REVIEW

Mortality trends and disparities for essential hypertension with obesity in the United States (1999–2020)

Sajan Sawai Suthar[1], Parshant Dileep Bhimani[2], Mahnoor Khalil[3], Salih Abdella Yusuf[4*]

ABSTRACT

Background: Essential hypertension and obesity are leading, interrelated risk factors for cardiovascular morbidity and mortality. The joint mortality burden of these conditions appears to be rising in the US, but detailed trend analyses are limited. We analyzed national mortality involving essential (primary) hypertension with obesity to assess temporal trends and demographic and geographic disparities from 1999 to 2020.

Methods: We used the CDC WONDER multiple-cause-of-death database (1999-2020) to identify deaths listing essential hypertension (ICD-10 I10) and obesity (ICD-10 E66) on the death certificate. Annual age-adjusted mortality rates (AAMRs) per 100,000 population (2000 US standard) were calculated. Trends were stratified by sex, race/ethnicity, U.S. Census region, state, and urban vs. rural residence. Joinpoint regression identified trend inflection points and was used to estimate annual percent change (APC) and average annual percent change (AAPC) in AAMRs.

Results: From 1999 to 2020, there were 162,274 deaths (54% in men) involving co-listed essential hypertension and obesity. The national AAMR increased from 1.4 in 1999 to 12.7 per 100,000 in 2020. Mortality rose gradually through 2018 (AAPC 5% annually), then surged after 2018, reaching an APC of +26.5% per year during 2018-2020. The late acceleration was most pronounced in Hispanic and American Indian/Alaska Native (AI/AN) populations (APCs 77% and 43%/year in 2018–2020). Non-Hispanic Black and Asian/Pacific Islander groups also saw sharp increases (37%-40%/year) versus +24% in non-Hispanic Whites. Female AAMRs, while lower than male, rose faster in 2018–2020 (+33%/year vs +20%/year in males). By 2020, the rural mortality rate (18.1 per 100k) exceeded the metropolitan rate (12.8), with rural areas showing an earlier upward inflection. All four major U.S. regions experienced marked late increases (APCs 20%-26%/year post-2018) after modest pre-2018 growth. Mortality shifts were accompanied by changes in place-of-death: in-hospital deaths for this cause subset more than doubled in 2020, and a greater share of deaths occurred at home in 2020 (50% of the subset) compared to prior years (30%-40%).

Conclusions: Mortality involving co-existing essential hypertension and obesity climbed dramatically in recent years, particularly among Hispanic and Indigenous (AI/AN) communities, women, and rural populations. These widening disparities highlight critical gaps in prevention and care for individuals with both obesity and hypertension. Intensified, targeted public health interventions are urgently needed, especially in the most affected groups and regions, to improve cardiometabolic health equity and reduce preventable deaths attributable to the combined effects of hypertension and obesity.

Keywords: Mortality, essential hypertension, obesity, United States.

Introduction

Hypertension and obesity are two of the most prevalent and impactful chronic health conditions worldwide. High blood pressure remains the leading modifiable risk factor for death globally, implicated in roughly 10-11 million deaths in 2019 (about one-fifth of all deaths). In parallel, the world has seen a steep rise in obesity prevalence as of 2016, with more than 650 million adults were obese

Correspondence to: Salih Abdella Yusuf
*Department of Medicine, Hawassa University, Awasa, Ethopia.
Email: salihabdellayusuf@gmail.com
Full list of author information is available at the end of the article.
Received: 28 October 2025 | **Revised:** 20 November 2025 | **Accepted**: 24 November 2025

(approximately 13% of adults globally) [1]. The United States, in particular, faces a co-epidemic of obesity and hypertension. Nearly half of U.S. adults meet criteria for hypertension, and over 40% have obesity [2]. These conditions frequently coexist and act synergistically to worsen cardiovascular outcomes. Obesity is estimated to contribute to the majority of primary hypertension cases, and having both hypertension and obesity markedly elevates risks of heart disease, stroke, and mortality. Despite advances in therapy, the joint burden of hypertension and obesity has not abated. Recent data even suggest unfavorable trends, for example, national surveys show blood pressure control rates have declined over the past decade while obesity prevalence continues to climb [3].

Understanding mortality trends that involve both hypertension and obesity is important for public health planning. Prior analyses have documented increases in obesity-related cardiovascular mortality and a slowing of past improvements in hypertension-related mortality. However, few studies have specifically examined U.S. mortality where both obesity and hypertension are listed as contributing causes. Given the strong clinical links between these conditions, often described as "two epidemics or one", their combined impact on mortality deserves focused attention [4]. Moreover, little is known about how such mortality may vary across demographic groups and geographies. Social determinants, structural inequalities, and access to care can influence hypertension and obesity outcomes, potentially creating disparities across sex, race/ethnicity, and rural versus urban communities. Indeed, the COVID-19 pandemic has further exposed and exacerbated these disparities, since individuals with obesity or hypertension are at higher risk of severe COVID-19 illness and death [5,6].

In this study, we leveraged the CDC WONDER national mortality database to characterize 22-year trends in U.S. mortality involving coexisting essential hypertension and obesity. We aimed to quantify overall temporal changes in mortality rates from 1999 to 2020 and to identify demographic and geographic subgroups with significantly different trends. We present findings stratified by sex, race/ethnicity, region, state, and urbanization level (rural vs urban). By illuminating these patterns, we hope to inform targeted public health strategies to address the intertwined epidemics of hypertension and obesity in the most vulnerable populations.

Methods

Data source

We conducted a retrospective observational analysis using the Centers for Disease Control and Prevention (CDC) Wide-Ranging Online Data for Epidemiologic Research (WONDER) multiple cause-of-death database[7]. This publicly available database contains national mortality data derived from death certificates filed in all 50 states and the District of Columbia, as compiled by the National Center for Health Statistics. We accessed CDC WONDER's Multiple Cause of Death files for years, 1999 through 2020 (the latest year available at the time of analysis) to obtain counts of deaths and population estimates. In accordance with the TITAN Guidelines 2025 for transparent use of AI in scholarly communication, no AI tools were used in the research design, data collection, analysis, or interpretation; AI assistance was limited solely to language refinement during manuscript preparation[8]. Because this study utilized de-identified, aggregate public data, institutional review board approval was not required. We followed STROBE guidelines for observational studies in reporting methods and results.

