Identifying barriers, facilitators, and interventions to support healthy eating in pregnant women with or at risk for hypertensive disorders of pregnancy

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BACKGROUND Heart-healthy diets are important in the prevention and treatment of hypertension (HTN), including among pregnant women. Yet, the barriers, facilitators, and beliefs/preferences regarding healthy eating are not well described in this population.

OBJECTIVE To identify barriers and facilitators to healthy diet, examine the prevalence of food insecurity, and determine interest in specific healthy diet interventions.

METHODS Pregnant women, aged 18–50 years (N = 38), diagnosed with HTN, hypertensive disorders in pregnancy (HDP), or risk factors for HDP, were recruited from a large academic medical center in central Massachusetts between June 2020 and June 2022. Participants completed an electronic survey using a 5-point Likert scale (strongly disagree to strongly agree).

RESULTS The mean age of participants was 31.6 years (SD 5.5) and 35.1% identified as Hispanic. Finances and time were major barriers to a healthy diet, reported by 42.1% and 28.9% of participants, respectively. Participants reported that their partners and families were supportive of healthy eating and preparing meals at home, though 30.0% of those with children considered their children's diet a barrier to preparing healthy meals. Additionally, 40.5% of the sample were considered food insecure. Everyone agreed that healthy diet was important for maternal and fetal health, and the most popular interventions were healthy ingredient grocery deliveries (89.4%) and meal deliveries (84.2%).

CONCLUSION Time and cost emerged as major challenges to healthy eating in these pregnant women. Such barriers, facilitators, and preferences can aid in intervention development and policy-level changes to mitigate obstacles to healthy eating in this vulnerable patient population.

KEYWORDS Hypertension; Hypertensive disorders of pregnancy; Pregnancy; Healthy diet; Food insecurity

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Introduction

Structural and social determinants of health along with health behaviors contribute more than 80% to health outcomes such as length and quality of life.[1] These structural and social determinants also play an important role in hypertensive disorders in pregnancy (HDP), a leading preventable cause of severe maternal morbidity and mortality.[2] Healthy diets, such as the Dietary Approaches to Stop Hypertension (DASH) and Mediterranean diets, are proven to prevent hypertension and lower blood pressure (BP) in adults with elevated BP and hypertension (HTN).[3,4] Such diets emphasize fruits and vegetables, whole grains, low-fat proteins, nuts and legumes, and olive oil.[3,4] Some studies suggest that these diets are safe and are associated with lower diastolic BP and lower risk of HDP in pregnant women.[5–7] Additionally, dietary approaches have been shown to lower BP more in those with higher BP and have a more modest BP effect on those with lower-range BP, which may indicate that dietary intervention is a safer approach to control BP during pregnancy.[5] Despite the importance of a healthy diet for BP control and to limit gestational weight gain, only 6%–7% of pregnant women or women of childbearing age with hypertension adhere to the recommended DASH diet.[8] To effectively improve adherence to healthy diet in pregnant

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KEY FINDINGS

- Time and affordability of healthy foods emerged as major barriers in maintaining a healthy diet for pregnant women with hypertension, hypertensive disorder of pregnancy (HDP), or risk factors for HDP.
- Food insecurity was common in this population of pregnant women, at 40.5%, with 16% reporting hunger and 25% reporting difficulty accessing food consistently during the COVID-19 era.
- Tailored dietary plans, weekly grocery lists, and healthy ingredient/meal deliveries were the most popular interventions supported by this population, reflecting the main barriers identified in this study.

women with hypertension, the barriers, facilitators, and preferred dietary interventions must be identified.

While various studies have examined the associated difficulties in adherence to hypertensive treatment regimens in nonpregnant populations,[9,10] studies examining the barriers to a healthy diet in pregnant women with HTN or HDP are limited. Other studies have looked at barriers to therapies addressing obesity and diabetes, common risk factors for HDP.[11–13] One study in obese pregnant women highlighted the physiological components of pregnancy along with environmental, cognitive, and interpersonal factors as barriers to making healthy changes during pregnancy.[13] These interpersonal barriers included the cost of healthy eating and exercise classes; lack of support from family, friends, and health professionals; and lack of a prepregnancy healthy eating and exercise routine.[13] Similar barriers to diabetic medication adherence were mentioned by women who experienced diabetes in pregnancy, in addition to the barrier of complex medication regimens.[12] Such studies point to the need for public health policies in additional to individualized methods of healthy eating that consider all psychosocial components of patients' lives that could pose as barriers to address or strengths to build on.

