coupons redeemable for the purchase of fruits and vegetables are a system of incentivising people with low incomes to purchase healthy foods, by addressing access through affordability similar to subsidized food pricing. Food coupons is a way of decreasing or subsidizing food cost. The qualitative evidence reviewed by Afshin et al., (2017) revealed that coupons specifically have a positive effect on supporting increased fruit and vegetable purchasing, which is even more profound when coupled with education. Other quantitative

studies had similar results influencing healthy food choices (Afshin et al., 2017; Cavanagh et al., 2016; Cohen et al., 2017; Weinstein et al., 2014).

The distribution of coupons, redeemable at farmers' markets in New York City (NYC), with timely education, increased the use of these markets and the affordability of fruit and vegetables (Weinstein et al., 2014) Seventy-eight percent of participants in the study identified an increased ability to afford healthy food ($p=0.008$) as a reason to use coupons for purchasing food at a farmers' market (Weinstein et al., 2014). The increase of a 0.2 serving of fresh fruits per day, however, was not clinically significant (Weinstein et al., 2014). BMI and A1C improved marginally in both the experimental and control study arms, likely due to the short nature of the study (Weinstein et al., 2014). It was also hypothesized by the authors that this neighbourhood had already experienced food access interventions, which would have changed food purchasing behaviour prior to the research being completed. The intervention had minimal effect in this context, but with the limits of the research in mind, Weinstein et al., (2014) was able to demonstrate that coupons do incentivise purchasing at farmers' markets where healthy food choices are available. This intervention may have greater impact if sustained over a longer period of time or integrated into standards of care to enhance positive outcomes.

The benefit of coupons incentivising healthy food choices is further supported by Cavanagh et al., (2016), who found a decrease in BMI in a veggie prescription intervention. BMI is used by Cavanagh et al. (2016) and other authors as an outcome marker extrapolated to be a result of a healthy diet. A low income population living with a diet-related chronic condition such as diabetes mellitus, hypertension, or obesity, were prescribed a coupon book for the purchase of fruits and vegetables (Cavanagh et al., 2016). Coupons could be used at a mobile market that parked in front of the clinic one day a week, as well as other locations in the

neighbourhood on other days during the week (Cavanagh et al., 2016). The authors found that with a minimum of 5-week, non-consecutive coupon use, there was a statistically significant ($p=0.02$) reduction in BMI of 0.74 kg/m2 compared to a gain of 0.34 kg/m2 in the control group (Cavanagh et al., 2016). Although the results may not seem clinically significant, weight control is an important aspect of T2DM management and prevention; therefore, any weight loss or no change in weight can be considered clinically significant. There is potential for greater results with continued intervention of either study, underscoring the importance of improving affordability in low income populations who are at greatest risk for T2DM.

Benefits of State Wide Programs that Incentive Purchasing Healthy Foods

The U.S.A. government reduces food security through the SNAP, which is a form of cash value assistance that can be used to purchase grocery items (US Department of Agriculture [USDA], n.d). Michigan state has made an effort to incentivise the purchasing of produce, specifically with the Double Up Food Bucks (DUFB) program (Cohen et al, 2017). DUFB is an optional program that can be used in addition to SNAP, encouraging people to purchase more fruits and vegetables by doubling the cash value of money spent on fruits and vegetables at participating farmers' markets and grocery stores throughout the state (Cohen et al., 2017a). The primary purpose of this project was to increase awareness and uptake of the DUFB incentive program (Cohen et al., 2017). Secondary outcomes included the increased purchasing of fruits and vegetables in a low-income population who were already using SNAP (Cohen et al., 2017). An important discovery by the authors was a prolonged impact of increased fruit and vegetable consumption that persisted beyond the weeks DUFB farmers' markets were available (Cohen et al., 2017). It might be the case that when people are given an opportunity to incorporate more fruits and vegetables into their diet, they see and understand the benefits on their health, making

a healthy diet a priority. Improved food access through a cash rebate incentive, in addition to government assistance, promotes long term healthy food choices among low income groups. This was an important discovery for promoting long term healthy food choices for this population, with the potential for more encompassing interventions in the future.

Understanding Effective and Ineffective Food Interventions

Upon examining the literature, many innovative food interventions revealed a notable impact toward improving healthy food choice and food access to populations with chronic disease and low socioeconomic circumstances. Three knowledge categories of food intervention were used for this integrative literature review. The first food intervention category was understood as healthy food being made directly available to a population through food delivery/distribution (Berkowitz et al., 2019, 2020; Cheyne et al., 2020; Palar et al., 2017; Seligman et al., 2015). The second category was understood as a food intervention that is indirect, achieved through the increased density of grocery stores (Zhang et al., 2017) or increased variety of food available in stores (Lawman et al., 2015). Lastly, the third category was understood as a food intervention based on an increased budget for food purchasing and on an examination of healthy food choices (Mayer et al., 2016). The evidence is informative, in that not all food interventions are equal, with direct interventions overall being more successful than indirect approaches in supporting a healthy diet and T2DM management in a population that is food insecure.

Foodbank Distribution and Healthy Meal Delivery Programs as Effective Food Interventions

Two projects in partnership with food banks, targeting populations with T2DM to receive food that met the recommendations for a diabetic diet over the course of six or 12 months, were of particular interest (Cheyne et al., 2020; Seligman et al., 2015). Not only did these projects

address food needs, directly, but they also provided education and management support for people living with T2DM, and discussed further in the section of this chapter highlighting nutrition education as a standard of care (Cheyne et al., 2020; Seligman et al., 2015). The benefit of food delivery or distribution is that it can address multiple access dimensions at once, breaking down barriers of availability, accessibility, affordability, and acceptability. The participants in this study were specifically targeted, as they were already accessing food assistance, meaning they were likely food insecure and more at-risk for developing T2DM.

Seligman et al.'s., (2015) study involved three food banks in three different U.S.A. states. The primary outcome of this intervention resulted in a significant improvement in A1C values, as well as increased fruit and vegetable intake with participants eating all or most of the food from the diabetes food boxes (Seligman et al., 2015). There was a greater impact on participants that had poorer control of T2DM at baseline, demonstrating the ability for such interventions to target this particular food insecure group (Seligman et al., 2015). Cheyne et al.'s, (2020) study further supports the understanding of how a food bank intervention targeting a specific at-risk population can improve people's access to healthy food. This food bank project was directed at people at-risk for developingT2DM, who were using food bank services (Cheyne et al., 2020). Since the diet management for at-risk individuals and those with T2DM is the same, increased healthy food consumption continues to be an important outcome to be measured in both groups (DCCPGEC, Prebtani, et al., 2018). The results of Cheyne et al.'s (2020) study focused on improved food security, improved healthy food consumption, and reduced unhealthy food consumption. The engagement level of participants was not detrimental to the outcomes (Cheyne et al., 2020). It was found that as food access barriers are removed, engagement in intervention programs is better achieved. What is interesting is that, those who were more food secure at

baseline were more engaged throughout the project, implying that the factors contributing to food insecurity may not be fully understood; thus making the situation more difficult to address (Cheyne et al., 2020).

Food distribution conducted with other charitable organizations, also addressing multiple food access dimensions, have similar results. Several projects reviewed directly delivered medically-appropriate food to their sample populations (Berowitz et al., 2019; Palar et al., 2017). An intervention targeting those with HIV or T2DM, for example, delivered 100% of daily food needs over a six month period (Palar et al., 2017). Berkowitz et al., (2019) studied a similar intervention that only provided 50% of daily food needs delivered over 12 weeks. The results of both interventions were similar in their influence to reduce food insecurity, increase fruit and vegetable consumption, and reduce unhealthy eating (Berkowitz et al., 2019; Palar et al., 2017). The benefit of the longer food delivery program was that, it was able to demonstrate a reduction in BMI for those with T2DM (Palar et al., 2017) which was not seen with the 12-week delivery program (Berkowitz et al., 2019). The intervention time does appear to matter for long-term outcome goals. Berkowitz et al., (2019) measured the outcomes with a validated healthy eating index (HEI), noting a significant difference in scores during intervention versus post/pre-intervention. There was no difference in the study arms, meaning that no changes lasted beyond the medically tailored meal (MTM) delivery program. The most important finding for this integrative review was that, food delivery was an effective strategy to improve food access and to promote healthy food consumption in a population with T2DM, with the need to access emergency food programs (Berkowitz et al., 2019: Palar et al., 2017). In the qualitative research conducted on the same 12-week MTM intervention, participants expressed that they had to go to the grocery store less frequently, which translated to unhealthy food being purchased less often

(Berkowtiz et al., 2020). A project like this is targeted at a high-risk population to reduce risk. Foodbank-based projects that either deliver or distribute diabetes-appropriate food are an effective strategy for targeting people living with low socioeconomic status and T2DM, and could be effective beyond the limits of a food bank.

Government Assistance, Convenience Store Health Food, and Reduced Distance to Grocery Stores as Ineffective Food Interventions

The literature explored food access interventions that were not direct approaches of food distribution or delivery. Government assistance is correlated with better food security and reduced hypoglycemia (Mayer et al., 2016), but other strategies such as decreasing distance to grocery stores (Zhang et al., 2017) and increasing the amount of healthy food in local stores, (Lawman et al., 2015) did not demonstrate effect on diet-related outcomes or diabetes biomarkers. It is important to present alternative findings to highlight that not all strategies are equal toward improving food access to support healthy food choices.