We defined the outcome of interest as any death of a U.S. resident aged 45 years or older (to focus on adult mortality) in which essential (primary) hypertension and obesity were both listed as causes on the death certificate. In ICD-10 coding, essential primary hypertension is I10, and obesity is E66 (including all E66 subcodes). Thus, we queried deaths with ICD-10 code I10 in any cause-of-death field and ICD-10 code E66 in any field (underlying or contributing causes). This "multiple cause" approach captures the joint involvement of both conditions in mortality. We excluded secondary hypertension codes (I11–I15) to specifically focus on essential hypertension. We also excluded the population aged <45 due to the rarity of the combination in youths and potentially different etiologies.

Mortality rate calculation

For each calendar year 1999-2020, we extracted the number of qualifying deaths along with mid-year population estimates (by demographic strata) from CDC WONDER. Annual age-adjusted mortality rates (AAMRs) per 100,000 population were computed using the direct method and standardized to the year 2000 U.S. standard population (the default standard in WONDER). We also examined crude death rates for supplemental description. Results were stratified by sex (male, female), race/ethnicity (non-Hispanic White, non-Hispanic Black, American Indian/Alaska Native [AI/AN], Asian or Pacific Islander [API], and Hispanic of any race), U.S. Census region (Northeast, Midwest, South, West), and metropolitan status (urban vs. rural county of residence). Race and ethnicity were categorized according to NCHS definitions; Hispanic origin was treated as mutually exclusive from racial categories (e.g., "non-Hispanic White") in stratified analyses. Urban-rural classification of the decedent's county was based on the NCHS Urban-Rural Classification Scheme for Counties, dichotomized into "metropolitan" (urban) and "non-metropolitan" (rural) as per CDC convention [9]. We also tabulated deaths by U.S. state and by place of death (e.g., hospital inpatient, home, and nursing facility) for descriptive purposes.

Statistical analysis

We first plotted annual mortality rates over time and calculated the total percentage change in AAMR from 1999 to 2020 overall and for each subgroup. To assess changes in trend slopes, we applied Joinpoint regression software (Version 4.9, National Cancer Institute) [10]. For each segment, we obtained the estimated Annual Percent Change (APC) with 95% confidence interval (CI) and significance test (two-sided $p < 0.05$ indicating

a non-zero trend). We also calculated the Average Annual Percent Change (AAPC) over the entire 1999-2020 period (or the longest interval applicable) for each group, which is a weighted summary of segment-specific APCs. Statistical significance of AAPC was noted if the 95% CI excluded 0. Analyses were completed using the Joinpoint software for trend analysis and Microsoft Excel for data tabulation. All significance testing was two-tailed with p < 0.05 as the threshold.

Figures and Tables

We present a central illustration summarizing key mortality trends, as well as detailed figures for subgroup trends. All figures are based on aggregated national data (no individual-level data). Supplementary tables provide the underlying data: Supplementary Table 1 shows annual deaths stratified by sex and race/ethnicity; Supplementary Table 2 shows mortality counts by place of death; Supplemental Table 3 displays joinpoint regression results for each subgroup (time segments and APCs).

Results

Overall mortality trends

From 1999 to 2020, a total of 162,274 adult deaths in the United States were recorded with both essential hypertension and obesity listed as causes. The annual number of these deaths increased more than fifteen-fold, from 1,325 in 1999 to 19,988 in 2020. The age-adjusted mortality rate (AAMR) for hypertension-with-obesity rose from 1.4 per 100,000 population in 1999 to 12.7 per 100,000 in 2020, an overall relative increase of about 807%. Notably, the mortality trend was nonlinear over time. As shown in Figure 1 and Central Illustration, the national AAMR climbed gradually through the early 2000s and 2010s, then accelerated sharply in the late 2010s. Joinpoint regression identified a significant inflection in 2018. From 1999 to 2018, the AAMR increased at a modest but steady pace (APC +5.07% per year, 95%CI 3.40%-6.50%, $p = 0.0028$). After 2018, the slope steepened dramatically – during 2018-2020 the AAMR surged by +26.5% per year (95%CI 12.9%-34.6%, $p < 0.000001$). In absolute terms, the age-adjusted rate jumped from 9.7 in 2018 to 12.7 in 2020, the highest on record for this cause combination (Supplementary Table 1 and 3).

Place of death and circumstances

We examined where hypertension + obesity related deaths were occurring. Over the study period, a majority of these deaths happened in medical facilities (hospitals), but this proportion changed in 2020. From 1999 to 2019, approximately 50%-60% of the deaths occurred in a hospital (inpatient or ER), 20%-25% in nursing homes or long-term care facilities, 5%-6% in hospices, and 15%-20% at home (with some "other/unknown" as well), see Supplementary Table 2. In 2020, there was a notable shift: hospital deaths rose sharply (e.g., 1,804 hospital/inpatient deaths in 2020 vs 1,017 in 2019, a 77% increase), and the fraction of deaths at home also increased [home deaths in 2020,in 2019]. Meanwhile, nursing home deaths grew modestly [in 2020,vs 299 in 2019], and hospice deaths remained low [in 2020,vs 45 in 2019]. As a result, 2020 saw about 34% of these deaths occurring in hospitals [up