Food insecurity is especially important when examining barriers and beliefs about healthy diet, as it has been associated with negative health outcomes in pregnant women and may lead to increased risk of HDP and gestational diabetes.[14,15] However, there is a limited amount of research examining food insecurity in pregnant women, and studies looking at its effects have been conflicting.[16] Additionally, food prices continue to increase, and COVID-19-related mitigation strategies have contributed to difficulty in accessing healthy foods for food-insecure families.[17] Studies examining healthy diet barriers/facilitators, food insecurity, and preferred interventions in pregnant women with HTN or its risk factors are lacking. By surveying pregnant women with HTN, HDP, or risk factors for HDP, we aimed to (1) identify barriers and facilitators to healthy diet, including barriers specific to COVID-19; (2) examine the prevalence of food insecurity; and (3) determine interest in specific healthy diet interventions.

Methods

Study population

For this survey-based study, pregnant women diagnosed with HTN, HDP, or risk factors for HDP from a large academic medical center were invited to participate. Subjects (aged 18–50 years) were recruited from June 2020 until June 2022 by an electronic research invitation sent through MyChart or during their scheduled outpatient appointment. Ethics approval for this study was received from the University of Massachusetts Chan Medical School Institutional Review Board.

Women were identified as eligible for study inclusion based on review of the electronic medical record with confirmation of pregnancy and a diagnosis of HTN, HDP, and/or risk factors for HDP (obesity, chronic kidney disease, and diabetes) (Supplemental Table 1). Women who were prisoners were excluded. Eligible participants were contacted by study personnel by phone to obtain study consent. If interested, participants were sent a link to the electronic survey for completion. During the study period, 208 pregnant women were invited to complete the survey and 90 (43.3%) responded to the initial invitation request. Of the 90 who responded, 38 (42.2%) completed the full survey. All but one survey, which was completed over the phone with the research assistant, were filled out by the participants through a link sent by e-mail or MyChart. The participants were then invited to complete the survey at their own pace.

Assessment of survey variables

Women completed an electronic survey describing personal, environmental, and economic barriers and facilitators to healthy eating. COVID-19 pandemic–specific barriers to healthy diet were also determined. A 5-point Likert scale was used to quantify barriers and facilitators, ranging from strongly disagree to strongly agree. Sociodemographic questions included age, race/ethnicity, education, marital status, parity, work hours, and zip code. Comorbidities were self-reported, including hypertension, HDP (gestational hypertension and preeclampsia), and diabetes (type I, type II, or gestational diabetes).

Food insecurity was defined by a response of "true" or "sometimes true" to either "(I/we) worried whether (my/our) food would run out before (I/we) got money to buy more in the last 12 months" or "The food that (I/we) bought just didn't last and I/we didn't have money to get more in the last 12 months." If a participant answered "true" or "sometimes true" to either food insecurity question, they were then asked, "Were you ever hungry but didn't eat because you could not afford enough food?" Any participant answering any of these 3 questions in the affirmative were directed to https://www.helpsteps.com/#/ for local resources. Participants were also asked about current participation in

Table 1 Sociodemographic/comorbid features

	All women (N = 38)
Age, years	31.6 (5.5)
Race	
Non-Hispanic Black	5 (13.2)
Non-Hispanic White	22 (57.9)
Multiracial	2 (5.2)
Asian	5 (13.2)
Native American	1 (2.6)
Other	3 (7.9)
Ethnicity	
Hispanic	13 (35.1)
Non-Hispanic	24 (64.9)
Education level	
≤ Associate degree	20 (52.6)
Bachelor's degree or higher	18 (47.4)
Marital status	
Single	13 (34.2)
Married	22 (57.9)
Widowed	1 (2.6)
Separated	2 (5.3)
Living with family	6 (15.8)
Number of children	1 (1)
% Working	29 (76.3)
Part-time (11–30 hours/wk)	10 (26.3)
Full-time (31–40 hours/wk)	12 (31.6)
More than full-time (>40 hours/wk)	7 (18.4)
Community	
Rural	14 (38.9)
Suburban	12 (33.3)
Urban	10 (27.8)
Medical Conditions	
Gestational hypertension	5 (12.8)
Preeclampsia	3 (7.7)
Hypertension	7 (17.9)
Diabetes (gestational, type I, or type II)	12 (30.8)

Data reported as number of subjects (percentage of subjects), mean (standard deviation), or median (interquartile range) number of indicated units.

federal or state assistance programs and COVID-19 pandemic–specific barriers to healthy diet, given the study period time was impacted by the COVID-19 pandemic.

Healthy beliefs were determined through prompts about fruits/vegetables, whole grains, saturated fats, salt, potassium, healthy diet to manage BP, and weight gain in pregnancy. These prompts asked the participant to self-reflect to answer questions such as "I am currently eating a healthy diet," "I am motivated to eat healthier," and "I like to eat healthy foods." A 5-point Likert scale was used to assess dietary beliefs and interventions, ranging from strongly disagree/not interested at all (1) to strongly agree/very interested (5).