Enrollment in government food assistance, such as SNAP, is a strategy that improves the management of T2DM for people who are food insecure (Mayer et al., 2016). The authors found that SNAP enrollment partially alleviated food insecurity and improved blood sugar control (Mayer et al., 2016). Conclusions about the correlation with blood sugar management and fruit and vegetable intake was positive, but dietary intake was not a primary outcome measured (Mayer et al., 2016). SNAP was found to increase healthy food availability due to an increased grocery budget, and alleviates the use of coping strategies for money management; but the choice of the type of food purchased remains with the individual at the level of purchasing. The factors affecting blood sugar management for this group are varied and difficult to identify. A government initiative studied by Lawman et al. (2015) was even less predictive of improved

healthy food choices. A program was introduced to improve the availability of healthy food in low income, food desert neighbourhoods in the USA (Lawman et al., 2015). This food initiative provided education, incentive, and infrastructure changes to support corner stores to expand the variety of food available in them to include fruits, vegetables, and other grocery items (Lawman et al., 2015). Due to more complex store infrastructure, the price of items was increased, leading to higher spending; however, there was no change in the types of foods purchased in these stores, regardless of customer age or sex after comparing a baseline group of 8,671 people to the intervention group of 5,949 (Lawman et al., 2015). With no change in purchasing habits after improved health food availability at corner stores, it is not surprising that a reduction in distance to a grocery store also did not have a measurable impact (Zhang et al., 2016). With some variability in the findings, a retrospective cohort study with an average reduction in grocery store distance of 0.7 miles found no change to BMI 10 months after the new grocery store opened (Zhang et al., 2016). The sample population examined was people living in low-income neighbourhoods with T2DM (Zhang et al., 2016). It is possible that the people with T2DM had already attained a reduction in BMI, due to receiving the standard of care from their medical team making the distance to the grocery store a negligible change to habits they had already created. It is important to note that, according to the results of these studies, indirect food interventions which simply increase the availability of food, does not have the power to make an impact on food choices. It is possible that indirect food interventions could be more effective if combined with other food intervention strategies.

Enhancing Nutritional Education in the Standard of Care

Nutrition education has been established as part of the standard of care for T2DM. Because of that standard, education was not administered alone in any of the research studies

included in this integrative literature review. Education is a common theme integrated into a variety of interventions (Berkowitz et al., 2020; Cheyne et al., 2020; Seligman et al., 2015; Weinstein et al., 2014). The qualitative evidence from Afshin et al. (2017) found that, education as a strategy alone does increase fruit and vegetable consumption, but impact is maximized when combined with incentives like coupons to reduce food prices. Education is discussed here in light of the impact other strategies have had on improved food access to promote healthy food choices. Some projects had education integrated into them as part of the intervention, referred to as intentional education (Cheyne et al., 2020; Seligman et al., 2015; Weinstein et al., 2014). While in other projects, for example, education was identified retrospectively by the participants receiving medically delivered meals (MTM) program, referred to as passive education (Berkowitz et al., 2019, 2020). One educational component that cannot be ignored, regardless of the intervention, is ensuring that people living with low SES and T2DM are informed about food access resources available, especially interventions that promote and support healthy food choices (Cohen et al., 2017a).

Three Forms of Intentional Nutritional Education

Within the setting of a foodbank, it was noted in some of the studies that nutrition education and diabetes support was targeted to low income individuals experiencing food insecurity who also had T2DM (Seligman et al., 2015) or were at risk for developing T2DM (Cheyne et al., 2020). Cheyne et al. (2020) administered education through text messages, whereby participants received tips about healthy eating and maintaining an active lifestyle in conjunction with diabetes appropriate food packages from their local foodbank. Alternatively, healthy eating tips and recipes developed by registered dieticians were included in pre-packed diabetes appropriate boxes, being distributed by food banks to encourage healthy food use and

consumption. Even with variation in administering the education, there were positive effects of improved A1C and increased fruit and vegetable consumption for the sample participants and their households (Seligman et al., 2015). Of note is that, providing healthy food with no context of what it is or how best to prepare and serve it may not translate into sustained consumption of health food. Both these interventions that had a component of education along with diabetes appropriate food, demonstrated similar results: a significant increase in fruit and vegetable consumption (Cheyne et al., 2020; Seligman et al., 2015), an improvement in A1C (Seligman et al., 2015), and a decreased intake of unhealthy calorie dense/low nutritional food (Cheyne et al., 2020). Another example was the randomly controlled trial in New York City that integrated education into a veggie prescription intervention (Weinstein et al., 2014). With education and coupons deployed in this study, there was an increase in the purchase of fresh fruits and vegetables from 39% to 91 % ($p=0.003$). A reduced BMI and A1C in both study arms imply that the standard of care could be enhanced by increasing the ability of people to purchase affordable healthy food (Weinstein et al., 2014). And finally, Cohen et al. (2017) directly studied how providing information about a food access resource increased uptake, which translated into healthy food consumption. Every intervention focused on providing information to participants about the program during recruitment, which was a significant part of how education was incorporated to make the program successful. Significantly, nutritional education is a pillar within the standard of care, and an integral part of any health intervention aimed to increase knowledge about how healthy food enables positive outcomes in the management of T2DM.

Two Forms of Passive Nutritional Education

Modelling was an unexpected but effective type of education that promoted healthy food choices in the quantitative analysis of a medically tailored meals (MTM) delivery program,

providing 50% of diet needs over a span of 12 weeks (Berkowitz et al., 2020). Participants described how the MTM modelled a healthy, well portioned diet that was appropriate for someone with T2DM (Berkowitz et al., 2020). Without intentionally integrating education, MTM gave the sample population a direct example of what a well balanced meal, appropriate for T2DM, consisted of. Many participants were also willing to try unfamiliar foods, because they were delivered pre-prepared and ready to eat (Berkowitz et al., 2020). A few participants expressed how they incorporated new ideas related to the preparation of food and introduction of new types of food into their diet, following the intervention (Berkowitz et al., 2020). These findings are evidence of how the acceptability of food is impacted by modelling with real food examples, which then promotes healthy food choices. Many participants expressed having limited knowledge of what to eat, and identified formal education as a suggested improvement for the program. The MTM did reduce food insecurity and increased fruit and vegetable intake while participants were receiving meals, but it did not translate into a significant change in diet patterns beyond the intervention (Berkowitz et al., 2019). This suggests that passive education is not likely to be as beneficial as formal education, or education combined with other approaches, is in promoting long term change in the consumption of healthy food choices.

Manifesting Empowerment through Self-Efficacy and Diabetes Management

As food security improved in a previously food insecure group, there was a sense of empowerment manifested by reported enhanced self-efficacy and a greater ability to self manage T2DM. Empowerment could be the driving factor of making healthy choices long term. Self-efficacy refers to the perceived health status or control of health for a person (Seligman et al., 2015). Self-efficacy was measured most commonly by direct food intervention research (Berkowitz et al., 2020; Cheyne et al., 2020; Palar et al., 2017; Seligman et al., 2015) and by

passive food interventions (Mayer et al., 2016). Self-management of diabetes was identified as improved diabetes biomarkers as discussed in previous sections; however, there were other self-management strategies noted in the literature that are not well-captured as A1C or BMI, and are discussed in the following sections.

Benefits of Self Efficacy to Reduce the Burden of Chronic Disease

Self-efficacy in study participants was enhanced and identified as such within the integrated literature review as food access or food security improved. The qualitative research conducted on the medically tailored meals (MTM) program revealed a few contributing factors as a result of conversations with participants (Berkowitz et al., 2020). Participants stated that their distress or emotional burden related to having a chronic disease lessened by having food delivered to them that was appropriate for T2DM (Berkowitz et al., 2020). Surveys following foodbank or other food delivery interventions identified similar results (Palar et al., 2017; Seligman et al, 2015). Self-efficacy and reduced stress could have been a result of having reduced financial stress and a greater ability to afford or access the food that was medically appropriate (Berkowitz et al., 2020; Mayer et al., 2016). An improvement in depression may have also been a factor contributing to reduced disease distress when participants received diabetes-specific food (Cheyne et al., 2020; Palar et al., 2017). Furthermore, the authors studying the outcomes of 100% food delivery to food insecure people with T2DM found that there was a statistically significant reduction in binge drinking ($p=0.008$), and a reduction (although not statistically significant) in other drinking and smoking habits (Palar et al., 2017). The change in the aforementioned factors contributed to self-efficacy. Overall, self-efficacy was captured best by the reported improvement in health status and quality of life found by those who experienced greater food security (Cheyne et al., 2020; Berkowitz et al., 2020). This evidence may shed some

light on why passive food interventions like decreased distance to the grocery store (Zhang et al., 2016) or increased healthy food at corner stores (Lawman et al., 2015) were not successful in changing healthy food choices. Impersonal interventions were not enough to make any impact on self-efficacy.