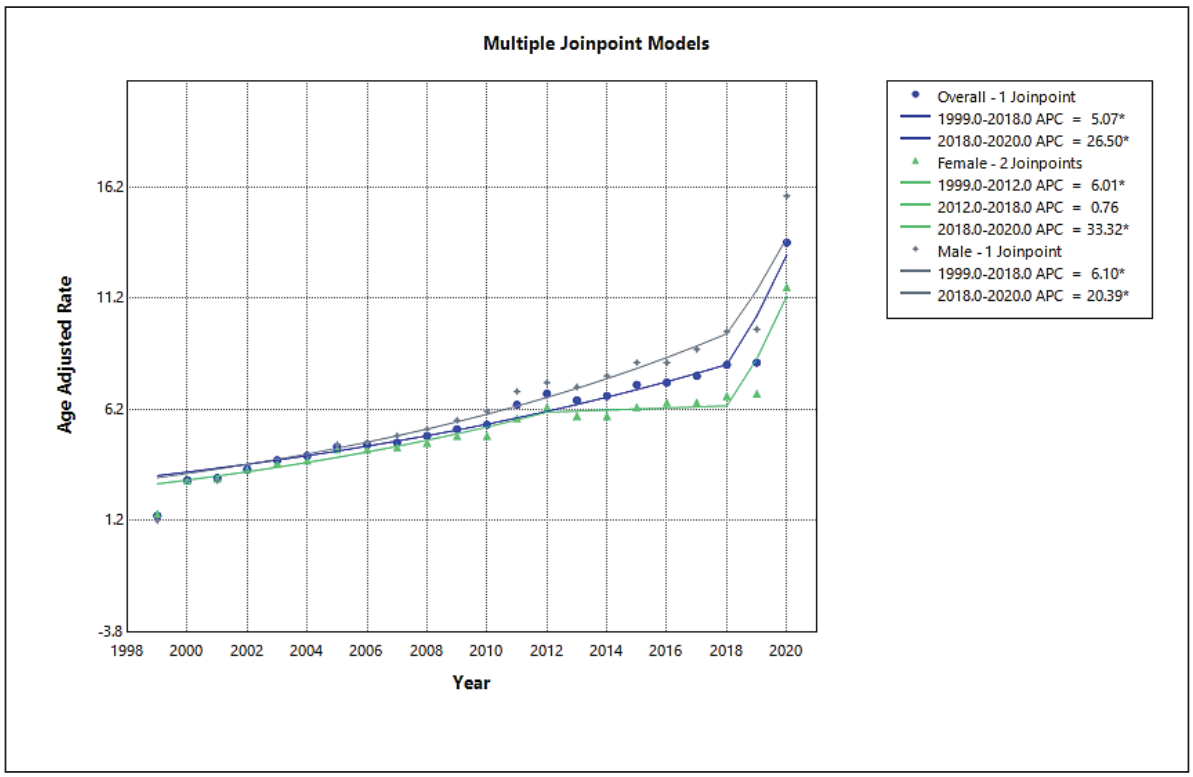

Figure 1. *Trends and Disparities in Overall, Males and Females from 1999-2020 in Hypertensive Obese US Adults.*

from 27% in 2019] and 50% occurring at home (up from 41%), with relatively fewer in nursing facilities.

Sex differences

Throughout 1999-2020, males had higher hypertension/obesity mortality rates than females. Over the entire period, the age-adjusted death rate in men averaged 40%-60% greater than in women (e.g., 2020: 15.8 vs 10.8 per 100,000 for males vs females). However, the temporal trend for women showed a more pronounced late increase. Female AAMRs rose slowly until 2012, plateaued in the mid-2010s, then escalated after 2018. Specifically, female mortality had an early APC of +6.0%/year (1999-2012, p = 0.0004) followed by a non-significant flat period (2012-2018 APC +0.8%, p = 0.79), then a 33.3% per year increase during 2018-2020 (95%CI 20.7%-45.6%, p < 0.000001). In males, the pre-2018 increase was more sustained: male AAMRs grew 6.1% annually from 1999 to 2018 (p = 0.038) with no mid-period plateau, and then 20.4% per year growth in 2018-2020 (95%CI 6.7%-29.0%, p < 0.000001). Thus, the late-pandemic-era surge was steeper in women than men (+33% vs +20% APC), even though men's absolute rates remained higher. By 2020, the sex gap in AAMR had narrowed somewhat: 15.8 (males) vs 10.8 (females) per 100k. Cumulatively from 1999-2020, 51.7% of decedents were male and 48.3% female (see Figure 1, Supplementary Table 1, 3, and 4).

Race/ethnicity disparities

Significant racial and ethnic disparities in mortality were observed, both in baseline rates and in trend magnitudes (Figure 2). Non-Hispanic Black adults experienced the highest mortality burden over most of the study period. In 1999, the Black population's AAMR was 1.8 (per 100k), more than double the White rate (0.8); this disparity persisted and even widened by the late 2010s. For example, by 2019, the Black AAMR reached 11.2 vs 5.3 in Whites. However, the largest relative increases in recent years occurred among Hispanic and American Indian/Alaska Native (AI/AN) populations. From 2018 to 2020, the AAMR APC was +76.99% per year in Hispanics (95%CI 46.4%-112.5%), the steepest rise of any group, and +42.98% per year in AI/AN (95%CI 18.6%–61.3%). These surges catapulted Hispanic and AI/AN mortality rates upward relative to other groups. For instance, the Hispanic AAMR, historically lower than the White AAMR, nearly doubled from 4.3 in 2018 to an estimated 7.6 in 2020 (surpassing the White rate). AI/AN rates, starting from 4–5 in the mid-2010s, climbed to roughly 9–10 by 2020, approaching the Black rate. Non-Hispanic Asian or Pacific Islander populations also showed a notable late increase (2018–2020 APC +39.9% per year), although their absolute mortality remained lowest of all groups [AAMR 1.8 in 2020]. Non-Hispanic Whites had the smallest relative uptick post-2018 (+24.3%/year APC), yet still a significant acceleration compared to earlier years. Across the full 1999-2020 span, all racial/ethnic groups experienced a net mortality increase (AAPC significantly > 0 in each). By 2020, provisional AAMRs by group were approximately: Black 15 per 100k, AI/AN 9-10, Hispanic 8, White 6.6, and Asian 1.8 (based on extrapolation of trends and 2020 data). Non-Hispanic Black adults continued to bear the highest mortality rate in 2020 despite not having the

