Sarcouncil Journal of Internal Medicine and Public Health

ISSN(Online): 2945-3674

Volume- 05| Issue- 02| 2026

Review Article **Received:** 01-03-2026 | **Accepted:** 25-03-2026 | **Published:** 12-04-2026

Synergistic Roles of Diabetes, Hypertension, and Food Insecurity on Cardiovascular Disease Factors among Underserved American Communities: A Narrative Review

Emmanuel Amoako Agyei

Washington University in St. Louis, USA

Abstract: Cardiovascular disease (CVD) continues to be the most common cause of death in the United States of America. This problem disproportionately affects underserved populations. In these populations, diabetes mellitus, hypertension, and food insecurity are highly prevalent and tend to co-occur. This may lead to a potential interaction effect on CVD outcomes. This narrative review synthesizes epidemiological, biological, behavioral, and policy-based evidence on the interaction of these conditions on CVD outcomes in underserved American populations. Diabetes mellitus and hypertension are known to co-occur through common pathophysiological pathways. In contrast, food insecurity may co-occur with diabetes mellitus and hypertension through factors such as dietary habits, chronic psychosocial stress, disease self-management, and healthcare access. Nationally representative surveys and studies have shown that food insecurity correlates with poor management of cardiometabolic conditions, increased rates of cardiovascular disease, particularly among individuals with diabetes mellitus and hypertension. Though interaction studies are scarce, existing evidence supports a syndemic effect of these conditions on CVD outcomes in underserved American populations. Integrated prevention strategies addressing both cardiometabolic conditions and food insecurity are essential to reducing persistent cardiovascular disparities.

Keywords: Cardiovascular disease; Food insecurity; Hypertension; Diabetes mellitus.

INTRODUCTION

Cardiovascular disease (CVD) remains the leading cause of death in the United States, contributing to substantial mortality and health system costs each year (Martin *et al*., 2022; Virani *et al*., 2020). Although CVD affects every population group, its burden is not evenly shared. The existing socioeconomic, racial or ethnic, and geographic disparities in CVD occurrence and death are well reported, with underserved communities showing disproportionate CVD rates and deaths due to the socioeconomic, chronic stress exposures, and structural barriers to prevention and care (Havranek *et al.*, 2015; Schultz *et al.*, 2018). accessing healthcare, nutritious food and preventive services due to low income, racial and ethnic marginalization (Morelli, 2017). Such inequalities are especially apparent in Black, Hispanic, and Native American groups and are associated with accumulating disadvantage but not biological distinctions (Javed *et al*., 2022; Velarde *et al*., 2023). The current levels of cardiovascular mortality and its persistent impact on the population health are also demonstrated by recent national surveillance (Murphy *et al.*, 2024).

In underserved American communities, the overlap of diabetes mellitus, hypertension and food insecurity is a very consequential risk factor of cardiovascular disease. A large percentage of adult populations in the United States have diabetes, and it is more prevalent among low-income and underserved groups (Hassan *et al*., 2023). Hypertension has major disparities and is more prevalent, with Black adults being at a disproportionate risk (Tsao *et al*., 2023). Food insecurity, which is defined by the U.S. Department of Agriculture (USDA) as uneven access to sufficient food to lead an active and healthy life owing to limited resources, is experienced by millions of U.S. households and occurs disproportionately among low-income households and most racial and ethnic minorities (Rabbitt *et al*., 2023). Notably, food insecurity is not merely food deprivation. It tends to be an indicator of poor financial condition, quality of accommodation or healthcare, and limited options to follow long-lasting treatment plans (Berkowitz *et al*., 2013; Seligman *et al*., 2010). In practice, these exposures are often co-occurring, which makes it possible that the joint effect of the risk factors on the risk of heart disease may be larger than would be approximated by treating each risk factor separately.

In the past, most cardiovascular prevention systems and risk prediction models have focused on single clinical risk factors, namely, blood pressure, glycemia, lipids, and smoking, and placed less emphasis on social risks that influence exposure, disease control, and access to effective care (Havranek *et al*., 2015). This is important since social adversity could change the baseline risk and effectiveness of standard interventions. As an illustration, popular risk instruments fail to

***Corresponding Author:** Emmanuel Amoako Agyei

DOI- https://doi.org/10.5281/zenodo.19545415

include food insecurity or other indicators of material hardship, and risk prediction will hence become less precise in low-income and underserved groups (Havranek *et al*., 2015; Schultz *et al*., 2018). There, the intersection between social factors, diabetes and hypertension is not just an issue but rather one that has a direct impact on prevention strategy. The key research question that will drive this narrative review is whether diabetes, hypertension, and food insecurity have a synergistic effect on the occurrence of cardiovascular diseases among underserved communities in the United States. Synergy is defined as interaction in which the combined effect of co-occurring exposures is greater than their distinct individual effect. Additive interaction is informative because it quantifies excess risk attributable to joint exposure and helps to identify subgroups that may benefit from vigorous prevention strategies (VanderWeele, 2013).