Statistical analysis

Continuous variables were summarized with means and standard deviations (SD) for those with normal distributions or median and interquartile ranges for non-normal distributions. Categorical variables were summarized with raw numbers and percentages. All data were managed using REDCap (Research Electronic Data Capture) tools, and all statistical analyses were performed using STATA/IC 16.0 (StataCorp, College Station, TX).

Results

Sociodemographics

Of the 38 women who completed the survey, the mean age of participants was 31.6 (SD 5.5) years, with 57.9% White, 13.2% Black, and 35.1% Hispanic participants (Table 1). These women were from urban (27.8%), suburban (33.3%), and rural (38.9%) communities. Regarding education, 47.4% had a bachelor's degree or higher. When asked about time spent preparing meals, 47.4% of the participants spent 30 minutes to 1 hour, 26.3% spent 1–2 hours, and 21.1% spent >2 hours per day in meal preparation. Diabetes (gestational, type 1, or type 2) was the most common comorbidity at 30.8%, while 12.8% had gestational hypertension, 17.9% had chronic hypertension, and 7.7% had preeclampsia.

Barriers and facilitators

Finances and lack of time were major barriers to a healthy diet (Figure 1). Nearly half of the participants (42.1%) agreed that eating healthy was not financially practical for them, and 28.9% did not have time to cook healthy meals. Conversely, 57.9% reported being able to eat healthy food consistently for all meals. Regarding COVID-19-specific barriers, 25.0% of our participants found it more difficult to afford food consistently during the pandemic, 18.8% were limited by locations to buy healthy food due to safety precautions, and 12.5% felt it was more difficult to provide healthy food due to increased family size at home.

When asked about family support, 76.3% reported support from their partner to eat healthy food, and 92.1% reported being able to prepare most meals at home with or without their family members, as opposed to eating out (Figure 2). Nearly half (47.4%) were not living with children. Of those living with children, 30.0% reported that their children's diet made it more difficult for them to make healthy meals. Healthy cooking skills, work location, transportation, and space at home were infrequently considered barriers to healthy eating, reported as such by <9% of the participants. Of our participants, 68.4% are aware of resources outside of their family to support healthy eating. Compared to before pregnancy, 57.9% of participants felt more confident during their pregnancy about how to eat healthily.

Food insecurity

Food insecurity was common, reported by 40.5% of these pregnant women (Figure 3); however, there was no difference in food security based on location of residence (rural vs suburban, rural vs urban residence). Specifically, 40.5% of women worried about whether food would run out before getting money to buy more, and 24.3% of women reported that the food they bought did not last and they did not have money to get more. Of these 15 women