Improvement in Diabetes Self-Management as a Result of Experiencing Food Security

Greater self-efficacy was strongly associated with improved diabetes self-management. As people perceive better health, they may be motivated to take better control of health behaviours, or alternatively, as people have better control of health behaviours, they perceive their health as better. Regardless of which direction the association lies, there was noted improvement in individual ability to self-manage T2DM that led to improved food security (Berkowitz et al., 2020; Berkowitz et al., 2019; Mayer et al., 2016; Palar et al., 2017; Seligman et al., 2015). The authors noted that, with improved food security through direct food interventions, individuals reported less hypoglycemic events (Berkowitz et al., 2019; Seligman et al., 2015). Mayer et al. (2016) noted that those who were food secure had a lower risk of poor glucose control, such as high or low blood glucose. Another interesting finding in the literature analysis was the reduced use of coping strategies or trade-offs used by people with food insecurity and T2DM when food access was addressed (Berkowitz et al., 2020; Mayer et al., 2016; Palar et al., 2017; Seligman et al., 2015). Trade-offs or coping strategies are when a person with T2DM chooses between food and medication or food and health care (Mayer et al., 2016; Palar et al., 2017). These trade-offs often lead to non-adherence to medication or diet regimes (Berkowitz et al., 2020; Mayer et al., 2016; Seligman et al., 2015). Canadians may not have to choose between food and health care, but it is common to have to make other sacrifices to afford food or medication for T2DM management. Coping may also have been manifested by binge drinking,

which was significantly reduced as medically appropriate food was delivered to people living with T2DM or HIV or both (Palar et al., 2016). Mayer found that those with T2DM who were more food secure did not need to change their purchasing or eating patterns to be able to manage medication or diet, which again supports the need for interventions that improve food security. These findings are evidence that food security impacts diabetes self-management in ways that are beyond changes measured by FPG, A1C or BMI.

Chapter 4: Discussion

In this chapter, the analyzed and synthesized findings of the articles that formulated the integrated literature review are discussed, providing evidence that is relevant to nurse practitioner (NP) practice in B.C. The NP scope of practice document from the British Columbia College of Nurses and Midwives (BCCNM) includes a description of the responsibilities of a NP. As advanced practice nurses, we are expected to "analyse, synthesize and apply evidence to make decisions about [a] client's health care" and to "work collaboratively with clients…[to] identify and advocate to close gaps in health outcomes" (BCCNM, 2021). In primary care NPs are screening, treating, and diagnosing patients with T2DM. They understand the risk factors for developing T2DM, are responsible for using and sharing evidence in decisions about how the health of patients is managed, and disseminate the evidence while working collaboratively with patients to improve health inequity. Managing chronic disease and helping patients reduce the risk factors contributing to chronic disease is significant service delivery for primary care providers. Beyond primary care, lowering the incidence of chronic disease would have massive impacts on the health of populations and health care systems in Canada. Effective interventions for promoting healthy food choices for adults living with both low SES and T2DM have been derived from an analysis/synthesis of the evidence. NP's have a role to play in promoting health by implementing the strategies found, as appropriate. Next, what these findings mean and how they impact primary care practice, guide policy-making, and inform a call for more research are discussed through specific recommendations, followed by an examination of the limitations of the integrated literature review.

Recommendations for Primary Care Practice

Every primary care visit for a patient with T2DM should include a diet review and a screen for food insecurity (Camp, 2015; Palmer, 2017). Once this practice is established, then improving food access can target those at risk. Primary care does well at identifying high-risk populations and reducing the risk for disease in those groups (Rose, 1985). Applicable recommendations on how the four strategies found in the literature can be implemented into primary care is discussed. The overarching role of primary care in this context is to connect people to and advocate for resources in the community that are effective in promoting healthy food choices.

Promoting Affordability Through Food Incentives or Disincentives

With the evidence already established that a Mediterranean type diet reduces morbidity and mortality (Carlos et al., 2018; DCCPGEC, Prebtani, et al., 2018), it is imperative that this diet is not only taught but also made more affordable through the primary care setting. The evidence in the integrative literature review has demonstrated that making healthy food affordable increases the purchasing of it (Afshin et al., 2017; Anekwe & Rahkoysky, 2014). Primary care providers (PCP) are unable to set the price of food in their communities, but they can seek opportunities to partner with food distributers, such as grocery stores or farmers' markets to make food more affordable. The literature provided examples of how coupons from local food vendors where distributed in a primary care clinic, and as a result fruit and vegetables were made more affordable and purchased more frequently (Cavanagh et al., 2016; Cohen et al., 2017; Weinstein et al., 2014). Coupon use distributed in primary care leads to important outcomes of improved BMI and A1C, which is significant for people living with T2DM (Afshin et al., 2017; Cavanagh et al., 2016; Cohen et al., 2017). Food vendors might have existing

incentives in some communities that would benefit from a partnership with a primary care clinic to build awareness. The NP in primary care needs to seek out these programs in their community if they are going to ask their patients who are low income to actively participate in a Mediterranean diet. Where such a program does not exist, the NP in primary care can be a community leader to support involvement of local businesses or charitable food providers in the health of the community with coupons or similar incentives that make fruit and vegetables affordable for a low income population.

Understanding Effective and Ineffective Food Interventions

Food interventions that are effective in promoting healthy food choices are food delivery programs that distribute healthy food boxes or prepared meals directly to patients. These approaches need to be designed and delivered in partnership with primary care. Primary care can assist in identifying high-risk groups who are accessing PCPs. The vulnerable people who are not consistently interacting with PCPs may be identified through food assistance programs. Because of the known risk associated with food insecurity and development of T2DM, the high-risk group outside the reach of a PCP must be included as a priority. NP's in primary care can approach charitable food organizations to ensure that medically appropriate food is being distributed to those who are at-risk of developing a chronic disease, and those living with chronic disease. Providing medically appropriate food boxes or prepared meals are interventions that concurrently address many of the complex barriers that prevent healthy food choices in a population with low SES and food insecurity. NP's in partnership with food banks can identify those who would benefit most from healthy food distribution and delivery. The evidence shows that increased fruit and vegetable intake by delivering as little as 50% of daily food needs is beneficial (Berkowitz et al., 2019). With long term interventions like this, an improvement in

fruit and vegetable consumption, as well as markers such as A1C and BMI, is possible. Food or meal delivery makes healthy food choices the easiest choice. Step by step instructions to prepare meals from a box of healthy ingredients are becoming more popular through companies like Hello Fresh © or Chef's Plate ©. Making these types of meal deliveries available to low income populations are strategies that could be the focus of primary care and charitable food organizations, together. In situations where an individual is unable to make a meal, the delivery of prepared meals would be more appropriate. Having one balanced meal a day will model healthy eating and increase the consumption of fruits and vegetables for those receiving them. This impact has the potential to reach entire households. NP's as community health leaders can advocate for changes in food assistance to reflect the evidence for interventions that will promote healthy food choices in adults with low SES and T2DM.

It is crucial to discuss what are ineffective food access strategies in promoting healthy food choices, in order to caution NPs in primary care not to advocate or blindly accept interventions that have not been proven to benefit health. The ineffective food interventions are in the context of policy and are discussed further in that section. NPs in primary care should be knowledgeable about the evidence demonstrating effective and ineffective food access strategies to direct patients and communities appropriately toward better health.

Enhancing Nutritional Education in the Standard of Care

Education is part of the standard of care for T2DM in primary care and is effective in promoting reductions in A1C and BMI (DCCPGEC, Sherifali et al., 2018). Much of the education is delivered through the primary care team that includes the PCP. One of the goals of diabetes education is food literacy. Food literacy is "the knowledge, skills and attitudes" used to choose, prepare, or grow healthy food and to understand its impact on health (Fraser Valley

Health, n.d.). Food choices and ways to prepare food are entrenched in family cultures and layers of environmental factors (Wansink & Sobal, 2007), making it imperative that nutritional education address skills and attitudes around food, in order to promote healthy choices. Culturally appropriate education and meal ideas would also be supportive. Pairing nutritional education with food access interventions can further enhance the standard of care for a more powerful impact in promoting healthy food choices, especially for low SES patients with T2DM. The role of the NP in food interventions previously discussed needs to be combined with the standard nutritional education. Education combined with food affordability has a greater effect on behaviour change then education alone (Banerjee & Nayak, 2018). Education can be simple, as demonstrated in the research as recipes and meal ideas, nutritional tips in text messages, or modelling paired with the medically appropriate food distribution of boxes or prepared meals. Step-by-step instructions on all the ingredients describing how to prepare a healthy balanced meal is education that could be achieved by charitable organizations or food banks in partnership with primary care. Not only is this building food literacy, it is also modelling what a balanced meal should look like. NPs in primary care provide nutritional education about healthy food and can be a part of creating the resources for patients to practice what they learn. NPs in primary care can ensure there is a focus on populations of low SES with T2DM who are at greatest risk (Palmer, 2017).