There are several evidence gaps that drive this review. It remains debatable whether food insecurity is an independent cardiovascular factor, or if it reflects underlying poverty. Income and education have a correlation with food insecurity, yet other effects might be mediated by the stress factors, the quality of diet, and underutilization of medication (Berkowitz *et al*., 2013; Seligman *et al*., 2010). There is also some evidence that indicators of food insecurity are related to incidents of coronary heart disease and heart failure outcomes following socioeconomic indicators and conventional factors, which leads to a perspective that food insecurity might be an additional factor beyond income itself (Liu & Eicher-Miller, 2021). Cross-sectional studies always observe a relationship between food insecurity and the cardiometabolic risk profile, such as worse diabetes control and increased prevalence of hypertension, but cross-sectional designs do not determine temporal sequence or can quantify interaction (Berkowitz *et al*., 2013; Seligman *et al*., 2010). Though a study by Ahmed *et al*. (2020) has shown that formal additive interaction testing can work and have clinical relevance in cardiometabolic studies (Ahmed *et al*., 2020), similar interaction analyses combined with diabetes, hypertension, and food insecurity are not common. Consequently, synergy is still likely and clinically significant but not proven.

Accordingly, this narrative review synthesizes evidence on how diabetes, hypertension, and food insecurity jointly influence cardiovascular disease in underserved American communities. We review epidemiologic evidence, examine biological and behavioral mechanisms, assess population and contextual heterogeneity, and evaluate food-as-medicine and policy interventions with potential to reduce cardiovascular risk.

METHOD

A narrative review methodology was applied, which utilized a specific yet non-exhaustive search strategy to maximize transparency without the limitations of a systematic review. This methodology has the advantage of minimizing selection bias, allowing for the interpretive synthesis of epidemiological, mechanistic, and policy-relevant literature related to food insecurity, hypertension, diabetes, and cardiovascular outcomes. The narrative review methodology was conducted in accordance with the Scale for the Assessment of Narrative Review Articles (SANRA) guidelines for narrative reviews, as published by (Baethge *et al*., 2019). The relevant literature was identified through a targeted search of the PubMed, Embase, and Scopus databases. The search was limited to peer-reviewed literature published up to September 2025. The search terms were refined to include major thematic areas relevant to the narrative review, with a focus on U.S. populations and underserved groups. The major search concepts included a combination of search terms related to food insecurity, cardiovascular diseases, and cardiometabolic diseases. The search terms related to food insecurity were combined with search terms related to cardiovascular outcomes such as coronary heart disease, heart failure, myocardial infarction, and stroke, as well as cardiometabolic diseases such as diabetes and hypertension. To ensure the identification of the most comprehensive literature, the reference lists of key narrative reviews, systematic reviews, and high-impact epidemiological studies were hand-checked to identify relevant literature. The focus was on major U.S. cohort studies and nationally representative surveys commonly cited in the literature related to food insecurity and cardiovascular diseases. The search results were limited to English-language articles.

BIOLOGICAL AND SOCIAL PATHWAYS LINKING DIABETES AND HYPERTENSION

The biologic interaction between diabetes and hypertension is mutual and overlapping, with pathophysiologic processes that are insulin-

Publisher: SARC Publisher

resistance-induced, endothelial-dysfunction-induced, chronic low-grade inflammation-induced, oxidative-stress-induced, and renin- angiotensin-aldosterone system (RAAS)-induced (Cheung & Li, 2012; Ferrannini & Cushman, 2012). Constant hyperglycemia is involved in vascular stiffness and reduced nitric oxide bioavailability which conditions favor high blood pressure, and hypertension increases microvascular damage, aggravating glycemic dysregulation and triggering diabetic complications (Strain & Paldánius, 2018). These processes are interrelated and promote unfavorable cardiovascular remodeling and accelerate the atherosclerosis development.

The epidemiologic evidence always proves that people with comorbid diabetes and hypertension have significantly increased risks of coronary heart disease, heart failure, stroke, and cardiovascular mortality, as opposed to those with either of these conditions (ElSayed *et al*., 2024; Fox *et al*., 2015). This positive feedback process gives rise to a self-reinforcing process whereby inadequate metabolic and blood pressure regulation leads to increased cardiovascular risk, especially in the absence of effective long-term control of the disease (Saqib *et al*., 2023). Notably, syndemic theory points out that these biological interactions are not isolated, but they are exacerbated when conditions of social adversity are experienced. Neuroendocrine stress responses, heightened inflammatory systemic effects, and impaired chronic disease self-management behaviors are enhanced by structural and contextual issues like food insecurity, financial strain, neighborhood deprivation, and poor access to healthcare (Hill-Briggs *et al*., 2021; Mendenhall, 2017). Consequently, the diabetes-hypertension syndemic is the strongest among low-income and marginalized groups in which poor social conditions further amplify biological susceptibility and the existence of enduring cardiovascular inequality in the United States.