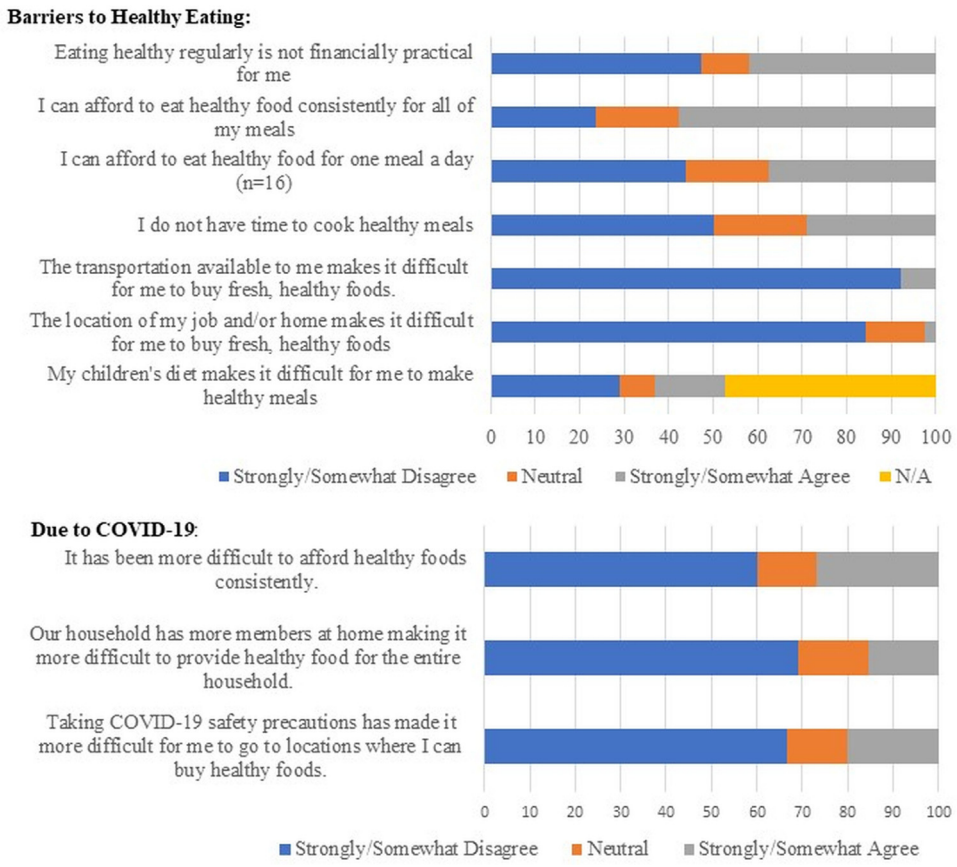

Figure 1 Personal, environmental, economic, and COVID-19 barriers to healthy eating in pregnant women with hypertension, hypertensive disorders of pregnancy, or risk factors for hypertensive disorders of pregnancy. A 5-point Likert scale was used to quantify barriers, ranging from strongly disagree to strongly agree. Women who answered strongly/somewhat agree that they could afford healthy food for all meals were not asked about affording healthy food for 1 meal a day (n = 22).

with food insecurity, 6 (40.0%) also reported that they experienced hunger but did not eat owing to their inability to afford food. State or federal assistance was also common, with 42.1% currently enrolled in federal or state assistance such as SNAP or WIC.

Healthy beliefs

Of the surveyed women, the majority strongly agreed with the prompts about healthy habits (Figure 4). There was 100% agreement in the importance of a healthy diet for a mother's and baby's health, while more than 95% of women

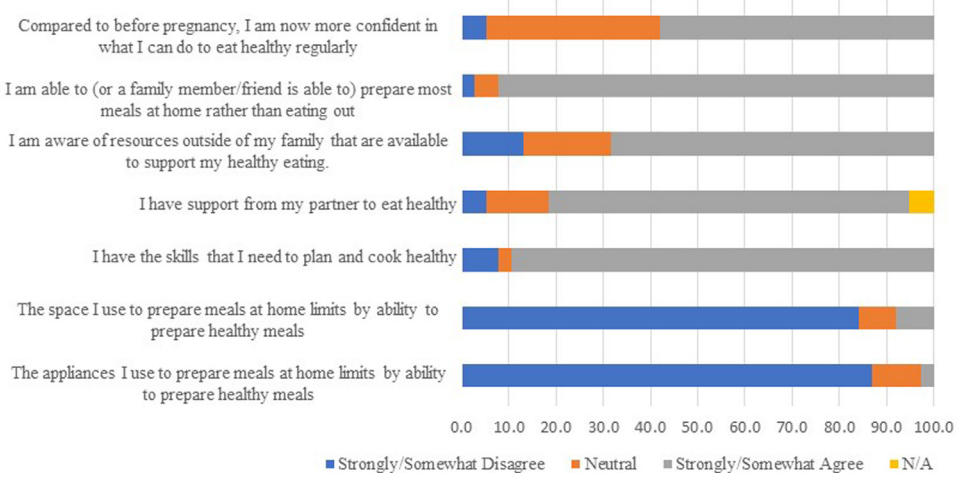

Figure 2 Personal, environmental, and economic facilitators to healthy eating in pregnant women with hypertension, hypertensive disorders of pregnancy, or risk factors for hypertensive disorders of pregnancy. A 5-point Likert scale was used to quantify facilitators, ranging from strongly disagree to strongly agree.

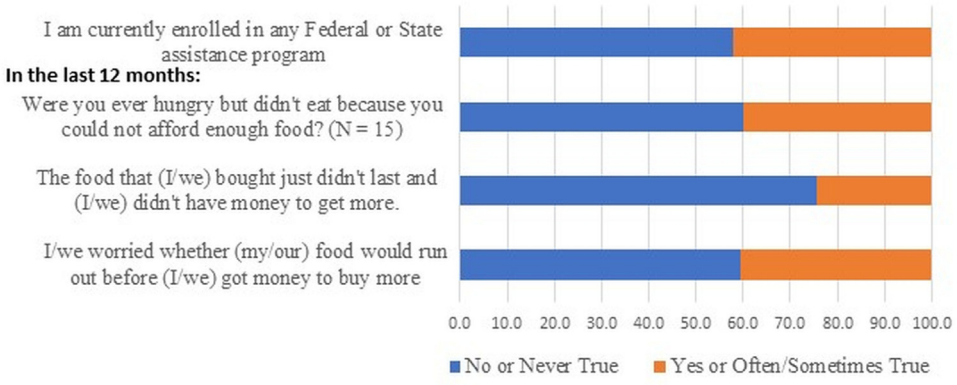

Figure 3 Food insecurity in pregnant women with hypertension, hypertensive disorders of pregnancy, or risk factors for hypertensive disorders of pregnancy. Women were asked a 2-question screener to assess food insecurity ("The food that (I/we) bought…" and "I/we worried whether (my/our) food would run out…" If either response was "often or sometimes true," they were asked about hunger (n = 15).

agreed that eating less salt and plenty of fruits and vegetables is good for their health. However, for the prompt "I am aware of the recommended weight gain in pregnancy," 17.2% of the participants disagreed or were neutral. Additionally, 10.5% of participants were neutral on the prompts "Eating healthy can manage high blood pressure" and "Whole grains are a part of a healthy diet."