Manifesting Empowerment through Self-Efficacy and Diabetes Management

People living with T2DM will largely be managed in the primary care setting where they will first learn of the diagnosis and receive initial education on self management (Palmer, 2017). Nutritional education empowers people living with T2DM to self-mange their chronic condition (Gómez-Velasco et al., 2019). Screening for food insecurity is also a key component of all

diabetes visits, because improved access to healthy food empowers people with T2DM. Empowerment enables the self-management of T2DM, resulting in multiple positive outcomes for diabetes biomarkers (Gómez-Velasco et al., 2019). Empowerment is critical for patients to navigate the complexity of healthy food choices in the context of T2DM and low SES. Primary care providers are well situated to empower patients through education and by connecting high-risk people to resources that improve food security. To guide patients toward self efficacy, PCPs need to be knowledgeable of the evidence about effective food security interventions. Primary care clinics can connect people to resources, and can also directly apply food access interventions through the provision of education and incentives for healthy food choices as has been described in the literature (Cohen et al., 2017; Seligman et al., 2015; Weinstein et al., 2014). NP's can adapt these interventions to empower the clients in their own clinics.

Food affordability, food interventions, and nutritional education are strategies that can culminate to empower clients with the knowledge and means to make healthy food choices. Client empowerment is the motivation that underpins the behaviour change required for chronic disease self-management and empowerment.

Recommendations for Policy Change

Population health is defined by the Public Health Agency of Canada (PHAC) as "an approach to health that aims to improve the health of the entire population and to reduce health inequities among population groups…by [looking at and acting] upon the broad range of factors and conditions that have a strong influence on our health" (Government of Canada, February 7, 2012). This approach is gaining momentum and is calling for the collaboration of health care providers and other health care leaders to partner for this change (CIHI, n.d.). Diabetes Canada recommends an expanded chronic care model that includes building healthy public policy to

support diabetes management (DCCPGEC, Clement et al., 2018). Primary care is not population health; however, as advanced practice nurses there is an opportunity to step into roles beyond primary care, in order to research and advocate for policy that supports the movement toward population health. The education of NP's does support creation of new knowledge through research and should consider the inclusion of how NP's can be leaders in policy creation. There are two strategies identified in this integrated literature review that could guide policy change to promote healthy food choices, in order to benefit both at-risk groups and populations. NP's who are prepared with a background in health and are concerned about health equity are well situated to take initiative into shaping policy.

Promoting Healthy Food Affordability Through Incentives and Disincentives

Food price at the buyer level has been changed recently in B.C. through the implementation of a provincial sales tax of 7% on sweetened carbonated beverages (Provincial Sales Tax Act [SBC 2012]). This policy change follows the example of other Canadian provinces and has set a precedence about the possibility of taxing other food items that contribute to obesity. The reverse, subsidizing healthy food, would be a similar strategy, which according to Afshin et al. (2017) can be even more effective in influencing purchasing. Policy change that subsidizes fruits and vegetables for the buyer would increase the purchasing of healthy food for an entire population. If an entire population could afford a Mediterranean diet, then the morbidity and mortality of that population would be reduced (Carlos et al., 2018). Subsidizing healthy food is ideal for promoting health among the working poor who are not in need of food assistance programs, but are unable to afford a Mediterranean diet. Although taxation or subsidization could be an effective population health policy, it is not without its challenges. It is unknown what affect a broad taxation or subsidization policy might have on a

free market, and it is also difficult to define the rules for what food is taxable and what food is healthy enough to subsidize. Sugar added to carbonated beverages can be easily defined, but should fruit which also has sugar be taxed or subsidized? One other challenge of food taxation or subsidization is that people still have alternative motivators for money allocation, which means such an intervention may not be as impactful outside the context of a research study. With these challenges in mind, subsidizing healthy food would be difficult but not impossible, and would likely still prove to be a beneficial population health approach. Advanced practice nurses can be players in guiding research for and promoting effective policy changes for population health.

Policy around government assistance is another approach to target fruit and vegetable consumption in high-risk groups. A provincial program like the DUFB functioning in Michigan state, could have a massive impact on the purchasing of fruits and vegetables while also supporting the local food economy (Cohen et al., 2017). The time frame of such a program would be somewhat limited in Canada, due to the short growing season and inability to grow all types of fruits and vegetables; however, Cohen et al.'s (2017) research demonstrated an effect beyond the farmers' market season. Some fruits and vegetables produced in B.C. are also stored or processed, making them available at other times of the year (Field Vegetables n.d.). The DUFB program could be applied to high-risk groups or to entire communities. Increasing people's ability to purchase local fruits and vegetables demonstrated a stable or reduced BMI and A1C, which is a meaningful outcome for the health of a population (Cavanagh et al., 2016; Cohen et al., 2016). Slight weight reductions or prevention of weight gains, and improvement in A1C may seem insignificant at the primary care level, but can have the potential to be significant for population health (Cavanagh et al., 2016).

Understanding Effective and Ineffective Food Interventions

Changing the type of food available in a convenience store, reducing the distance to a grocery store, or providing an increased cash allowance for food from government assistance are ineffective policies that do not promote healthy food choices or improve BMI (Lawman et al., 2015; Zhang et al., 2016). These interventions look like enticing policy changes, but they do not accurately address the barriers to healthy food choices. Healthy food choices are more complex than simply a matter of availability (Cheyne et al., 2020).

Policies that change government assistance to use strategies that support healthy food choices could impact groups who are experiencing food insecurity. As previously discussed, food interventions that include distribution or delivery of medically appropriate food boxes or prepared meals are effective in improving the diet of those receiving them. This could be done in primary care in partnership with charitable food organizations, but it could also be a strategy built into government food assistance. In Canada, government assistance for food is in the form of a cash allowance, but if that was exchanged for a subscription to a medically appropriate food box or meal, there could be reduced risk of chronic disease for the population receiving assistance. This food subscription could be a government program or could be contracted out to a company or organization that already exists, in order to provide at least 50% of daily food needs with the remainder coming from cash assistance. This would mean a massive overhaul of the current system, but if a cost analysis proved it to be effective, would it be worth it? Instead of cash for food, people would receive actual food, and it could be food that promoted health. This paired with the education that is already a standard of care could mean better health for a greater number of people who are at the greatest risk. NP's as advanced practice nurses have an

incredible responsibility and opportunity to influence change in policy, and to impact population health.

Limitations

There are multiple limitations in this research and this review. First, it is likely that the literature search was limited due to the world pandemic of COVID-19, making online literature searches the only possible form. As the reviewer, I am subject to bias as the analyser and presenter of the results based on a view of my own experience. The literature that has been reviewed has its own set of methodological limits. Sample size and selection bias is a concern with every study that reduces the power and generalizability of the research. The majority of the samples were also women, which makes it difficult to generalize; however, this may also point to where food access interventions need to be targeted. The systematic review had the largest sample size, but it was also the least homogeneous, with some of the research including children (Afshin et al., 2017). The small sample size was further limited by some studies lacking a control group, making it challenging to account for confounding variables. The short time frame (5 weeks to 1.5 years) of all the research is a significant limitation, as food is consumed over a lifetime and behaviour is likely to change several times. The interventions that compiled multiple components are at-risk for temporal bias, or the Hawthorn effect when looking at behaviour changes in the context of a multistep study. Eating more fruits and vegetable for a short period of time while in a study or even over a year may be easier than an entire lifestyle change, but may not impact long term outcomes.

Measurement tools and definitions of a healthy diet also varied throughout the research, making it challenging to compare data. Outcomes either focused on fruit and vegetable purchases or intake, or objective biomarkers (A1C, FPG and BMI). The assumption was made that

objective sales of food types were equivalent to consumption. The measurement tool of greatest value is controversial and is largely determined by the authors of the research. Food consumption is commonly measured with tools, such as the HEI or FFQ that rely on self report. Any self-report measurement tools are subject to social desirability bias. A1C, FPG and BMI are highly reliable quantitative values, but cannot measure healthy food choices that are better captured in a HEI or FFQ. Unfortunately, no measurement tool is able to fully explain the complex factors that are negotiated in making healthy food choices, long term. Despite these limitations in measurement, this is how food research is currently being completed and it does provide a valuable beginning to understand how food insecurity can be addressed.

Next Steps in Research and Expanded NP Roles

A reasonable next step in the research surrounding food access would be to investigate long term feasibility of food access strategies and to complete a cost analysis of upstream interventions. A strategy in place to improve food access to healthy food over the span of a few years would reveal more about lasting effects, and possibly generate better data for hard outcomes like morbidity and mortality. Long term research would need to be done for these results before making sweeping policy changes. A larger quantity of qualitative research could produce more information on the complexities of behaviour surrounding food choice in the context of chronic disease. As the body of advanced nursing practice research grows, there is a role for NP's to conduct research, to generate new knowledge, and to critique it. With supporting evidence, NP's could then be an integral part of the movement toward population health that leads to the support of policies which reduce the incidence of disease in B.C. and even Canada.

Conclusion

It is imperative that NP's engage in the evidence to support and prevent T2DM, as the incidence continues to increase across Canada. Screening for food insecurity among all clients in primary care, and among people accessing food programs, can help address the complexity of barriers preventing healthy food access that further contributes to the problem. Multiple approaches are required to find solutions in the mitigation and elimination of food insecurity, and NP's are well situated to act and be leaders. The findings of this integrative literature review can serve as a starting point for strategies targeted at addressing food access to improve health equity and to promote healthy food choices, especially for people experiencing low SES and living with T2DM. The primary care NP needs to be aware of resources in their community and be a partner in the implementation of strategies to improve food access that promote healthy food choices. Beyond primary care practice and education, NP's can be leaders in research and participants in building healthy public policy to improve food access and promote healthy food choices.