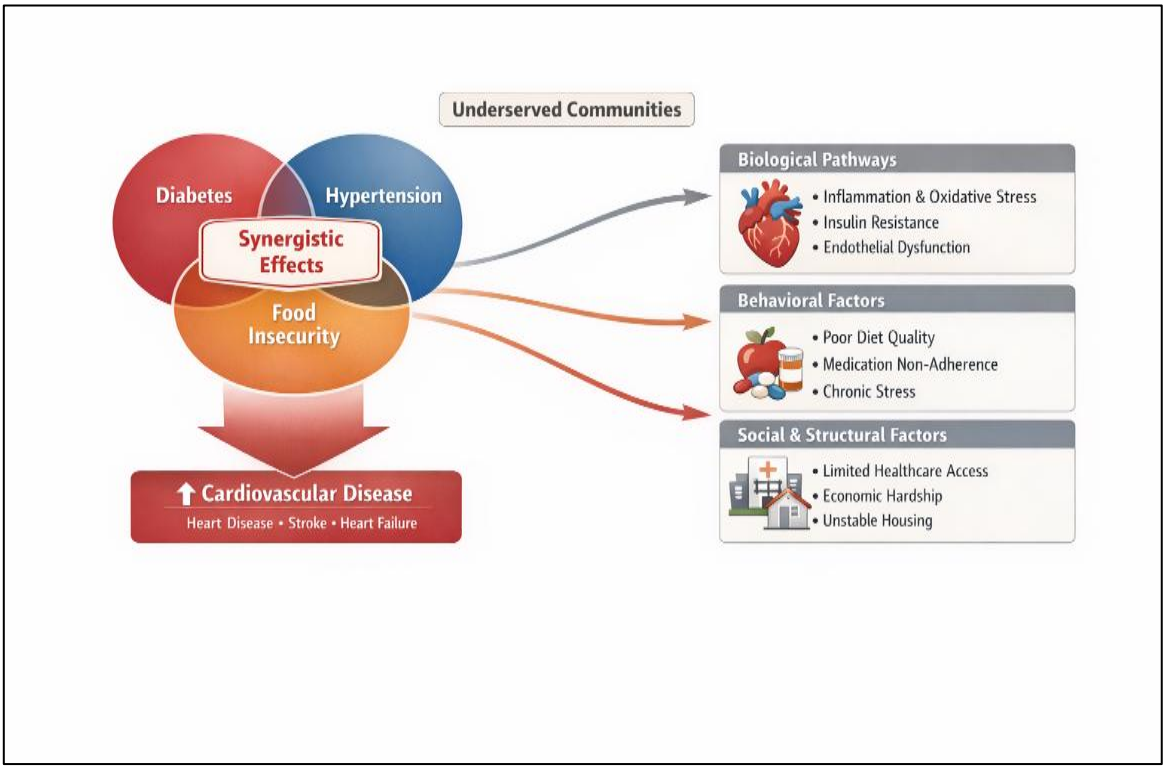

Figure 1: A summarised framework of the synergistic effects of diabetes, hypertension, and food security on cardiovascular disease risk in underserved communities

OVERVIEW OF KEY CONDITIONS AND THEIR INDEPENDENT ASSOCIATIONS

Cardiovascular disease is a proven independent risk factor that is mediated by pathophysiologic processes such as rapid atherosclerosis, systemic inflammation, endothelial dysfunction, and insulin resistance, which are all caused by diabetes mellitus (King & Grant, 2016). Continuous hyperglycemia promotes oxidative stress and formation of end-products of advanced glycation, vascular damage, and unstable plaque (Low Wang *et al*., 2016). Research demonstrate that coronary heart disease and cardiovascular death is two to

Publisher: SARC Publisher

four times more common in adults with diabetes than in the absence of the condition (Fox *et al*., 2015). The risk is highly concentrated among the underserved populations, and the manifestation of diabetes, earlier disease onset, and poorer glycemic control are coupled by social determinants of poverty, food insecurity, and lack of preventive care, which lead to persistent cardiovascular disparities (Hill-Briggs *et al*., 2021).

Hypertension also remains a leading cause of cardiovascular morbidity and mortality that manifests in the form of progressive vascular damage, arterial stiffness, endothelial dysfunction, and left ventricular hypertrophy, all increasing the risk of myocardial infarction, stroke, heart failure, and chronic kidney disease (Oparil *et al*., 2018). Any small rises in blood pressure correlate with a higher risk of CVD, which highlights the primary role that hypertension plays in the cardiovascular burden of the population (Forouzanfar *et al*., 2017). In America, there are severe disparities in the hypertension diagnosis, treatment, and control, especially among the low-income and racial and ethnic minorities who have higher rates of uncontrolled blood pressure and poor cardiovascular disease outcomes due to structural barriers, medication costs, and inadequate access to health care(Muntner *et al*., 2020).

Food insecurity on the other hand has been revealed as a risk factor of its own, leading to adverse cardiovascular outcomes by mechanisms that encompass unhealthy intake of diet, prolonged psychosocial stress, and impaired metabolic control. Food-insecure people are more likely to be using high sodium, refined carbohydrates and ultra-processed foods in their diets, and they have irregular energy intake, which fosters obesity and cardiometabolic dysfunction- a tendency sometimes outlined in the context of the so-called obesity paradox, in resource-constrained environments (Leung *et al*., 2014). In addition to diet, food insecurity is one of the reasons that cause long-term stress reactions and avoidance of healthcare, which increases the risk of cardiovascular disease further. Nationally representative studies show that food insecurity is related to improved cardiovascular disease and weightier cardiovascular and all-cause mortality even following correction with conventional hazards (Liu & Eicher-Miller, 2021; Sun *et al*., 2020; 2021).