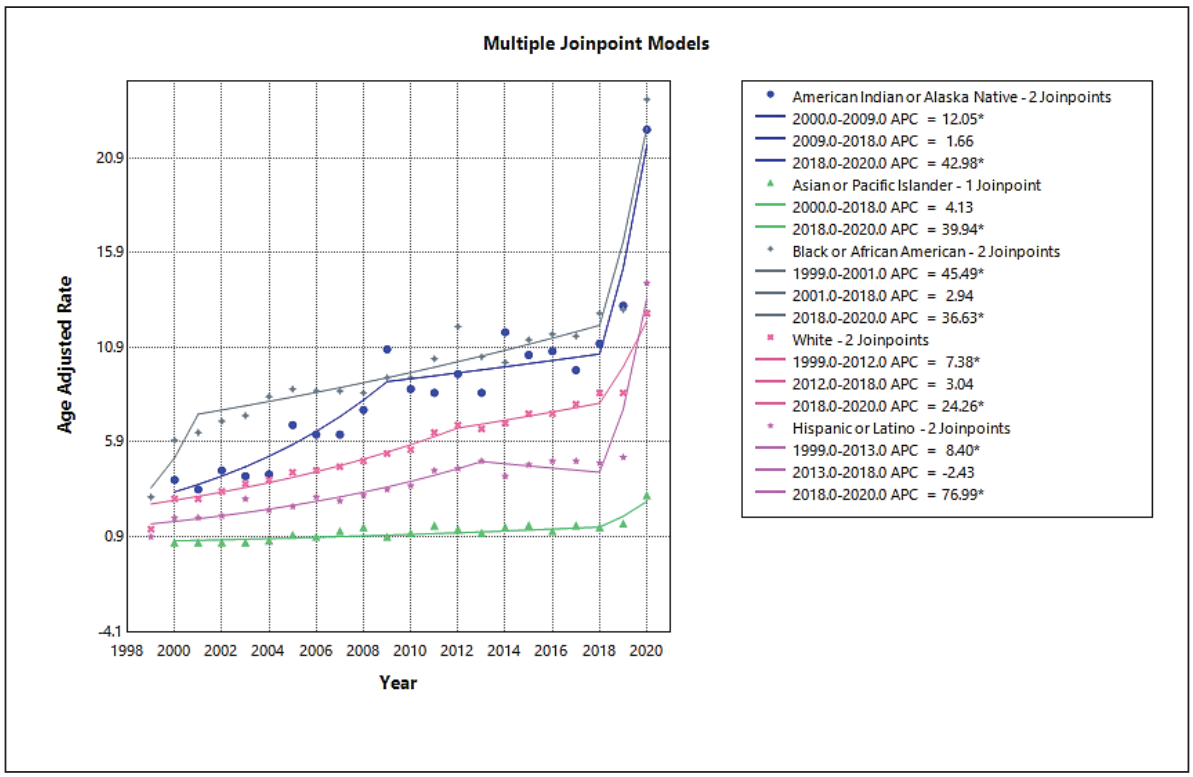

Figure 2. *Trends and Disparities in Races from 1999-2020 in Hypertensive Obese US Adults.*

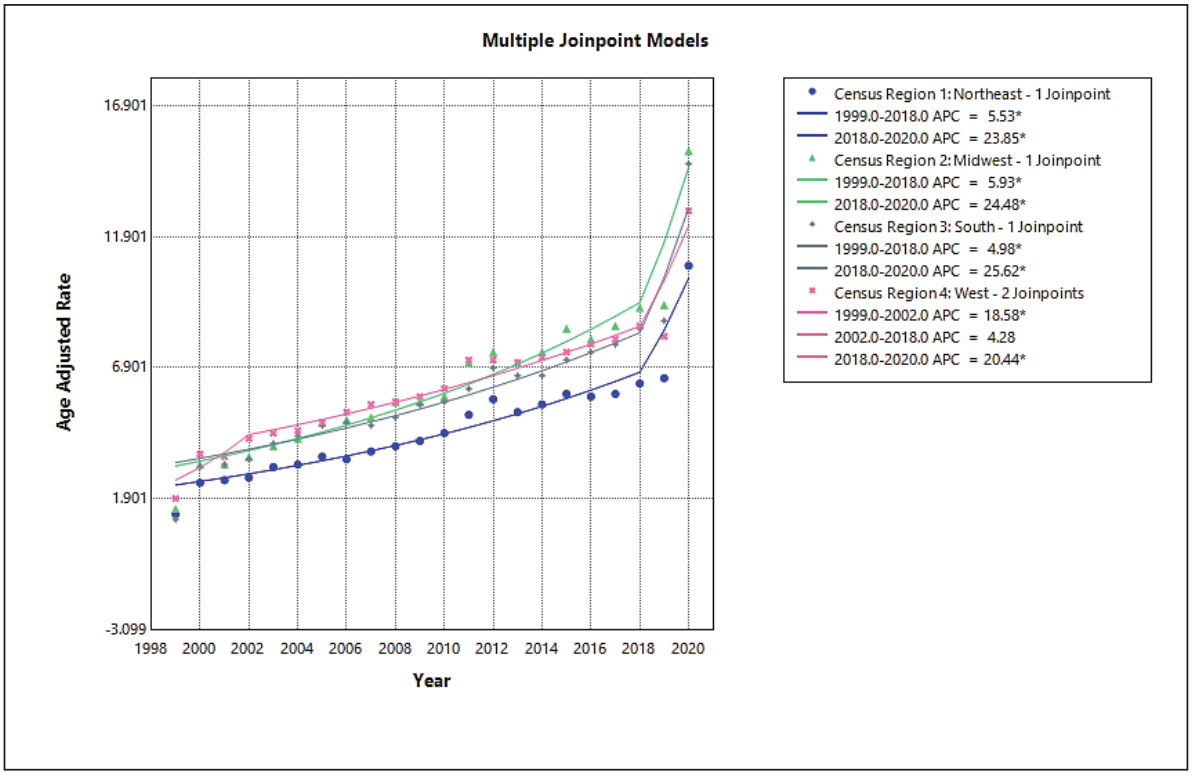

Figure 3. *Trends and Disparities in Census from 1999-2020 in Hypertensive Obese US Adults.*