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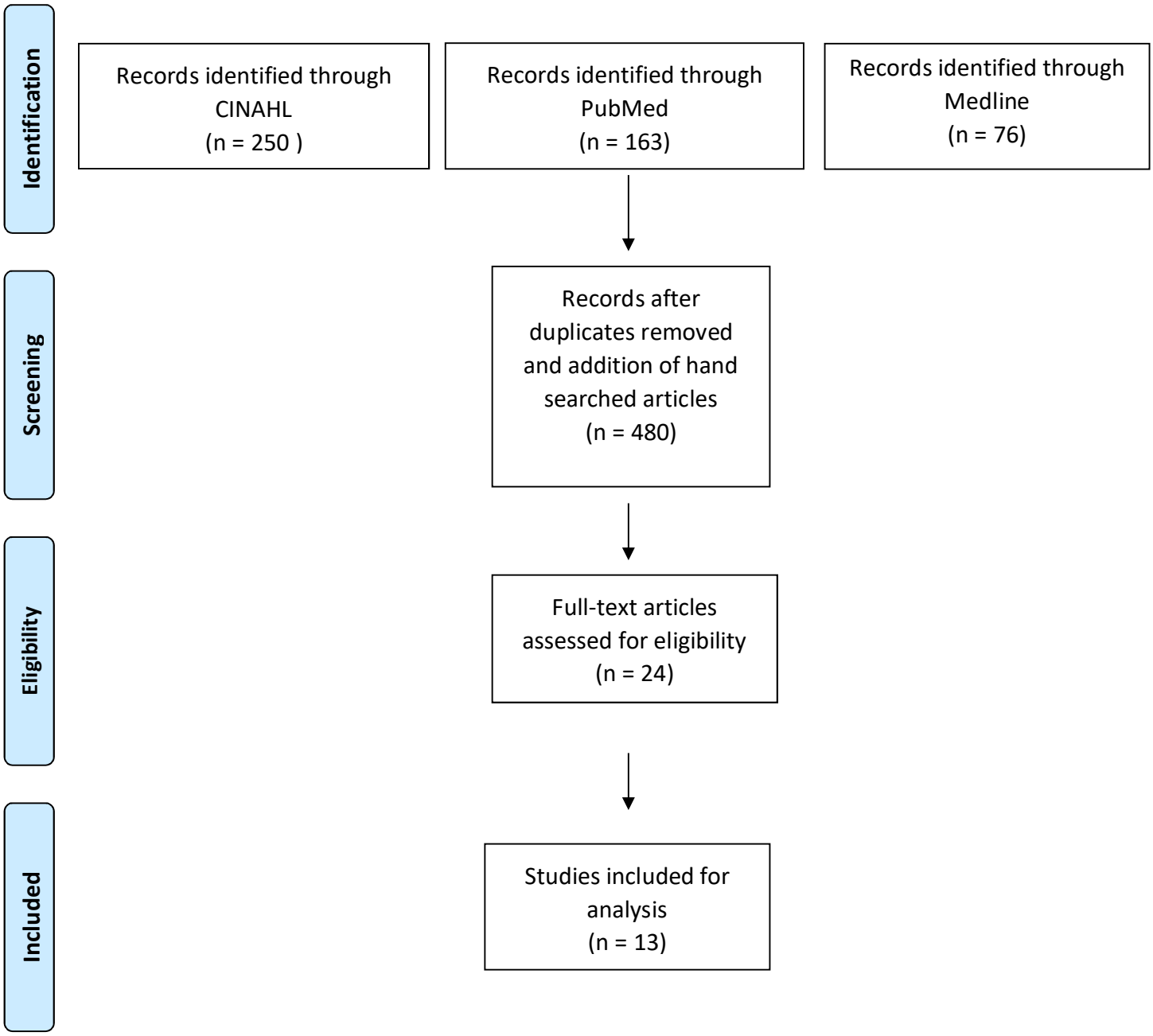
Appendix A – PRISMA Flow Diagram



(Diagram adapted from Liberati et al., 2009)

Appendix B: Literary Matrix

Abbreviations used in Matrix

A1C – glycated hemoglobin
BG – blood glucose
BMI – body mass index
CDE – certified diabetes educator
CPA – consumer purchasing assessment
ED - education
DM – diabetes mellitus
DUFB – double up food bucks
FPG – fasting plasma glucose
FV – fruit and vegetable
HEI – healthy eating index
HCSI – healthy corner store initiative
HTN – hypertension
MTM – medically tailored meals
PA – physical activity
POH – project open hands
SNAP – supplemental nutrition assistance program
SSB – sugar sweetened beverages

1. Author/Title	**Berkowitz, S. A., Shahid, N. N., Terranova, J., Steiner, B., Ruazol, M. P., Singh, R., Delahanty, L. M., & Wexler, D. J.** **"I Was Able to Eat What I am Supposed to Eat" - Patient Reflections on a Medically-Tailored Meal Intervention: A Qualitative Analysis** ***BMC Endocrine Disorders***
Date	2020
Purpose/ Hypothesis	Analyse MTM intervention as one approach to address food insecurity for people living with chronic disease. Goal is to determine how well the MTM worked and what could be improved for greater clinical benefit and to facilitate more widespread implementation.
Context	Baltimore primary care network – food insecure with diabetes
Method	Qualitative study - exploratory and descriptive
Intervention	Medically tailored meals are delivered to patients with diabetes for 12 weeks on and 12 weeks off. #1) 12 weeks with MTM then 12 weeks without MTM #2) 12 weeks without MTM then 12 weeks with MTM Outcomes measured through healthy eating index (HEI)
Strengths	Researchers not involved in intervention until asking research questions. Interviews recorded and reviewed among two authors for data saturation and accurate coding. Two interviewers compared themes derived from recorded data to reach consensus. Note about achieving content saturation at 20 interviews.
Limits	Small sample size. Expensive intervention. Relied on primary study to explain the method of recruiting original participants. Purposeful selection of participants from original intervention trial – 50% of total.
Results/ Recommendations	MTM intervention was generally satisfactory to the participants because of improved quality of life, reduced financial stress and reduced stress related to knowing about and obtaining healthy food to manage diabetes. Satisfaction and experience with MTM - Convenience, Positive Interactions with staff, food quantity and proportions. Suggestions for improvement - Seasoning and Spices, Food options, Meal quantity, nutrition education with the food intervention.
Relevance	Lived experience is important to health behaviour change. With an understanding of how MTM food delivery promoted healthy food choice of people with low SES living with T2DM will facilitate effectiveness of other food access programs. Access dimensions: accessibility, acceptability, affordability, and accommodation Modeling of healthy foods and meal size. FOOD INTERVENTION; PASSIVE ED; LESS STRESS; DM MANAGEMENT

2. Author/Title	**Cheyne, K., Smith, M., Felter, E. M., Orozco, M., Steiner, E. A., Park, Y., & Gary-Webb, T. L.** **Food Bank-Based Diabetes Prevention Intervention to Address Food Security, Dietary Intake, and Physical Activity in a Food-Insecure Cohort at High Risk for Diabetes** ***Preventing Chronic Disease***
Date	2020
Purpose/ Hypothesis	Assess effectiveness of a food bank-delivered intervention aimed at improving food security, dietary intake, and other risk factors for type 2 diabetes among food-insecure clients at risk for diabetes.
Context	Alameda County Community Food Bank in Oakland California
Method	Quasi-Experimental
Intervention	Distribution of diabetes-appropriate food packages to participants; text-based health promotion/education addressing PA and nutrition; text-based administrative and engagement messages over 12 months.
Strengths	Food bank had experience with research projects. Population is culturally diverse geography. Text messages to maintain intervention intention – in preferred language. Used validated tools for surveying and measuring diabetes risk, food security, dietary intake, PA, depression. Recruited from 12 different food pantries over 5 months with multiple strategies. Low attrition rate
Limits	There are multiple interventions must they be together to be effective. Unable to provide DEC classes Only to English and Spanish. Convenience sample, lacked comparison group, Short intervention - 12 months, Temporal bias in self-reported data. Potential for social desirability bias.
Results/ Recommendations	Outcome goals: Assess changes in household food security, minutes of PA, consumption of healthy food (FV), consumption of unhealthy food, health status Food security: Adults skipping meals went from 43.6% to 29.3% ($p<.001$) at midpoint. Participants with low or very low food security decreased from 68.8% to 62.5% ($P<0.001$). Physical activity: Increased from 95.6 min/wk to 145.1 min/wk ($P<0.001$). Started regular physical activity once/wk went from 62.5% to 80.7% ($P<.001$). Reported health status as poor or fair reduced from 73.9% to 60.1% ($p<0.001$). Dietary intake: Consumption of green salad, nonfried vegetables, cooked beans, cooked whole grains, whole-grain foods, and fruits and vegetables increased significantly. Consumption of SSB, fried potatoes, candy/chocolate, and cookies/cakes and other sugary desserts decreased significantly. Healthy food consumption increased regardless of how engaged or how food insecure the groups where at baseline. Highly engaged participants were more food secure at baseline. No change to BMI. Post intervention: results remained the same as midpoint results therefore maintenance of improvements. There was improvement in food security, dietary intake and PA at 6 months.
Relevance	This intervention is targeting those at risk for DM not those that have DM, however lifestyle management and prevention are parallel and the results of this study are similar to results of similar DM management studies. Effective intervention. Food banks are good places to focus interventions. Access Dimensions: availability, affordability, accommodation. FOOD INTERVENTION; FOOD EDUCATION; DIABETES MANAGEMENT