EPIDEMIOLOGIC EVIDENCE: FOOD INSECURITY, DIABETES, HYPERTENSION, AND CARDIOVASCULAR DISEASE

Recent epidemiologic literature and research carried out in the last twenty years indicate that food insecurity is closely linked with prevalence and incidence rate of diabetes, hypertension, and cardiovascular disease (CVD) in the United States (Leblang *et al*., 2025). Low-income, racial and ethnic minority, and medically underserved populations are also disproportionately affected by food insecurity, which is defined as restricted or unpredictable access to nutritional adequate and safe foods(Berkowitz *et al*., 2017; Brandt *et al*., 2022) and have a disproportionately high burden of cardiometabolic disease. Extensive cross-sectional and longitudinal studies of nationally representative samples, such as the National Health and Nutrition Examination Survey (NHANES) have indicated that food insecure adults are at a substantially increased risk of developing diabetes and hypertension relative to food secure people, even when socioeconomic and demographic confounding factors are controlled (Liu & Eicher-Miller, 2021). Berkowitz *et al*. (2017) also found that adult food insecurity rates were higher and persistently elevated between 2005 and 2012 between adults with diabetes, hypertension, and coronary heart disease, which indicated the bidirectional and reinforcing relationship between food insecurity and cardiometabolic disease (Berkowitz *et al*., 2017). It has also been noted that food insecurity is associated with poor cardiometabolic control, which leads to downstream cardiovascular complications. Food insecurity is linked to poor glycemic control, uncontrolled blood pressure, dyslipidemia, and poor medication adherence in adults with diabetes- the major risk factors of CVD development and progression (Dong *et al*., 2023). The associations are especially sharp in underserved groups, with structural issues concerning the access and affordability of healthcare contributing to a further escalation of the risk of diseases. There is also epidemiologic evidence of a direct relationship between food insecurity and existing cardiovascular disease. Research shows that food insecurity affects persons with atherosclerotic cardiovascular disease more often than the general population and is linked to greater morbidity and mortality of CVDs independently (Mahajan *et al*., 2021). A national representative cohort study of Sun *et al*. (2020)

Publisher: SARC Publisher

concluded that adults with food insecurity were at much higher risk of cardiovascular and all-cause mortality, with disproportionately high risks in the presence of hypertension or diabetes co-morbidities (Sun *et al*., 2020). Such patterns of epidemiology are largely dependent on racial and ethnic disparities. Brandt *et al*. (2022) revealed that the prevalence of food insecurity in people having the cardiometabolic risk factors was disproportionately high in non-Hispanic Black and Hispanic people, which showed the overlapping of structural racism, economic inequality, and health disparities (Brandt *et al*., 2022). These results highlight food insecurity as an important social factor that increases synergy outcomes of diabetes and hypertension on cardiovascular disease (Odoms-Young *et al*., 2024) among underserved American populations. Together, epidemiologic evidence suggests a conceptual framework that food insecurity has been stressing as a disease modifier and a disease risk factor that aggravates the comorbidity and cardiovascular negative effects of diabetes and hypertension (Li *et al*., 2025). The three groups form a significant health issue of concern that has led to chronic cardiovascular inequalities in the United States.

INTEGRATED BIOLOGICAL, BEHAVIORAL AND STRUCTURAL PATHWAYS DRIVING CARDIOVASCULAR RISK

The synergistic relationship between diabetes, hypertension, and food insecurity is also partly driven by the convergence of biological mechanisms underlying cardiovascular risk. Low-grade inflammatory processes have emerged as a key player, with food insecurity and psychosocial stressors driving inflammatory biomarkers, leading to insulin resistance, endothelial dysfunction, and atherosclerosis progression (Laraia *et al*., 2017; Liu & Eicher-Miller, 2021). Endothelial dysfunction, characterized by impaired bioavailability of nitric oxide and vascular stiffness, is also exacerbated by hyperglycemia and prolonged hypertension, leading to accelerated atherosclerosis progression (Ferrannini & Cushman, 2012). At the same time, neuroendocrine pathways, including hypothalamic-pituitary-adrenal axis dysfunction and sympathetic nervous system activation, are driving forces for metabolic dysregulation, hypertension, and abdominal obesity, leading to a self-perpetuating cycle of cardiovascular risk, especially for individuals experiencing food insecurity (Hill-Briggs *et al*., 2021; Seligman *et al*., 2010).

These biological processes are closely related to the behavioral and lifestyle patterns shaped by material deprivation. For example, food insecurity has consistently been associated with dietary patterns characterized by high sodium and refined carbohydrate intake, as well as the availability of ultra-processed food products and low intake of fruits, vegetables, and whole grains, which are known to adversely affect glucose and blood pressure control(Berkowitz *et al*., 2018; Leung *et al*., 2014). In addition, the lack of access to safe environments for physical activity and the competing priorities for survival may lead to a sedentary lifestyle, which increases the risk of cardiometabolic diseases. Moreover, increased rates of smoking and negative coping strategies have also been observed among individuals exposed to chronic economic stress, which provides a coping mechanism for stress but causes long-term cardiovascular damage (Mendenhall, 2017). Thus, the pathways of structural deprivation lead to chronic physiological damage.