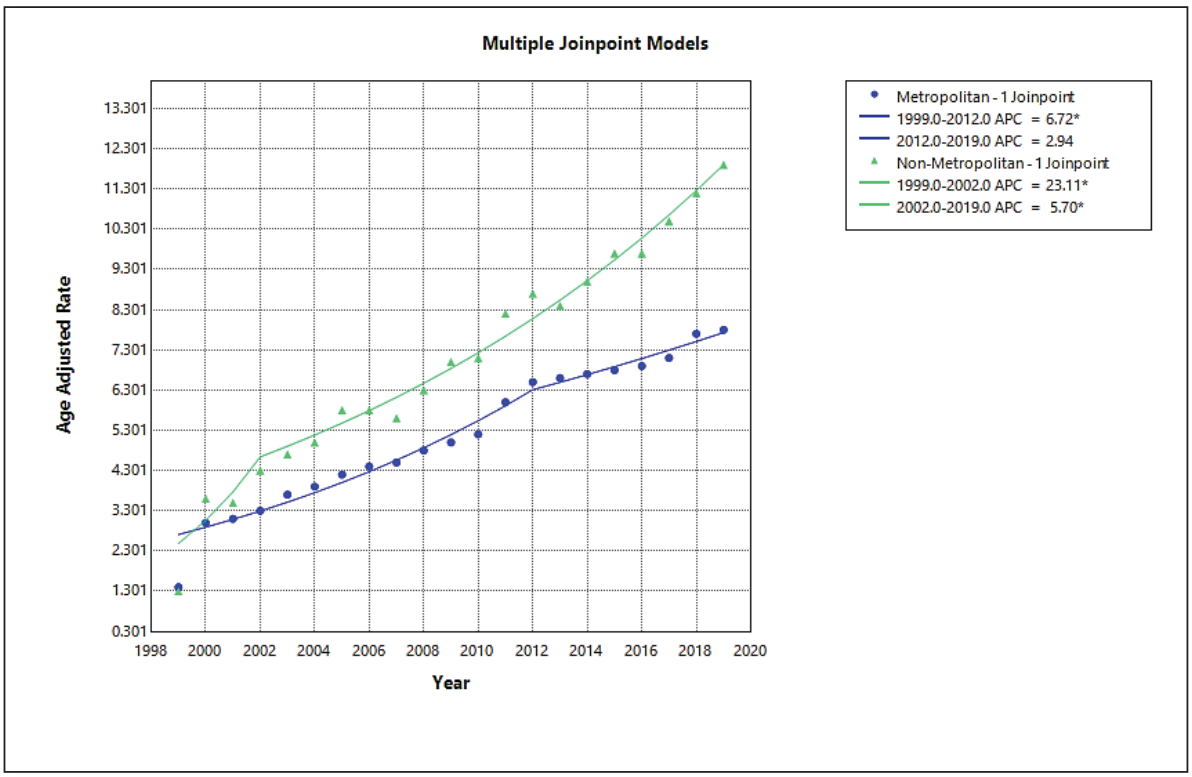

Figure 4. *Overall AAMR in States of USA from 1999-2020 in Hypertensive Obese US Adults.*

fastest recent APC. In terms of counts, White decedents constituted the majority (74%) of total hypertension with obesity related deaths over two decades (owing to population size), followed by Black (17%), Hispanic (6%), API (0.9%), and AI/AN (0.9%) (Supplementary Table 1, 3, and 5).

Geographic and rural–urban patterns

Mortality rates increased in all major regions of the U.S., with some regional variation in timing and magnitude of trend changes. The Southern and Midwestern states exhibited the highest rates by the end of the study

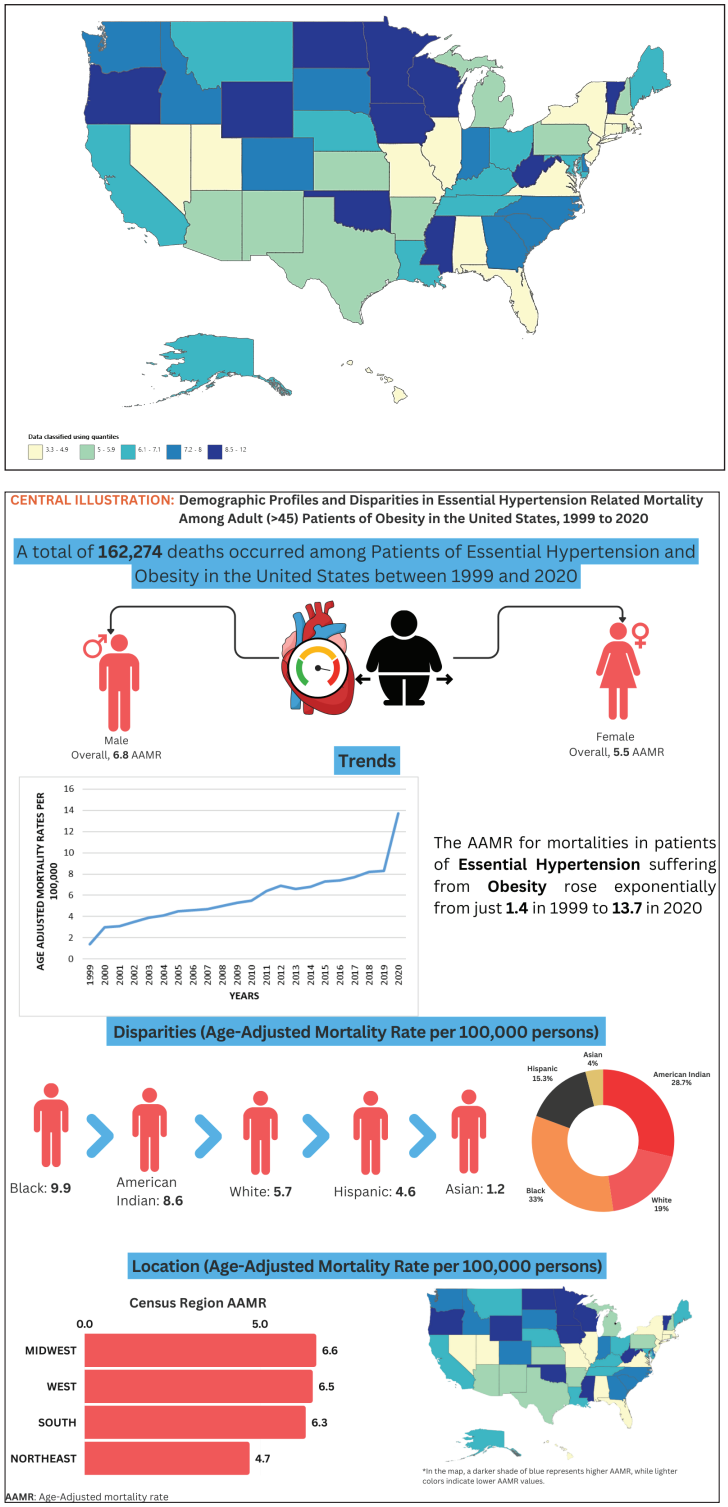

Figure 5. *Trends and Disparities in Urban from 1999-2020 in Hypertensive Obese US Adults.*