Interventions

The dietary health interventions that these participants were most interested in included (1) healthy ingredient grocery deliveries (89.4%, somewhat-very interested), (2) healthy meal deliveries (84.2%), (3) a weekly healthy recipe book and grocery list (81.6%), (4) a tailored diet plan developed based on their own food preferences (78.9%), (5) working with a nutritionist (63.2%), and (6) logging meals in a food diary (55.3%) (Figure 5).

Fewer women were interested in attending virtual healthy eating classes (53.2%). Fewer than half were interested in attending in-person healthy cooking classes or taking photos of meals with an app or camera.

Discussion

This study was undertaken to identify barriers and facilitators to healthy diet, examine the prevalence of food insecurity, and determine interest in healthy diet interventions in pregnant women with HTN, HDP, or risk factors for HDP. These pregnant women spend on average >1 hour a day preparing meals, and they reported that time and the affordability of healthy foods were the main challenges they experienced. While most women had support from their families, nearly one-third were not aware of resources outside their family to support healthy eating. Food insecurity was unacceptably common, and COVID-19 restrictions exacerbated already

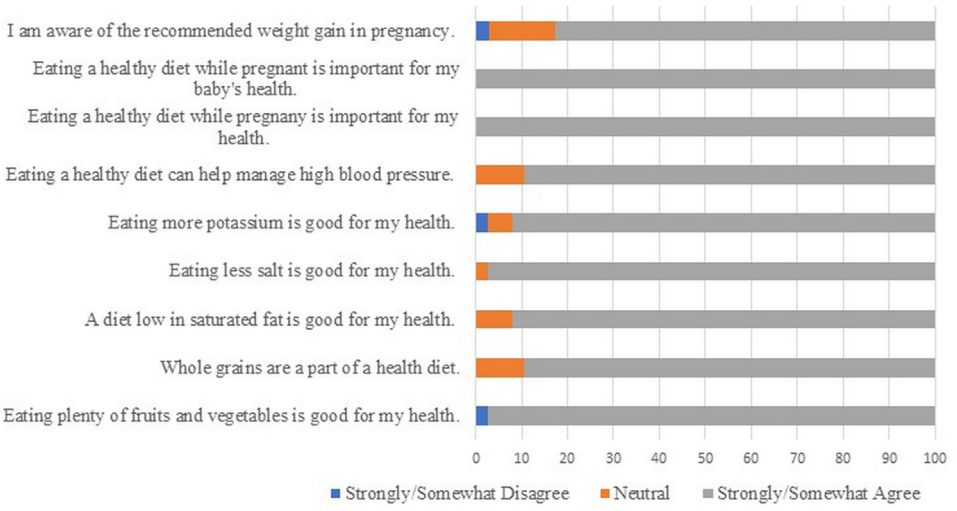

Figure 4 Dietary health beliefs in pregnant women with hypertension, hypertensive disorders of pregnancy, or risk factors for hypertensive disorders of pregnancy. A 5-point Likert scale was used to quantify dietary health beliefs, ranging from strongly disagree to strongly agree.

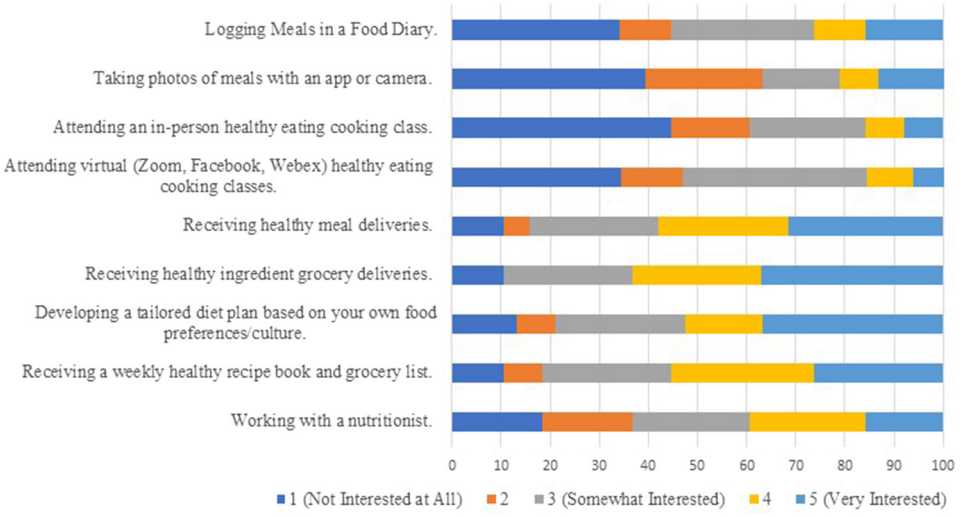

Figure 5 Perspectives on healthy dietary interventions in pregnant women with hypertension, hypertensive disorders of pregnancy, or risk factors for hypertensive disorders of pregnancy. A 5-point Likert scale was used to quantify interest, ranging from not interested at all to very interested.

present issues with obtaining healthy food. While the importance of healthy food for both mom and baby were health beliefs all our participants endorsed, nearly 20% were unclear on the recommended weight gain in pregnancy. When asked about healthy diet interventions, healthy meal/healthy ingredient delivery and a tailored eating plan/grocery list were the most popular interventions.