Compounding these biological and behavioral pathways of the syndemic of diabetes, hypertension, and food insecurity, the lack of access to healthcare may hinder the prevention, early detection, and effective control of diseases (Schwarz *et al*., 2022). For example, individuals with food insecurity and diabetes and hypertension may experience difficulties in managing their diseases because of the trade-offs between the cost of medication and the cost of food, leading to poor medication adherence, uncontrolled hypertension, and poor glycemic control (Berkowitz *et al*., 2013). Structural barriers that also lead to uneven healthcare engagement, late diagnosis, and disjointed continuity of care include absence of insurance, transportation barriers, and suboptimal access to culturally sensitive services in underserved communities (Mahajan *et al*., 2021). These barriers support the diabetes-hypertension-food insecurity syndemic, enabling preventable cardiovascular complications to develop and continue to persist despite the presence and application of effective clinical solutions.

TRANSLATIONAL IMPLICATIONS FOR CARDIOVASCULAR PREVENTION AND HEALTH EQUITY

Clinical practice emerges as a key point for disrupting the syndemic link between diabetes, hypertension, and food insecurity through the early

Publisher: SARC Publisher

identification and management of the interrelated conditions (Miguel *et al*., 2020). For example, the integrated management of the conditions, including blood pressure, glucose, and cardiovascular risk, has been found to enhance the early identification of high-risk patients. This has been achieved through the integrated management of the conditions, particularly in underserved populations (Fox *et al*., 2015; Oparil *et al*., 2018). The support for the routine screening of food insecurity in the clinical practice environment is gaining momentum, particularly due to the understanding of the condition as a modifiable social factor with direct implications for the management of the conditions (Seligman *et al*., 2010; Taher *et al*., 2022). The integration of validated screening tools into the electronic health record facilitates the identification of patients at high risk of developing the conditions, thus enhancing the provision of preventive cardiovascular care.

Following from clinical identification, community-based interventions can significantly contribute to the effective translation of screening into population-level health improvements (Sharma *et al*., 2019). Medically tailored meals and food as medicine interventions have shown promising results in improving dietary intake, blood glucose, blood pressure, and healthcare use among food-insecure individuals with cardiometabolic diseases (Berkowitz *et al*., 2018; Wetherill *et al*., 2018). Moreover, community health workers can significantly contribute to improving intervention outcomes by addressing cultural, language, and logistical factors, as well as improving chronic disease management among marginalized communities, such as food-insecure individuals or racial and ethnic minorities, who experience a high burden of cardiovascular diseases (Kangovi *et al*., 2018). Faith-based and community-level interventions can significantly contribute to improving nutrition knowledge, dietary intake, and behavior change, particularly in communities that experience a high burden of cardiovascular diseases and other healthcare disparities (Dunn *et al*., 2021; Wilcox *et al*., 2013).

At the system and policy level, structural interventions can significantly contribute to improving cardiovascular disease outcomes at a population level. Expanding and improving the Supplemental Nutrition Assistance Program (SNAP), a food support program, has been shown to significantly contribute to improving food security, dietary intake, and cardiovascular disease risk factors, particularly when incentives are aligned with food purchases that promote healthy diets (Gregory *et al*., 2020). Food prescription programs, which provide access to food as part of a comprehensive treatment plan, can significantly contribute to improving blood pressure, blood glucose, and food insecurity among individuals with diabetes and hypertension, providing a link between healthcare systems and food access (Olstad *et al*., 2022). Finally, value-based care models that incentivize addressing social determinants of health offer a scalable framework for aligning clinical outcomes with upstream prevention, reinforcing the need for integrated policy approaches to address the syndemic drivers of cardiovascular disease in underserved American communities.

GAPS AND FUTURE RESEARCH DIRECTIONS

Although there is considerable evidence of the associations of diabetes, hypertension, and food insecurity individually with cardiovascular disease, there is a significant research gap in the longitudinal research on the combined and interactive effects of these syndemics over time. Most of the research on these syndemics and their effects on cardiovascular disease and other outcomes is cross-sectional or of short-term design, making it difficult to elucidate the effects of the changing levels of food insecurity on the development and co-occurrence of these syndemics and the subsequent development of cardiovascular outcomes and disease, particularly in underserved populations in the US (Liu & Eicher-Miller, 2021; Thomas *et al*., 2021).

There are also significant research gaps in intervention and implementation of research. Although there are emerging intervention studies on food-as-medicine and care navigation approaches for cardiovascular outcomes and syndemics, there are few studies that have addressed the syndemics of diabetes, hypertension, and food insecurity concurrently and long-term cardiovascular outcomes and their feasibility (Berkowitz *et al*., 2018; Olstad *et al*., 2022). Most of the studies also lack representation of underserved populations, including those in the US, such as the rural population, Native Americans, immigrants, and those in other marginalized regions of the US. Future research should address the implementation of these syndemics and their effects on cardiovascular outcomes and the development of cardiovascular

Publisher: SARC Publisher

disparities, particularly in underserved populations in the US.