period. In 2020, the age-adjusted death rate reached approximately 15.2 per 100k in the Midwest and 14.7 in the South, compared to 12.9 in the West and 10.8 in the Northeast. Notably, each region experienced a significant inflection around 2018. Prior to 2018, regional APCs ranged from about +4.98%/year in the South to +5.93%/year in the Midwest (all $p < 0.02$), with the West showing an early uptick in 1999-2002 (APC +18.6%/year) followed by a long stable period. After 2018, mortality rose sharply in all regions, with APCs of +23.85%, +24.48%, +25.62%, and +20.44% per year in 2018-2020 for Northeast, Midwest, South, and West, respectively (all $p < 0.000001$). By 2020, the absolute difference between the highest- and lowest-rate region (Midwest vs Northeast) was about 4.4 per 100k (Figure 3). Some of the highest state-specific rates were observed in the South and Midwest; for example, states such as Mississippi, Oklahoma, and West Virginia had among

the top mortality rates (as per supplemental state data). This geographic pattern parallels known distributions of obesity and uncontrolled hypertension in the population (Figure 4, Supplementary Table 6, 7).

Perhaps most striking was the rural–urban disparity that emerged and widened. Residents of non-metropolitan (rural) counties had consistently higher hypertension/obesity mortality rates than those in metropolitan areas, and this gap expanded over time. The rural AAMR exceeded the urban AAMR in almost every year observed. An earlier joinpoint was detected for rural areas: rural mortality surged in the early 2000s (1999-2002 APC +23.1%/year, $p < 0.0001$) before settling into a slower increase through the 2000s-2010s (+5.7%/year during 2002-2019, $p = 0.03$). Urban areas, by contrast, showed a steadier climb initially (+6.7%/year, 1999-2012, $p < 0.000001$) and then little change in the mid-2010s (2012-2019 APC +2.94%/year, not significant). Crucially, both rural and urban areas experienced a spike after 2018, but the absolute jump was larger in rural communities. In 2020, the rural AAMR was 18.1 per 100,000, compared to 12.8 in metropolitan areas marking, the first time the rural rate was roughly 40% higher than the urban rate. In 1999, by comparison, rural and urban rates had both been about 1.3-1.4 per 100k (virtually no gap). Thus, the mortality surge in recent years disproportionately affected rural America, exacerbating a rural–urban mortality disparity. This mirrors broader U.S. mortality trends in which rural communities have seen less improvement or worse outcomes for cardiovascular conditions (Figure 5, Supplementary Table 8).

Discussion

In this national study spanning 22 years, we found that U.S. mortality involving the coexistence of essential hypertension and obesity has increased dramatically, with an especially steep climb in 2019-2020. To the best of our knowledge, this analysis is among the first to comprehensively quantify the joint mortality trends of these conditions through the first year of the COVID-19 pandemic. Several important observations emerge. First, after nearly two decades of gradual rise, the mortality rate for hypertension with obesity surged in the late 2010s. The timing and magnitude of this inflection strongly suggest that the COVID-19 pandemic contributed to the sudden spike [11,12]. Individuals with obesity and hypertension are highly vulnerable to severe COVID-19 outcomes. COVID infection can acutely destabilize cardiovascular health, and people with these comorbidities faced elevated risks of hospitalization and death during the pandemic [13,14]. It is telling that half of the excess cardiovascular deaths in 2020 occurred in patients who also had obesity, and that excess mortality was disproportionately high in those with multiple chronic conditions [12]. Our data align with those findings: the mortality rate for the hypertension–obesity combination jumped by over 30% in 2020 alone. Other research documented an unprecedented drop in U.S. life expectancy in 2020, largely driven by COVID-19 and with larger decreases among Black and Hispanic Americans [5,15]. The concentration of late-period mortality increases in our study among Hispanic, Black, and AI/AN populations likely reflects the disproportionate impact of COVID-19 on these groups due both to higher infection rates and higher case-fatality rates linked to comorbidities and social determinants [15,16].

Second, beyond the pandemic's acute effects, our findings highlight a worrying chronic trend: even before COVID-19, mortality involving hypertension and obesity was rising, not falling. From 1999 to 2018, we observed a 5% per year increase in the death rate. This occurred despite overall improvements in some cardiovascular outcomes over the 2000s. It underscores that the synergistic effects of obesity and hypertension may be undermining progress made in other areas (e.g., better acute cardiac care). Indeed, recent reports have noted stagnation or reversal of cardiovascular mortality trends in the 2010s, partly attributable to the obesity and diabetes epidemics [17]. A study similarly found an average +7.3% yearly increase in combined obesity–hypertension mortality from 2000-2019 [18]. Likewise, a 2020 analysis by Rethy et al. showed that hypertension-related cardiovascular mortality (e.g., hypertensive heart disease and stroke) stopped declining in the 2010s and began increasing in younger age groups. Our study extends these observations by specifically focusing on deaths where both obesity and hypertension are present effectively capturing a high-risk phenotype that has grown more common. The persistently rising trend in such deaths raises concern that advances in blood pressure treatment or cholesterol management have not been enough to counteract the impact of worsening obesity and metabolic health on population mortality [19].

Third, we found major disparities in mortality trends by sex, race/ethnicity, and geography. Women had a lower absolute mortality rate than men, consistent with men's higher cardiovascular risk profile historically. However, the rapid acceleration of the female trend after 2018 is notable. It suggests that women with obesity and hypertension experienced a particularly severe impact during the pandemic, or potentially that prior to COVID their mortality may have been under-recognized. Other studies have highlighted that women can have equal or greater relative risk from obesity for some outcomes, for example, one analysis estimated obese women lose more cumulative life-years to cardiovascular disease than obese men [20]. Our results reinforce that women are not spared in the obesity-hypertension syndemic; targeted interventions for women (especially women of color, who often have high obesity prevalence) are warranted. Racial and ethnic patterns in our study mirror broader health inequities. Non-Hispanic Black Americans had the highest mortality rates throughout, reflecting the well-documented excess burden of hypertension-related complications in Black communities [21]. Structural factors including inequitable access to healthcare, chronic stress, lower socioeconomic status, and historical racism contribute to poorer hypertension control and higher obesity rates in many Black populations [16,17]. Despite showing a large late increase (+37% APC), Black mortality did not rise as explosively as Hispanic mortality in 2018-2020, yet Black rates still ended up highest overall. Hispanic Americans saw the most

dramatic spike (nearly +77%/year), a striking finding that correlates with COVID-19's disproportionate toll on Hispanic communities in 2020 [15].