3. Author/Title	**Berkowitz, S. A., Delahanty, L. M., Terranova, J., Steiner, B., Ruazol, M. P., Singh, R., Shahid, N. N., & Wexler, D. J.** **Medically Tailored Meal Delivery for Diabetes Patients with Food Insecurity: a Randomized Cross-Over Trial** ***Journal of General Internal Medicine***
Date	2019
Purpose/ Hypothesis	Receiving medically tailored meals (MTM) would improve the HEI 2010 dietary quality score and improve food insecurity for diabetic patients.
Context	Baltimore primary care network – food insecure with diabetes
Method	24 week cross-over design - quasi-experimental
Intervention	Medically tailored meals are delivered by Community Services (non-profit food assistance organization) to patients with diabetes for 12 weeks on and 12 weeks off. #1) 12 weeks with MTM then 12 weeks without MTM #2) 12 weeks without MTM then 12 weeks with MTM Outcomes measured through healthy eating index (HEI)
Strengths	Internal validity with validated tools to assess food insecurity and diet quality. Few people lost too follow up. Assessed for reporting bias. Study group was control group.
Limits	Small study – only 43 participants. Difficult intervention to apply to a large group of people. Short – 24 weeks No wash out period between intervention and non-intervention.
Results/ Recommendations	Receiving 50% of total daily food from MTM significantly increased diet quality and improved food insecurity while MTM where being delivered to TIIDM who are food insecure. Health Eating Index HEI: "on meals" 71.3 HEI "off meals" 39.9 Difference of 31.4 (P<0.0001) increase in veg, fruit and whole grains and decrease in empty calories from solid fats, alcohol, and added sugars. Not a statistically significant different between study arms (P=0.57). Food Insecurity: "on meal" 42% "off meal" 62% (p=0.047) Reductions in Hypoglycemia: "on meal" 47% "off meal" 64% p=0.03 Expected outcomes that were not statistically significant due to the short study: A1C, LDL, Total cholesterol, HDL, BP, BMI, Triglycerides
Relevance	Addresses adults with diabetes and food insecurity. Improved diet quality and food security with increased food access. Could this be a sustainable approach? Only 50% of daily intake with positive results. Palar et al., (2017) provided 100% daily intake with similar results. Had positive results on quality of life and improved DM management. Access dimensions: affordability, accessibility, accommodation, availability FOOD INTERVENTION; DM MANAGEMENT

4. Author/Title	**Afshin, A., Peñalvo, J. L., Gobbo, L. Del, Silva, J., Michaelson, M., O'Flaherty, M., Capewell, S., Spiegelman, D., Danaei, G., & Mozaffarian, D.** **The Prospective Impact of Food Pricing on Improving Dietary Consumption: A Systematic Review and Meta-Analysis** ***PloS One***
Date	2017
Purpose/ Hypothesis	The objective was to systematically investigate and quantify the prospective, empirical effects of change in food price on dietary consumption, and how key additional interventions might modify these effects. Qualitative and quantitative analysis done.
Context	Wealthy and socially stable countries: USA, NZ, Netherland, South Africa, France
Method	Systematic review and meta-analysis of qualitative and quantitative data
Intervention	
Strengths	PRISMA design. 2 literature searches done by 2 individuals and then together, from many databases. Precise results. Strong evidence for effect of subsidization.
Limits	Taxation studies that where included did not have strong methodology. Evidence was not strong for health outcome of BMI. Change in diet based on objective sales. Adults and children studied.
Results/ Recommendations	Decreased pricing of healthful foods (A point of purchase sale; coupons; cash rebate): Overall a 10% reduction in price of healthful food increases consumption by 12% (95%CI: 10-15%) Fruit and vegetables: 10% reduction in price increased consumption by 14% (95%CI: 11-17%) (most often targeted) Low calorie/low fat food: 10% decreased in price increased consumption by 16% (95%CI: 10-23%) No significant effect with decreased price of low fat milk or zero calories beverages. Increased pricing of unhealthful foods: Overall a 10% increase in price of unhealthful foods reduced consumption by 6% (95%CI: 4-8%). (SSB, fast-food and other unhealthful foods/drink target most often) Effects of price on adiposity (less robust evidence): Each 10% decrease in price of fruits and vegetables correlated to a 0.04kg/m^2 (95%CI: 0-0.08) lower BMI Non-significant trend of lower BMI with increase in price of fast food and SSB Qualitative evidence: Coupon for farmers' markets increased FV consumption. Education increased FV consumption. Education plus coupons maximized FV consumption. Higher price of FV meant higher BMI in low income women and women with children.
Relevance	An intervention that can be applied on a large population scale to positively impact health behaviour. Was not specific to diabetes or low- income population but would still impact that population. Greater effect when encouraging healthy behaviour vs discouraging unhealthy behaviour. Addresses affordability aspect of access. FOOD INCENTIVE/DISINCENTIVE

5. Author/Title	**Cohen, A. J., Richardson, C. R., Heisler, M., Sen, A., Murphy, E. C., Hesterman, O. B., Davis, M. M., & Zick, S. M.** **Increasing Use of a Healthy Food Incentive: A Waiting Room Intervention Among Low-Income Patients** ***American Journal of Preventive Medicine***
Date	2017
Purpose/ Hypothesis	It was hypothesized that a significant proportion of the health center population would be SNAP enrolled, and the baseline rates of DUFB utilization would be low. The intervention would increase participation in DUFB.
Context	Low income racially and ethically diverse SNAP users in USA Michigan
Method	Longitudinal, repeated-measures, quasi-experimental trial
Intervention	Build awareness of DUFB program through a waiting room intervention.
Strengths	Diverse group of people served at health clinic. Descriptive data of the population. Similar base line rates of FV consumption compared with other research on the topic. Validated tool for measuring FV consumption. High retention rate compared to similar studies. Easily measurable outcomes.
Limits	Single health center, possible selection bias as people who go to farmers' markets would be more interested in DUFB. No control group so can't account for confounding factors for increased FV consumption. Possible seasonal component to increase in FV because DUFB is for season of farmers markets. Recall bias as FV consumption is self reported. Possible Hawthorn effect due to frequent assessments. Cannot be generalized to Canada – no SNAP. Possible reporting bias. Smallish sample - 177 participants. Short 5 months
Results/ Recommendations	DUFB use increased and FV consumption increased Primary outcomes: building awareness of healthy food incentive program increased use. AOR of 19.2, CI of 10.3-35.5 $p<0.001$ 69% used DUFB at least once and 34% used DUFB 3+ times Secondary outcomes: Increased FV consumption by 0.66 servings/day (95%CI: 0.38-0.93, $p<0.001$) from baseline at 3 months and remained increased at 5 months (0.63 servings/day, 95%CI: 0.34-0.92, $p<0.001$) from baseline. More significant impact on those with lower (0-3 serving/day) FV consumption at baseline compared to high (>4 servings/day) FV consumption. Frequency of DUFB use correlated with increased FV consumption. DUFB use 3+ times meant FV consumption increase by 1.04 servings/day from baseline at 3 months (95%CI: 0.52-1.55, $p<0.001$) and remained elevated at 5 months (1.16 servings/day 95%CI: 0.62-1.69, $p<0.001$). DUFB use 1-2 times increased FV consumption at 3 months but not 5 months. 3 months was the end of DUFB season, but results demonstrated maintained positive effect at 5 months.
Relevance	Clinically significant to my question because increased awareness of food access programs can increase use but more interesting is that increased ability to access healthy food translates over time even as incentive is now longer in place. People involved in socially funded food access programs would benefit from incentives. One quarter of population had DM but 100% of population was on food assistance program. Access dimension: acceptability, affordability. FOOD INCENTIVE INTERVENTION