CONCLUSION

This narrative review aims to identify the interrelated relationships between diabetes, hypertension, and food insecurity in the development of cardiovascular diseases in underserved communities in the US. The findings suggest that these conditions occur in a syndemic pattern in which biological dysregulation, behaviorally mediated pathways, psychosocial stress, and structural barriers to healthcare access work together to increase cardiovascular risk. Food insecurity appears to play an important role in the social determinants of health, which can influence cardiovascular health in ways that extend beyond traditional risk factors. However, there is little work that examines the synergistic effects of these conditions. To address cardiovascular health disparities, there is a need to develop an integrative approach to prevention that includes the assessment of food insecurity in the management of cardiovascular risk.

REFERENCES

1. Ahmed, W., Angel, N., Edson, J., Bibby, K., Bivins, A., O'Brien, J. W., & Mueller, J. F. "First confirmed detection of SARS-CoV-2 in untreated wastewater in Australia: a proof of concept for the wastewater surveillance of COVID-19 in the community." *Science of the total environment* 728 (2020): 138764.
2. Baethge, C., Goldbeck-Wood, S., & Mertens, S. "SANRA—a scale for the quality assessment of narrative review articles." *Research integrity and peer review* 4.1 (2019): 5.
3. Berkowitz, S. A., Baggett, T. P., Wexler, D. J., Huskey, K. W., & Wee, C. C. "Food insecurity and metabolic control among US adults with diabetes." *Diabetes care* 36.10 (2013): 3093-3099.
4. Berkowitz, S. A., Baggett, T. P., Wexler, D. J., Huskey, K. W., & Wee, C. C. "Food insecurity and metabolic control among US adults with diabetes." *Diabetes care* 36.10 (2013): 3093-3099.
5. Berkowitz, S. A., Berkowitz, T. S., Meigs, J. B., & Wexler, D. J. "Trends in food insecurity for adults with cardiometabolic disease in the United States: 2005-2012." *PloS one* 12.6 (2017): e0179172.
6. Berkowitz, S. A., Terranova, J., Hill, C., Ajayi, T., Linsky, T., Tishler, L. W., & DeWalt, D. A. "Meal delivery programs reduce the use of costly health care in dually eligible Medicare and Medicaid beneficiaries." *Health Affairs* 37.4 (2018): 535-542.
7. Brandt, E. J., Chang, T., Leung, C., Ayanian, J. Z., & Nallamothu, B. K. "Food insecurity among individuals with cardiovascular disease and cardiometabolic risk factors across race and ethnicity in 1999-2018." *JAMA cardiology* 7.12 (2022): 1218-1226.
8. Cheung, B. M., & Li, C. "Diabetes and hypertension: is there a common metabolic pathway?." *Current atherosclerosis reports* 14.2 (2012): 160-166.
9. Dong, T., Harris, K., Freedman, D., Janus, S., Griggs, S., Iyer, Y., & Al-Kindi, S. G. "Food insecurity and atherosclerotic cardiovascular disease risk in adults with diabetes." *Nutrition* 106 (2023): 111865.
10. Dunn, C. G., Wilcox, S., Saunders, R. P., Kaczynski, A. T., Blake, C. E., & Turner-McGrievy, G. M. "Healthy eating and physical activity interventions in faith-based settings: a systematic review using the reach, effectiveness/efficacy, adoption, implementation, maintenance framework." *American Journal of Preventive Medicine* 60.1 (2021): 127-135.
11. ElSayed, N. A., Aleppo, G., Bannuru, R. R., Bruemmer, D., Collins, B. S., Das, S. R., & American Diabetes Association Professional Practice Committee. "10. Cardiovascular disease and risk management: standards of care in diabetes—2024." *Diabetes Care* 47 (2024).
12. Ferrannini, E., & Cushman, W. C. "Diabetes and hypertension: the bad companions." *The Lancet* 380.9841 (2012): 601-610.
13. Neal, B., Abate, K., Alexander, L., Biryukov, S., & Estep, K. "Global burden of hypertension and systolic blood pressure of at least 110 to 115mmHg, 1990-2015." (2017).
14. Fox, C. S., Golden, S. H., Anderson, C., Bray, G. A., Burke, L. E., De Boer, I. H., & Vafiadis, D. K. "Update on prevention of cardiovascular disease in adults with type 2 diabetes mellitus in light of recent evidence: a scientific statement from the American Heart Association and the American Diabetes Association." *Circulation* 132.8 (2015): 691-718.
15. Gregory, C. A., Rabbitt, M. P., & Ribar, D. C. "The supplemental nutrition assistance program and food insecurity." *SNAP Matters:*