The rural–urban disparity we identified is in line with a widening gap in all-cause and cardiovascular mortality between rural and metropolitan America [22]. Residents of rural areas are more likely to have obesity, less access to healthful foods and exercise options, higher poverty rates, and less access to medical care (including specialists) [22]. These factors likely contributed to rural counties both having higher baseline hypertension/obesity mortality and being less resilient to the shocks of COVID-19. Indeed, studies show the rural U.S. saw greater relative increases in mortality during 2020-2021 than urban areas, partly due to healthcare resource limitations and later availability of advanced COVID therapies in rural hospitals, and vaccination uptake lagged in many rural regions [5].

Public health and clinical implications

Our study's findings sound a clarion call for enhanced public health efforts targeting the intertwined epidemics of hypertension and obesity. From a prevention standpoint, upstream strategies to reduce obesity rates would likely pay dividends in curbing hypertension incidence and severity [17]. Multi-faceted community interventions promoting healthier diets and physical activity through policy (e.g., sugary drink taxes, built environment improvements) have shown potential to address obesity at the population level [23]. Given the socio-demographic patterns observed, such interventions should prioritize Black, Hispanic, and rural communities, tailoring programs to be culturally relevant and accessible. Simultaneously, improving hypertension awareness, treatment, and control remains paramount. After years of improvement, hypertension control in the U.S. declined in the late 2010s (dropping from 54% to 44% of hypertensives controlled), and even controlled patients may not escape the risks if they also have obesity [24]. Novel care models (team-based care, telehealth monitoring) and broader implementation of evidence-based protocols could help regain momentum in blood pressure control, especially in resource-poor settings [24].

Limitations

This study has several limitations. First, death certificate data may have accuracy issues obesity or hypertension could be under- or over-reported on certificates. Obesity, in particular, might be under-recognized as a contributing cause by certifiers. If reporting changed over time (e.g., increased awareness leading to more frequent listing of obesity), some trend might reflect documentation changes. However, the abrupt jump after 2018 is unlikely explained by documentation alone, given its concordance with external events. Second, we did not have individual-level data on comorbidities beyond what was listed; many decedents likely had other conditions (diabetes, heart disease) which also play a role. Our focus was specifically on capturing the joint presence of hypertension and obesity, which by itself is an important syndemic. Third, the analysis by demographic subgroups inherently treats those categories as independent, but there is overlap (e.g., many rural residents are White, and so on). We presented each stratification separately; a more granular analysis (like rural Black vs urban Black) was beyond scope due to small cell counts in some strata. Fourth, 2020 was an atypical year due to COVID-19. The trends, including 2020, therefore, reflect a mix of chronic and acute influences. Caution is warranted in extrapolating beyond 2020, it is unclear if the high mortality will persist or recede in subsequent years as the pandemic's acute phase wanes. Early evidence from 2021-2022 suggests some continued excess mortality in cardiometabolic conditions. We also note that joinpoint can sometimes "over-fit" inflections; however, in our data, the 2018 joinpoint was consistently identified with strong statistical significance, supporting a true change in trend. Finally, we did not separately analyze secondary hypertension (I11–I15) with obesity, including those could yield an even larger total burden, but also introduce heterogeneity (since I11–I15 includes hypertensive heart or kidney disease, which might overlap with obesity effects). Our restriction to essential hypertension provides a focused picture.

Conclusions

In the United States, adults with the combined conditions of hypertension and obesity have experienced a dramatic escalation in mortality rates from 1999 through 2020. What was once a relatively infrequent cause combination has grown into a significant contributor to premature deaths a trend accentuated by the COVID-19 pandemic but evident even beforehand. The sharp uptick in late 2018-2020 and the pronounced disparities we observed (by race, ethnicity, sex, and rurality) highlight that the convergence of the obesity and hypertension epidemics is exacting an uneven toll. These findings call for renewed urgency in combating both hypertension and obesity on a population level. A multi-pronged strategy is needed: vigorous clinical management for individuals (with emphasis on those carrying both diagnoses) and broad public health initiatives to prevent and reduce obesity and high blood pressure in the first place. Importantly, interventions must prioritize the most affected groups Hispanic and AI/AN communities, Black Americans, rural residents, and women to achieve equity. As the U.S. emerges from the acute phase of the pandemic, addressing the "silent" epidemic of cardiometabolic mortality should be a top public health priority. Reversing these deadly trends will require tackling the underlying societal inequities and lifestyle factors that drive obesity and hypertension, ensuring access to care and preventive services, and possibly leveraging new therapies (such as effective anti-obesity medications) in high-risk populations. Without concerted action, the convergence of hypertension and obesity threatens to erode or undo decades of progress in cardiovascular mortality reduction. Our study's insights into who and where to target can help inform such action, guiding resources to those communities most in need. The time to intervene with passion and precision is now, to save lives and restore the momentum of cardiovascular health improvement in the United States.

Ethics approval
As this study was based solely on publicly accessible, de-identified data from the CDC WONDER database, it did not involve human subjects directly and thus did not require institutional review board approval or informed consent.

Consent for publication
No individual-level or personally identifiable information is included, rendering publication consent irrelevant.

Conflict of Interest
The authors declare the absence of any financial, personal, or academic conflicts that might have influenced the conduct or outcomes of this study.

Funding
This work was independently conducted without financial assistance from governmental bodies, commercial sponsors, or nonprofit institutions.

Author details
Sajan Sawai Suthar[1], Parshant Dileep Bhimani[2], Mahnoor Khalil[3], Salih Abdella Yusuf[4]
1. University Hospital Limerick, Limerick, Ireland
2. Department of Medicine, Shaheed Mohtarma Benazir Bhutto Medical College, Lyari, Karachi, Pakistan
3. Karachi Metropolitan University, Abbasi Shaheed Hospital, Karachi, Pakistan
4. Department of Medicine, Hawassa University, Awasa, Ethopia

Supplementary content (If any) is available online.