6. Author/Title	**Palar, K., Napoles, T., Hufstedler, L., Seligman, H., Hecht, F., Madsen, K., Ryle, M., Pitchford, S., Frongillo, E., Weiser, S., Hufstedler, L. L., Hecht, F. M., Frongillo, E. A., & Weiser, S. D.** **Comprehensive and Medically Appropriate Food Support is Associated with Improved HIV and Diabetes Health** ***Journal of Urban Health***
Date	2017
Purpose/ Hypothesis	Evaluate the feasibility, acceptability and potential impact of Food = medicine, a novel, medically appropriate 6-month food assistance intervention. We hypothesized that the intervention would improve nutrition, mental health and health behaviors.
Context	San Francisco Bay Area – Food assistance programs
Method	Quasi experimental
Intervention	6-month intervention delivering meals to those with chronic disease T2DM and/or HIV. Food=Medicine meant 100% of their daily caloric intake was provided. Diet was developed by POH nutritionists and based on Mediterranean diet. Individuals or surrogates picked food up daily.
Strengths	Good adherence rate. Used validated tools to measure variables. Similar to other studies. Results make sense as compared to other studies. Had questionnaire to ensure intervention was similarly applied across sites Survey done by researchers uninvolved in food delivery. Low attrition rate ~30% lost to follow up.
Limits	Limited population size. Many of the participant also had HIV - so skews the results I am personally looking for not a weakness of the study design. The short time frame may have made it difficult to see statistically significant results in A1C No control group T2DM was a new group to be added to the POH program so could account for the changes as they went from no services to full services. Selection bias Social desirability bias Small study group
Results/ Recommendations	Significant reduction in severity and frequency of food insecurity. Diet quality changed: Decreased fat intake from 3.19 to 2.21x/day (p=0.003); Increase in FV consumption from 1.85 to 2.4x/day (p=0.011); Decrease sugar overall (p=0.07); DM group decrease from 0.99 to 0.65x/day (p=0.006); BMI overall decrease (p=0.08) DM group from 36.1 to 34.8 (p=0.035); Fewer depressive symptoms (7.58 to 5.84; p=0.028); Decrease in binge drinking (26 to 13.5%; p=0.008); Decreased substance use (p=0.31) and Smoking decrease (p=0.19) – not statistically significant; Fewer giving up health care for food (p=0.029) and Fewer giving up food for health care (p=0.007); Less hospitalizations but not statistically significant; Diabetes distress scores decreased from 2.46 to 2.02 (p<0.001); Perceived diabetes self-management scores increased from 24.8 to 27.3 (p=0.007); Mean A1C decreased from 9.23 to 8.75% (p=0.41) – not statistically significant. Did see higher prevalence of optimal glycemic control. 93% adherence to food pick up; 78.9% ate all or most of food; 90.4% threw away intervention food at some point; 84.6% shared intervention food at some point (57% with family); 78.9% ate food other than intervention food; 3.9% only ate intervention food. Most common non-intervention foods: sweet snacks or desserts. fast food, vegetables, fruits.
Relevance	Primary objectives met. Significant decrease in food insecurity and improvements in overall health. Met the needs of people who were on social assistance or not. Filled the gap of the state food safety net. Access dimensions: Affordability, availability, acceptability. FOOD INTERVENTION; LESS DEPRESSION; LESS DM STRESS; DM MANAGMENT

7. Author/Title	**Cavanagh, M., Jurkowski, J., Bozlak, C., Hastings, J., & Klein, A.** **Veggie Rx: An Outcome Evaluation of a Healthy Food Incentive Programme.** ***Public Health Nutrition***
Date	2016
Purpose/ Hypothesis	Evaluate if writing prescription for FV and improved ability to purchase FV would reduce patients BMI.
Context	NY state with a focus on poor and underserved communities.
Method	Retrospective case-control study design.
Intervention	FV coupon book to people at risk deemed so by having a food related chronic condition, i.e DM, HTN, Obesity. "Veggie Mobile" stopped at clinic one a week and travelled to inner-city neighbourhoods to improve food access. Could use one coupon a week and if used all 13 could get another coupon book.
Strengths	There was a control to compare taken from the same EMR as the intervention group. Accounted for population variables.
Limits	Small sample - 54 people (30% of those enrolled in program had weight evaluated) Convenience sample – high potential for selection bias. Very short time (minimum of 5 weeks and up to 87 weeks with average of 22).
Results/ Recommendations	Primary outcome was change in BMI. Change in BMI of intervention group, after 5 non-consecutive weeks of coupon use, was statistically significant compared to control group ($p=0.02$). The intervention group had a 0.74 kg/m reduction in BMI and the control group had a 0.35 kg/m increase in BMI.
Relevance	Although there is not clinically significant weight loss the fact that the intervention group did not gain weight is significant and extremely important in the management and prevention of T2DM which population I am most interested in. Access dimensions: availability, accessibility, affordability. FOOD INCENTIVE INTERVENTION

8. Author/Title	**Mayer, V. L., McDonough, K., Seligman, H., Mitra, N., & Long, J. A.** **Food insecurity, coping strategies and glucose control in low-income patients with diabetes.** ***Public Health Nutrition***
Date	2016
Purpose/ Hypothesis	Examine relationship between food insecurity and coping strategies hypothesized to worsen glucose control in patients with diabetes.
Context	Pennsylvania Urban health center
Method	Cross-sectional design
Intervention	Survey adults with T2DM comparing those who were food secure with those who were not food secure.
Strengths	Validated measurement tools. Variables are identified, reasonable and accurately measured. New tool validated. Small sample size (34% response rate for a total of 427)
Limits	Only English speaking. Can't account for the possibility that those who are likely to apply for SNAP are also more likely to take care of diabetes. Other variables difficult to account for. Short study design so can't draw long-term conclusions. One clinic so can't generalize nationally. Very difficult to generalize to Canada. Limited population with a 33% response rate to initial contact to participate in the study.
Results/ Recommendations	40.5% food insecure. Food insecure v. food secure They were younger (53.5 years v. 59 years); Below 100% of the federal poverty line (67.9 v 52.5%, p<0.001); Disabled (70.3 v 49.6%, p<0.001); On Medicaid (50.9 v 30.3%) (p<0.001); Use of insulin (50.9 v 40.5%) (p=0.04); Higher BMI (40.3 v 37.7 kg/m^2) (p=0.004); Poorer glucose control (68.5 v. 52.9%) (p=0.002). A1C 8.5% v. 8.2%. Coping strategies were utilized more in those who where food insecure v. secure: Cost related med non-adherence (60.6 v. 37.5%, p<0.001); Foregone medical care (35.2% v. 9.1%, p<0.001); Use of emergency food programs (53.3%v. 24%, p<0.001); Receipt of SNAP (76.4% v. 59%, p<0.001); Frequency of food management practices (score of 18.8 v. 13.1, p<0.001); No difference between FV or sugar intake between groups. Those who where food insecure had poorer glucose control (OR 2.23, 95%CI: 1.22-4.10, p=0.01); Use of insulin associated with poor glucose control (OR=6.44, 95%CI: 3.95-10.5, p<0.001); Increased FV intake lowered risk of poor glucose control (OR=0.51; 95%CI: 0.32-0.82, p=0.005); food insecure SNAP users had lower risk of poor glucose control (OR=0.35; 95% CI 0.13-0.91, p=0.03) adjusted ratio for food insecure people receiving SNAP vs not receiving SNAP (OR=0.27; CI 0.09-0.80, p=0.02)
Relevance	Food insecurity associated with poor glucose control and coping strategies that further contribute to poor glucose control. SNAP seems to relieve some of the barriers for food access in food insecure group. Receiving SNAP could mean more FV intake leading to better glucose control. Health care systems should screen for food insecurity and inform people of supports. Health care systems can pilot programmes to address food insecurity. Access dimension: affordability. INDIRECT FOOD INTERVENTION; DM MANAGE

9. Author/Title	**Zhang, Y. T., Laraia, B. A., Mujahid, M. S., Blanchard, S. D., Warton, E. M., Moffet, H. H., & Karter, A. J.** **Is a reduction in distance to nearest supermarket associated with BMI change among type 2 diabetes patients?** ***Health & Place***
Date	2016
Purpose/ Hypothesis	Estimate the influence of increasing supermarket proximity on change in BMI among neighborhood residents with diabetes
Context	Patients with T2DM in residential neighbourhoods of northern California
Method	Quasi-experiment
Intervention	New grocery stores in neighbourhoods. 7/8 neighbourhoods had ≥15% of the population below federal poverty line and 1 neighbourhood was in a food dessert. Baseline measures where 12 months before supermarket opening and follow up was 10 months following supermarket opening.
Strengths	Good definitions and validation of the exposure and how it was confirmed and measured. Accounted for variables. Baseline and follow up constrained to a time with no other grocery store changes. Researcher visited supermarket to ensure met criteria. Sample from Kaiser electronic medical record. Had control group.
Limits	Not generalizable because population has DM and is likely receiving education about diet and may not have changed their shopping habits. Impact of recession may have skewed the results as people were behaving differently and cost of food was different. In only one neighbourhood was the superstore the first in a food desert. If more neighbourhood had been food deserts there may have been a more significant impact on BMI. There was no measure of frequency of store visits or what was purchased. Somewhat small study population.
Results/ Recommendations	Average BMI 32.2 kg/m^2 at baseline and 56% of patients obese. With new supermarket 32% of patients had a reduction in distance to nearest grocery store by average of 0.7 miles in exposed group with a distance of 1.8 miles to supermarket at baseline. In food dessert neighbourhood 90% of patients experienced a reduction in distance to nearest supermarket making for an average of 1.3 miles to grocery store. Overall reduction in distance to the nearest supermarket did not significantly impact BMI in unadjusted model (0.15 [-0.07, 0.40]) or adjusted models (0.17 [-0.07, 0.40]). Results highly variable in each neighbourhood.
Relevance	Food access has to be addressed on more than one level to make an impact. Proximity may have a greater impact if only food deserts were included. This study did not measure food insecurity among people with T2DM which might have made the impact of a new supermarket more impactful. Access dimensions: Accessibility INDIRECT FOOD INTERVENTION/ACCESS BARRIER