Publisher: SARC Publisher

How food stamps affect health and well-being 74 (2015).
16. Vandroux, R., & Wolff, F. C. "Santé et insécurité alimentaire pour les bénéficiaires de l'aide alimentaire en France." *Mardi des Chercheurs*. (2024).
17. Hassan, S., Gujral, U. P., Quarells, R. C., Rhodes, E. C., Shah, M. K., Obi, J., ... & Narayan, K. V. "Disparities in diabetes prevalence and management by race and ethnicity in the USA: defining a path forward." *The lancet Diabetes & endocrinology* 11.7 (2023): 509-524.
18. Havranek, E. P., Mujahid, M. S., Barr, D. A., Blair, I. V., Cohen, M. S., Cruz-Flores, S., & Yancy, C. W. "Social determinants of risk and outcomes for cardiovascular disease: a scientific statement from the American Heart Association." *Circulation* 132.9 (2015): 873-898.
19. Hill-Briggs, F., Adler, N. E., Berkowitz, S. A., Chin, M. H., Gary-Webb, T. L., Navas-Acien, A., & Haire-Joshu, D. "Social determinants of health and diabetes: a scientific review." *Diabetes care* 44.1 (2020): 258.
20. Javed, Z., Haisum Maqsood, M., Yahya, T., Amin, Z., Acquah, I., Valero-Elizondo, J., & Nasir, K. "Race, racism, and cardiovascular health: applying a social determinants of health framework to racial/ethnic disparities in cardiovascular disease." *Circulation: Cardiovascular Quality and Outcomes* 15.1 (2022): e007917.
21. Kangovi, S., Mitra, N., Norton, L., Harte, R., Zhao, X., Carter, T., & Long, J. A. "Effect of community health worker support on clinical outcomes of low-income patients across primary care facilities: a randomized clinical trial." *JAMA internal medicine* 178.12 (2018): 1635-1643.
22. King, R. J., & Grant, P. J. "Diabetes und kardiovaskuläre Erkrankung: Pathophysiologie einer lebensbedrohlichen Epidemie." *Herz* 41 (2016): 184-192.
23. Laraia, B. A., Leak, T. M., Tester, J. M., & Leung, C. W. "Biobehavioral factors that shape nutrition in low-income populations: a narrative review." *American journal of preventive medicine* 52.2 (2017): S118-S126.
24. Leblang, D., Smith, M. D., & Wesselbaum, D. "Food insecurity across age: Evidence from a global study." *Global food security* (2025): 100891.
25. Leung, C. W., Epel, E. S., Ritchie, L. D., Crawford, P. B., & Laraia, B. A. "Food insecurity is inversely associated with diet quality of lower-income adults." *Journal of the Academy of Nutrition and Dietetics* 114.12 (2014): 1943-1953.
26. Li, Z., Sun, R., Huang, T., Han, Z., Xuan, X., & Huang, C. "Bidirectional Mediation and Synergistic Mortality Risks in Diabetes and Cardiovascular Disease: Evidence From NHANES 2005–2018." *Journal of Diabetes Research* 2025.1 (2025): 8517492.
27. Liu, Y., & Eicher-Miller, H. A. "Food insecurity and cardiovascular disease risk." *Current atherosclerosis reports* 23.6 (2021): 24.
28. Wang, C. C. L., Hess, C. N., Hiatt, W. R., & Goldfine, A. B. "Atherosclerotic cardiovascular disease and heart failure in type 2 diabetes–mechanisms, management, and clinical considerations." *Circulation* 133.24 (2016): 2459.
29. Mahajan, S., Grandhi, G. R., Valero-Elizondo, J., Mszar, R., Khera, R., Acquah, I., & Nasir, K. "Scope and social determinants of food insecurity among adults with atherosclerotic cardiovascular disease in the United States." *Journal of the American Heart Association* 10.16 (2021): e020028.
30. Mahajan, S., Grandhi, G. R., Valero-Elizondo, J., Mszar, R., Khera, R., Acquah, I., & Nasir, K. "Scope and social determinants of food insecurity among adults with atherosclerotic cardiovascular disease in the United States." *Journal of the American Heart Association* 10.16 (2021): e020028.
31. Martin, L. T., Chandra, A., Nelson, C., Yeung, D., Acosta, J. D., Qureshi, N., & Blagg, T. "Technology and data implications for the public health workforce." *Big Data* 10.1_suppl (2022): S25-S29.
32. Mendenhall, E. "Syndemics: a new path for global health research." *The Lancet* 389.10072 (2017): 889-891.
33. da Silva Miguel, E., Lopes, S. O., Araújo, S. P., Priore, S. E., Alfenas, R. D. C. G., & Hermsdorff, H. H. M. "Association between food insecurity and cardiometabolic risk in adults and the elderly: A systematic review." *Journal of Global Health* 10.2 (2020): 020402.
34. Morelli, V. "An introduction to primary care in underserved populations: definitions, scope, and challenges." *Primary Care: Clinics in Office Practice* 44.1 (2017): 1-9.
35. Muntner, P., Hardy, S. T., Fine, L. J., Jaeger, B. C., Wozniak, G., Levitan, E. B., &