To effectively improve the well-being of women with various health risk factors during pregnancy, the barriers to achieving and maintaining a healthy diet must be identified. This study found that the most significant impediments included finances and time. A Canadian study of pregnant women without HTN or HDP highlighted the difficulties in applying information from guidelines, ineffective/inadequate counseling from healthcare providers, family responsibilities, and limitations in time, cost, and motivation as barriers to making healthy nutritional and physical choices.[18] One study of 138 middle-aged Korean adults with HTN also examined barriers and perceptions about healthy diet, and found that 79.7% limited sodium intake and 77.5% reported having a healthy diet.[19] When compared to middle-aged adults without HTN, these authors found that adults with HTN were more likely to think they needed to change their diet (84.8% vs 78.8%, $P = .03$), though all adults understood the potential benefits of healthy diet on BP control.[19] Of the barriers examined, these adults with HTN reported difficulty in preparing healthy food (63.8%), the tasteless nature of healthy foods (51.5%), and the difficulty of changing old habits (37.7%) as main barriers to healthy diet.[19]

Food insecurity, which encompasses affordability and access to any food (healthy or otherwise), was common in these pregnant women. As pregnant women are about to expand their household size, the presence of food insecurity is likely to be exacerbated further after delivery.[20] Prior studies have found that structural and social determinants of health and health behaviors contribute more than 80% to health outcomes, while medical care determines less than 20%.[1] The association between food security and hypertension is unclear, as a recent meta-analysis of 36 studies found an association between food insecurity in adults and self-reported HTN (odds ratio 1.44 [confidence interval 1.16–1.79]), but no association between food insecurity and measured BP in these studies.[21] Food insecurity has also been shown to disproportionately affect households of color, those with any children, and those with income <185% of the poverty threshold.[20,22–25] Approximately 40% of our participants reported food insecurity, difficulty with consistently affording healthy foods, and federal or state assistance, while about 20% experienced hunger. On a national level, about 55% of food-insecure households participated in SNAP, WIC, or the national school lunch program.[22] This shows how imperative public health policies and support programs are to allow for a healthy diet and proper well-being for these pregnant women during a time when nutrition is of paramount importance.

The COVID-19 pandemic has further impeded access and the ability to obtain healthy food. During the COVID-19 pandemic, 1 in 4 of our participants reported it had become more difficult to afford healthy food consistently. Overall, food insecurity rates have risen from 8.2% in 2019 to 10.5% in 2020, and rates have also increased for all households with children, from 13.6% to 14.8%.[22] During the pandemic, the Household Pulse Survey measured food hardship in terms of food insufficiency, which is closer in severity to the USDA's very low food security and captures situations where households did not have enough to eat.[26] In May of 2020, early in the COVID-19 pandemic, 10%–11% of the survey respondents reported food insufficiency in the past 7 days, which correlates to an estimated food insecurity rate of 22%–23%.[26] Despite these increases on a national level, our participants had more than 2-fold the national rates of food insecurity, speaking to their level of vulnerability. We can extrapolate that inflation will continue to have effects on these barriers to healthy foods.

To address the many barriers to healthy diet, we also evaluated interest in dietary health interventions. The most

popular interventions included developing a tailored diet plan or grocery lists or receiving healthy groceries or healthy meal deliveries. These interests reflect the main barriers identified and point to the need for more specialized knowledge to identify and funds/time to purchase healthier foods. Social media platforms, especially YouTube and Facebook, may also be beneficial for improving health education, especially for Hispanic/Latino Americans, who have lower rates of higher education and health literacy, though they are leading users of social media sites.[27] Women experiencing low socioeconomic status and those from minoritized racial/ethnic backgrounds are also disproportionately affected by food deserts (areas lacking access to affordable healthy foods) and food swamps (areas where nutrient-poor, energy-dense food availability "swamps" healthy food options).[20] These reported preferences by pregnant women with and at risk for HTN can direct health care organizations and policy change to address the barriers that this vulnerable population faces in the most effective way. Health care organizations and health departments have successfully worked with local governments and farmers to address the healthy food access barriers, through creating community gardens, pharmacies and clinics storing healthy food, home-delivered meals, and food vouchers/healthy food prescriptions.[28,29] There are also programs like farm to institution that allow for improved availability of locally grown healthy food options.[30] This study can be used to further tailor assistance programs to tackle the barriers that pregnant women face to mitigate the development of HDP.