10. Author/Title	**Lawman, H. G., Vander Veur, S., Mallya, G., McCoy, T. A., Wojtanowski, A., Colby, L., Sanders, T. A., Lent, M. R., Sandoval, B. A., Sherman, S., Wylie-Rosett, J., & Foster, G. D.** **Changes in quantity, spending, and nutritional characteristics of adult, adolescent and child urban corner store purchases after an environmental intervention.** ***Preventive Medicine***
Date	2015
Purpose/ Hypothesis	Evaluate the effects of a corner store intervention on the energy and nutrient content of customer purchases and assess differences in the intervention effectiveness by age, sex and level (dose) of the intervention.
Context	Low-income food desert neighbourhoods in USA
Method	Quantitative Natural experiment
Intervention	Healthy corner store initiative (HCSI) to improve access to healthy food through corner store owner training, incentives, and modest infrastructural changes. Basic and high intensity intervention.
Strengths	8671 CPA completed in 192 stores at baseline. 5949 CPA in 124 stores in follow up. Larger sample. 64.4% of stores at baseline participated in follow up. Excluded inappropriate outlying data i.e. purchase of oils or lard products. Accounted for cofounding variables.
Limits	41% attrition rate. Room for human error in data collection of CPA. Potential for bias in population selection and data collection.
Results/ Recommendations	p-value set at .01. 64.6% of stores as basic and 35.4% as high-intensity stores No significant change in the energy or nutrient content of purchases at baseline to follow-up. No significant difference between basic and high intensity stores over time in the energy and nutrient content of purchases. Amount spent in high-intensity stores was significantly different compared to basic store ($p<0.001$). No difference in purchasing according to age or sex. HCSI made no impact on nutritional values of foods purchased. Was no difference in effectiveness by age, sex, and level of intervention. The dose impacted money spent which can be accounted for by increased prices due to more store infrastructure.
Relevance	It is relevant to see that not all food access initiatives are equal in their ability to impact health behaviour. Access dimensions: accessibility and availability. INDIRECT FOOD INTERVENTION

11. Author/Title	**Seligman, H. K., Lyles, C., Marshall, M. B., Prendergast, K., Smith, M. C., Headings, A., Bradshaw, G., Rosenmoss, S., & Waxman, E.** **A Pilot Food Bank Intervention Featuring Diabetes-Appropriate Food Improved Glycemic Control Among Clients in Three States** ***Health Affairs (Project Hope)***
Date	2015
Purpose/ Hypothesis	We explore the feasibility of using food banks and partners to provide diabetes support. First study of its kind to target diabetes interventions specifically to food-insecure populations.
Context	Food banks in San Francisco Bay Area, Ohio and Texas
Method	Quasi experimental
Intervention	6 months intervention with 4 components - screening for DM and monitoring for control; distributing diabetes-appropriate food once or twice a month with healthy eating tips and recipes; referring clients who lacked a usual source of care to a primary care provider; provided diabetes self-management support and education
Strengths	There were core intervention elements and evaluation measures that were required. 3 different locations in different states. The intervention boxes created by dietician or CDE with recipes and tips to support implementation of the intervention. Validated tools. Evaluated the implementation of the program at each site using RE-AIM.
Limits	Many food pantries so difficult to ensure the intervention was applied equally at every site. Only English or Spanish speaking. Risk of sample bias - convenience sample, referrals point of care testing. No control. Risk of bias in implementation.
Results/ Recommendations	Had two groups those with DM and those with poorly controlled DM (A1C >9%). Improvements on primary outcome of A1C. Improvements on secondary outcomes of increased FV, self-efficacy, diabetes distress, medication non-adherence and trade-offs. Hypoglycemic events decreased but was not significant. Overall results (unadjusted mean change): A1C ($p<0.01$) FV ($p<0.01$) self-efficacy ($p<0.001$) diabetes distress ($p<0.001$) med non-adherence ($p<0.001$) Uncontrolled diabetes results (unadjusted mean change): A1C ($p<0.001$) FV ($p<0.05$) self efficacy ($p<0.001$) diabetes distress ($p<0.001$) Med non-adherence ($p<0.10$) Trade offs ($p<0.001$) unadjusted change in proportion. Satisfaction with food boxes was high. 60% reported eating more FV themselves 44% reported other adults ate more FV 51% reported children ages 0-5 ate more FV 54% reported children ages 6-18 ate more FV
Relevance	Improved diabetes markers as well as improvement in diabetes distress, med adherence and FV intake. Might be the first intervention of its kind in 2015. Primary outcomes meant better DM control. Access dimension: availability, accessibility, affordability, acceptability. FOOD INTERVENTION; INTENTIONAL ED; LESS DM STRESS; DM MANAGEMENT; LESS TRADEOFFs

12. Author/Title	**Anekwe, T. D. & Rahkovsky, I.** **The Association Between Food Prices and the Blood Glucose Level of US Adults with Type 2 Diabetes** ***American Journal of Public Health***
Date	2014
Purpose/ Hypothesis	Examined the association between food prices and blood sugar biomarkers among adults with type 2 diabetes. And the cost of healthy food will directly correlate with A1C or FPG. We expected people with lower income to have a higher price elasticity of BG.
Context	National health survey in the US combined with food at home price survey
Method	Cohort Study
Intervention	
Strengths	Food groups well defined and made sense. Validated measuring tools used appropriately i.e. A1C. Results make sense. Analysis well explained and accounted for variables. Robustness check by analysis with different definition of food price i.e. wt of macronutrient.
Limits	Could not differentiate between SSB and diet beverages. The surveys they used had limited health information. Definition of healthy food was lean meats and low fat foods. I am more interested in FV intake. Only estimated food at home did not account for how much people went out. Study time frame was limited due to a change in the way food price was measured. Had to combine two surveys instead of having the survey include both health measures and economic measures.
Results/ Recommendations	Increased price of produce (2.2 cents/100g): Decreased A1C - not statistically significant. Increased FPG statistically significant. Increased price of low fat cheese: Decrease A1C and FPG – Statistically significant. Increased price for healthy food groups (lean protein and low-fat dairy): increase in blood sugar among the poorer groups. Increase for less-healthy foods (processed foods and packaged refined grains): relative decrease in blood sugar among the poorer groups. Increase price for oils and nuts: decreased DM biomarkers in low income groups as compared to higher income groups - maybe due less frying foods. A second analysis with different food price definition demonstrated the same results.
Relevance	Access dimension - affordability. The cost of food does impact purchasing/consumption especially in lower income population. The price changes measured were minimal in the 2-3 cent range which makes an interesting case for slight change in food cost has potential to impact diabetes management. Ethical dilemma - who defines which foods to increase/decrease cost on. Could create a new access problem. FOOD INCENTIVE/DISINCENTIVE; DM MANAGEMENT

13. Author/Title	**Weinstein, E., Galindo, R. J., Fried, M., Rucker, L., & Davis, N. J.** **Impact of a Focused Nutrition Educational Intervention Coupled with Improved Access to Fresh Produce on Purchasing Behavior and Consumption of Fruits and Vegetables in Overweight Patients with Diabetes Mellitus** ***The Diabetes Educator***
Date	2014
Purpose/ Hypothesis	Test the impact of distributing NYC department of health and mental Hygiene (DOHMH) coupons, redeemable at farmers markets, plus an educational intervention on FV purchase and consumption in overweight patients with TIIDM and control of DM.
Context	NYC health clinic
Method	RCT
Intervention	A one-time education session - hour long class and health bucks redeemable at Green Markets in NYC for the purchase of fresh fruits and vegetables. Control group received standard care of physician and diabetes educator visits for 12 weeks.
Strengths	Varied sample population that is clearly defined. Education to small groups (3-5) and provided by members of the study team with use of script. Could attend in their language of fluency. Used a validated screening tool. Control group.
Limits	Only one medical center. Small sample 79 divided into intervention (45) and control (34). 68% female, 48% Latino, 65% low income. Very small numbers to draw any conclusions. Short term study - survey at baseline and in 12 wks. Risk of bias with self reporting FV intake. Very limited time frame with one-time distribution of coupons. Coupons available to any one at the clinic.
Results/ Recommendations	Intervention group: Fresh fruit consumption increase by 0.2 servings daily; Purchase of FV at markets 39% to 81% (p=0.003); Difficulty affording fresh FV improved from 74% at baseline to 55% (p=0.008) in follow up; BMI reduced by 0.4, A1C reduced by 0.8% 78% use of health bucks in the intervention arm. Control group: Fresh fruit consumption decreased (p=0.04) by 0.3; Purchase of FV at market 32% at baseline to 48% in follow up; Affordability problem no change; BMI reduced by 0.5; A1C reduced by 0.9%.
Relevance	Very small improvement in FV intake but intervention did not impact A1C or BMI more than standard of care. Would an increase in the "dose" increase the effect? An increase in fruit consumption is an improvement as compared to a decrease that was found in the control. Statistically significant but not clinically significant in this short minimal intervention study. Access dimensions: Affordability, accessibility, acceptability, availability. INCENTIVE INTERVENTION with EDUCATION