Publisher: SARC Publisher

Colantonio, L. D. "Trends in blood pressure control among US adults with hypertension, 1999-2000 to 2017-2018." *Jama* 324.12 (2020): 1190-1200.
36. Murphy, S. L., Kochanek, K. D., Xu, J., & Arias, E. "Mortality in the United States, 2023." *NCHS data brief* 521.10.15620 (2024).
37. Odoms-Young, A., Brown, A. G., Agurs-Collins, T., & Glanz, K. "Food insecurity, neighborhood food environment, and health disparities: state of the science, research gaps and opportunities." *The American journal of clinical nutrition* 119.3 (2024): 850-861.
38. Olstad, D. L., Beall, R., Spackman, E., Dunn, S., Lipscombe, L. L., Williams, K., ... & Campbell, D. J. "Healthy food prescription incentive programme for adults with type 2 diabetes who are experiencing food insecurity: protocol for a randomised controlled trial, modelling and implementation studies." *BMJ open* 12.2 (2022): e050006.
39. Oparil, S., Acelajado, M. C., Bakris, G. L., Berlowitz, D. R., Cífková, R., Dominiczak, A. F., & Whelton, P. K. "Hypertension. Nature reviews. Disease primers, 4, 18014." (2018),
40. Rabbitt, M. P., Hales, L. J., Burke, M. P., & Coleman-Jensen, A. "Household food security in the United States in 2022." (2023).
41. Saqib, K., Qureshi, A. S., & Butt, Z. A. "COVID-19, mental health, and chronic illnesses: A syndemic perspective." *International Journal of Environmental Research and Public Health* 20.4 (2023): 3262.
42. Schultz, W. M., Kelli, H. M., Lisko, J. C., Varghese, T., Shen, J., Sandesara, P., & Sperling, L. S. "Socioeconomic status and cardiovascular outcomes: challenges and interventions." *Circulation* 137.20 (2018): 2166-2178.
43. Schwarz, T., Schmidt, A. E., Bobek, J., & Ladurner, J. "Barriers to accessing health care for people with chronic conditions: a qualitative interview study." *BMC health services research* 22.1 (2022): 1037.
44. Seligman, H. K., Laraia, B. A., & Kushel, M. B. "Food insecurity is associated with chronic disease among low-income NHANES participants." *The Journal of nutrition* 140.2 (2010): 304-310.
45. Sharma, N., Harris, E., Lloyd, J., Mistry, S. K., & Harris, M. "Community health workers involvement in preventative care in primary healthcare: a systematic scoping review." *BMJ open* 9.12 (2019): e031666.
46. Strain, W. D., & Paldánius, P. M. "Diabetes, cardiovascular disease and the microcirculation." *Cardiovascular diabetology* 17.1 (2018): 57.
47. Sun, Y., Liu, B., Rong, S., Du, Y., Xu, G., Snetselaar, L. G., & Bao, W. "Food insecurity is associated with cardiovascular and all-cause mortality among adults in the United States." *Journal of the American Heart Association* 9.19 (2020): e014629.
48. Taher, S., Muramatsu, N., Odoms-Young, A., Peacock, N., Michael, C. F., & Courtney, K. S. "An embedded multiple case study: using CFIR to map clinical food security screening constructs for the development of primary care practice guidelines." *BMC Public Health* 22.1 (2022): 97.
49. Thomas, M. K., Lammert, L. J., & Beverly, E. A. "Food insecurity and its impact on body weight, type 2 diabetes, cardiovascular disease, and mental health." *Current Cardiovascular Risk Reports* 15.9 (2021): 15.
50. Tsao, C. W., Aday, A. W., Almarzooq, Z. I., Anderson, C. A., Arora, P., Avery, C. L., & Martin, S. S. "Heart disease and stroke statistics—2023 update: a report from the American Heart Association." *Circulation* 147.8 (2023): e93.
51. VanderWeele, T. J. "Reconsidering the denominator of the attributable proportion for interaction." *European journal of epidemiology* 28.10 (2013): 779-784.
52. Velarde, G., Bravo-Jaimes, K., Brandt, E. J., Wang, D., Douglass, P., Castellanos, L. R., & Watson, K. "Locking the revolving door: racial disparities in cardiovascular disease." *Journal of the American Heart Association* 12.8 (2023): e025271.
53. Virani, S. S., Alonso, A., Benjamin, E. J., Bittencourt, M. S., Callaway, C. W., Carson, A. P., & American Heart Association Council on Epidemiology and Prevention Statistics Committee and Stroke Statistics Subcommittee, "Heart disease and stroke statistics—2020 update: a report from the American Heart Association." *Circulation* 141.9 (2020): e139-e596.
54. Wetherill, M. S., White, K. C., & Rivera, C. "Food insecurity and the nutrition care process: practical applications for dietetics practitioners." *Journal of the Academy of Nutrition and Dietetics* 118.12 (2017): 22-23.
55. Wilcox, S., Parrott, A., Baruth, M., Laken, M., Condrasky, M., Saunders, R., & Zimmerman,

Publisher: SARC Publisher

L. "The Faith, Activity, and Nutrition program: a randomized controlled trial in African-American churches." *American journal of preventive medicine* 44.2 (2013): 122-131.

Source of support: Nil; **Conflict of interest:** Nil.

Cite this article as:
Agyei, E. A. "Synergistic Roles of Diabetes, Hypertension, and Food Insecurity on Cardiovascular Disease Factors among Underserved American Communities: A Narrative Review." *Sarcouncil Journal of Internal Medicine and Public Health* 5.2 (2026): pp 55-64.

Publisher: SARC Publisher