References

1. WHO Director-General's opening remarks at Obesity - Setting the Global agenda event. 2021 [Internet]. [cited 2025 Aug 24]. Available from: https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-obesity-setting-the-global-agenda-event-4-march-2021
2. Products - Data Briefs. 2020 [Internet]. [cited 2025 Aug 24]. Available from: https://www.cdc.gov/nchs/products/databriefs/db364.htm
3. American Medical Association. How to fight rising obesity, hypertension during a pandemic | [Internet]. [cited 2025 Aug 24]. Available from: https://www.ama-assn.org/delivering-care/prevention-wellness/how-fight-rising-obesity-hypertension-during-pandemic
4. Nabi R, Zanub A, Akhtar M, Chaudhry SAA, Awais AR, Farooqi HA, et al. Concomitant mortality trends due to obesity and hypertension in the U.S.: a 20-year retrospective analysis of the CDC WONDER database. BMC Cardiovasc Disord. 2025;25(1):496. https://doi.org/10.1186/s12872-025-04909-z
5. Woolf SH, Masters RK, Aron LY. Effect of the covid-19 pandemic in 2020 on life expectancy across populations in the USA and other high income countries: simulations of provisional mortality data. BMJ. 2020;373:1343. https://doi.org/10.1136/bmj.n1343
6. Decreases in life expectancy in 2020 much larger in the US than other high income countries | EurekAlert! [Internet]. [cited 2025 Aug 24]. Available from: https://www.eurekalert.org/news-releases/750488
7. Multiple Cause of Death Data on CDC WONDER [Internet]. [cited 2025 Aug 24]. Available from: https://wonder.cdc.gov/mcd.html
8. Agha RA, Mathew G, Rashid R, Kerwan A, Al-Jabir A, Sohrabi C, et al. Transparency In The reporting of Artificial INtelligence - the TITAN guideline. Premier J Sci. 2025; https://doi.org/10.70389/PJS.100082
9. Ingram D, SFV S, Data U. NCHS urban-rural classification scheme for counties. europepmc.org [Internet]. [cited 2025 Aug 24]. Available from: https://europepmc.org/article/med/22783637
10. Joinpoint Regression Program [Internet]. [cited 2025 Aug 24]. Available from: https://surveillance.cancer.gov/joinpoint/
11. Wadhera RK, Shen C, Gondi S, Chen S, Kazi DS, Yeh RW. Cardiovascular deaths during the COVID-19 pandemic in the United States. J Am Coll Cardiol. 2021;77(2):159–69. https://doi.org/10.1016/j.jacc.2020.10.055
12. Adair T. Premature cardiovascular disease mortality with overweight and obesity as a risk factor: estimating excess mortality in the United States during the COVID-19 pandemic. Int J Obes. 2023;47(4):273–9. https://doi.org/10.1038/s41366-023-01263-y
13. Xie Y, Xu E, Bowe B, Al-Aly Z. Long-term cardiovascular outcomes of COVID-19. Nat Med. 2022;28(3):583–90. https://doi.org/10.1038/s41591-022-01689-3
14. Martens I, Vostrov N, Mirolo M, Leake SJ, Zatterin E, Zhu X, et al. Defects and nanostrain gradients control phase transition mechanisms in single crystal high-voltage lithium spinel. Nat Commun. 2023;14(1):1–10. https://doi.org/10.1038/s41467-023-42285-4
15. Barbieri M. Covid-19 and the growing disadvantage in US life expectancy. BMJ. 2021;373:1530. https://doi.org/10.1136/bmj.n1530
16. Webb Hooper M, Nápoles AM, Pérez-Stable EJ. COVID-19 and racial/ethnic disparities. JAMA. 2020;323(24):2466–7. https://doi.org/10.1001/jama.2020.8598
17. Powell-Wiley TM, Poirier P, Burke LE, Després JP, Gordon-Larsen P, Lavie CJ, et al. Obesity and cardiovascular disease: a scientific statement from the American Heart Association. Circulation. 2021;143(21):e984–1010. https://doi.org/10.1161/CIR.0000000000000973
18. Zhou B, Carrillo-Larco RM, Danaei G, Riley LM, Paciorek CJ, Stevens GA, et al. Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants. Lancet. 1990;398(10304):957–80. https://doi.org/10.1016/S0140-6736(21)01330-1
19. Rethy L, Shah NS, Paparello JJ, Lloyd-Jones DM, Khan SS. Trends in hypertension-related cardiovascular mortality in the United States, 2000-2018. Hypertension. 2000;76(3):23. https://doi.org/10.1161/HYPERTENSIONAHA.120.15153
20. Nyberg ST, Batty GD, Pentti J, Virtanen M, Alfredsson L, Fransson EI, et al. Obesity and loss of disease-free years owing to major non-communicable diseases: a multicohort study. Lancet Public Health. 2018;3(10):e490–497. https://doi.org/10.1016/S2468-2667(18)30139-7
21. Ferdinand KC, Yadav K, Nasser SA, Clayton-Jeter HD, Lewin J, Cryer DR, et al. Disparities in hypertension and cardiovascular disease in blacks: the critical

role of medication adherence. J Clin Hypertens. 2017;19(10):1015–24. https://doi.org/10.1111/jch.13089

22. Atmore C, Dovey S, Gauld R, Gray AR, Stokes T. Do people living in rural and urban locations experience differences in harm when admitted to hospital? A cross-sectional New Zealand general practice records review study. BMJ Open. 2021;11(5):46207. https://doi.org/10.1136/bmjopen-2020-046207
23. Thomas KL, Dobis EA, McGranahan DA. Nature of the rural-urban mortality gap [Internet]. 2024 [cited 2025 Aug 24]. Available from: https://handle.nal.usda.gov/10113/8321813
24. Muntner P, Hardy ST, Fine LJ, Jaeger BC, Wozniak G, Levitan EB, et al. Trends in blood pressure control among US adults with hypertension, 1999-2000 to 2017-2018. JAMA. 2020;324(12):1190–200. https://doi.org/10.1001/jama.2020.14545