Strengths/limitations

The current study examined a vulnerable population of women with HTN, HDP, or risk factors for HTN to determine barriers, facilitators, healthy beliefs, and preferred interventions as related to diet. This study included women from diverse racial/ethnic groups, educational levels, marital backgrounds, and communities to make it more generalizable. Additionally, the current study had an acceptable response rate among this high-risk population. As more evidence supports the positive benefits of healthy diet, such as lower risk of preeclampsia with DASH and higher vegetable and fruit consumption, this messaging needs to be disseminated.[31]

However, this study does have limitations. Owing to the COVID-19 pandemic, recruitment of participants had to occur virtually, and we were limited to surveying women with access to health care. By asking participants to complete the survey electronically, we may have unintentionally excluded those without reliable internet. Additionally, without access to interpreters all subjects in this study marked English as their preferred language. This is important to highlight, as non-English-speaking pregnant women may have reported different barriers in maintaining a healthy diet and the reported barriers and facilitators to healthy eating in this study may be underestimated. Although this study included criteria to identify those with or at risk of HDP, our results are not broken down by subgroup. Thus, it is not possible to determine from these data if facilitators/barriers to healthy eating or preferred interventions differ significantly between these groups. Given the evolving nature of the COVID-19 pandemic and its growing social and economic effects, it is possible that the respondents would now answer the COVID-19-specific questions differently, so these results must be interpreted within the context of the time period in which they were answered.

Conclusion

Time and cost emerged as major challenges to healthy eating in these pregnant women, and approximately 40% of them experienced food insecurity. Policy and system-wide interventions along with personalized interventions to support behavior change are needed for these high-risk women.

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Disclosures

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Authorship

All authors attest they meet the current ICMJE criteria for authorship.

Patient Consent

As a minimal risk study, participants received a fact sheet and verbally consented to the survey prior to participating.

Ethics Statement

The authors designed the study and gathered and analyzed the data according to the Declaration of Helsinki guidelines on human research. The study protocol was reviewed and approved by the institutional review board.

Disclaimer

Given his role as Editor-in-Chief, David McManus had no involvement in the peer review of this article and has no access to information regarding its peer review. Full

responsibility for the editorial process for this article was delegated to Hamid Ghanbari.

Appendix

Supplementary data

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.cvdhj.2022.10.001.

References

1. Hood CM, Gennuso KP, Swain GR, Catlin BB. County health rankings: relationships between determinant factors and health outcomes. Am J Prev Med 2016; 50:129–135.
2. Umesawa M, Kobashi G. Epidemiology of hypertensive disorders in pregnancy: prevalence, risk factors, predictors and prognosis. Hypertens Res 2017; 40:213–220.
3. Appel LJ, Moore TJ, Obarzanek E, et al. A clinical trial of the effects of dietary patterns on blood pressure. DASH Collaborative Research Group. N Engl J Med 1997;336:1117–1124.
4. Toledo E, Hu FB, Estruch R, et al. Effect of the Mediterranean diet on blood pressure in the PREDIMED trial: results from a randomized controlled trial. BMC Med 2013;11:207.
5. Juraschek SP, Miller ER 3rd, Weaver CM, Appel LJ. Effects of sodium reduction and the DASH diet in relation to baseline blood pressure. J Am Coll Cardiol 2017; 70:2841–2848.
6. Makarem N, Chau K, Miller EC, et al. Abstract 073: a Mediterranean diet pattern is associated with lower risk of adverse pregnancy outcomes in US Women: results from the NuMoM2b cohort. Circulation 2022;145:A073.
7. Wiertsema CJ, Mensink-Bout SM, Duijts L, Mulders A, Jaddoe VWV, Gaillard R. Associations of DASH diet in pregnancy with blood pressure patterns, placental hemodynamics, and gestational hypertensive disorders. J Am Heart Assoc 2021;10:e017503.
8. Kovell LC, Maxner B, Ayturk D, et al. Dietary habits and medications to control hypertension among women of child-bearing age in the United States from 2001 to 2016. Am J Hypertens 2021;34:919–928.
9. Crowley MJ, Grubber JM, Olsen MK, Bosworth HB. Factors associated with non-adherence to three hypertension self-management behaviors: preliminary data for a new instrument. J Gen Intern Med 2013;28:99–106.
10. Wang HHX, Mercer SW. Understanding barriers to adherence to optimal treatment of elevated blood pressure and hypertension-insights from primary care. JAMA Netw Open 2021;4:e2138651.
11. McParlin C, Hodson K, Barnes AC, Taylor R, Robson SC, Araujo-Soares V. Views, experience and adherence among pregnant women with gestational diabetes participating in a weight loss study (WELLBABE). Diabet Med 2019; 36:195–202.
12. Mukona D, Munjanja SP, Zvinavashe M, Stray-Pederson B. Barriers of adherence and possible solutions to nonadherence to antidiabetic therapy in women with diabetes in pregnancy: patients' perspective. J Diabetes Res 2017;2017:3578075.
13. Sui Z, Turnbull D, Dodd J. Enablers of and barriers to making healthy change during pregnancy in overweight and obese women. Australas Med J 2013;6:565–577.
14. Laraia BA, Siega-Riz AM, Gundersen C. Household food insecurity is associated with self-reported pregravid weight status, gestational weight gain, and pregnancy complications. J Am Diet Assoc 2010;110:692–701.
15. Laraia B, Vinikoor-Imler LC, Siega-Riz AM. Food insecurity during pregnancy leads to stress, disordered eating, and greater postpartum weight among overweight women. Obesity (Silver Spring) 2015;23:1303–1311.
16. Dolin CD, Compher CC, Oh JK, Durnwald CP. Pregnant and hungry: addressing food insecurity in pregnant women during the COVID-19 pandemic in the United States. Am J Obstet Gynecol MFM 2021;3:100378.
17. Rabinowitz L, Smith Q, Wang S. Combating food insecurity during the COVID-19 pandemic and beyond: MCO efforts and initiatives. NORC; 2021, www.norc.org/PDFs/Medicaid%20Managed%20Care%20Organization%20Learning%20Hub/NORCMCOLearningHubIssueBrief_Food%20Insecurity_Final.pdf. Accessed September 9, 2022.
18. Grenier LN, Atkinson SA, Mottola MF, et al. Be healthy in pregnancy: exploring factors that impact pregnant women's nutrition and exercise behaviours. Matern Child Nutr 2021;17:e13068.
19. Shim JS, Heo JE, Kim HC. Factors associated with dietary adherence to the guidelines for prevention and treatment of hypertension among Korean adults with and without hypertension. Clin Hypertens 2020;26:5.
20. Kris-Etherton PM, Petersen KS, Velarde G, et al. Barriers, opportunities, and challenges in addressing disparities in diet-related cardiovascular disease in the United States. J Am Heart Assoc 2020;9:e014433.
21. Beltrán S, Pharel M, Montgomery CT, López-Hinojosa IJ, Arenas DJ, DeLisser HM. Food insecurity and hypertension: a systematic review and meta-analysis. PLoS One 2020;15:e0241628.
22. Coleman-Jensen A, Rabbit M.P, Gregory C.A, Singh A. Household food security in the United States in 2020. Published online 2021. www.ers.usda.gov/webdocs/publications/102076/err-298.pdf. Accessed July 7, 2022.
23. Kaiser LL, Townsend MS, Melgar-Quinonez HR, Fujii ML, Crawford PB. Choice of instrument influences relations between food insecurity and obesity in Latino women. Am J Clin Nutr 2004;80:1372–1378.
24. Kovell LC, Meyerovitz C, Ayturk D, et al. Abstract MP66: Social determinants and co-morbid conditions in women of child-bearing age with hypertension from 2001-2018. Hypertension 2021;78:AMP66. AMP66.
25. Nam Y, Huang J, Heflin C, Sherraden M. Racial and ethnic disparities in food insufficiency: evidence from a statewide probability sample. J Soc Soc Work Res 2015;6:201–228.
26. Keith-Jennings B, Nchako C, Llobrera J. Number of families struggling to afford food rose steeply in pandemic and remains high, especially among children and households of color. Center on Budget and Policy Priorities; 2021. www.cbpp.org/research/food-assistance/number-of-families-struggling-to-afford-food-rose-steeply-in-pandemic-and. Accessed July 22, 2022.
27. Hudnut-Beumler J, Po'e E, Barkin S. The use of social media for health promotion in Hispanic populations: a scoping systematic review. JMIR Public Health Surveill 2016;2:e32.
28. Columbus (OH) Health Department. Improving access to healthy food: a community planning tool. 2005. https://www.columbus.gov/uploadedFiles/Public_Health/Content_Editors/Planning_and_Performance/Cardiovascular_Health/Improving_Access_to_Healthy_Foods.pdf. Accessed September 9, 2022.
29. Whitman A, Lew ND, Chappel A, Aysola V, Zuckerman R, Sommers BD. Addressing social determinants of health: examples of successful evidence-based strategies and current federal efforts. ASPE, https://aspe.hhs.gov/reports/sdoh-evidence-review. Accessed September 15, 2022.
30. Harris D, Lott M, Lakins V, Bowden B, Kimmons J. Farm to institution: creating access to healthy local and regional foods. Adv Nutr 2012; 3:343–349.
31. Kinshella M-LW, Omar S, Scherbinsky K, et al. Maternal dietary patterns and pregnancy hypertension in low- and middle-income countries: a systematic review and meta-analysis. Adv Nutr 2021;12:2387–2400.