Supplemental Nutrition Assistance Program Eligibility and HIV Incidence in the United States

Aaron Richterman,1,2 Jason P. Block,1,2 Alexander C. Tsai,1,a and Louise C. Ivers1,5,a

Background. The connection between food insecurity and HIV outcomes is well established. The Supplemental Nutrition Assistance Program (SNAP), the primary food safety net program in the United States, may have collateral impacts on HIV incidence. “Broad-based categorical eligibility” for SNAP is a policy that provides a mechanism for states to increase the income or asset limits for SNAP eligibility.

Methods. We estimated the association between the number of new HIV diagnoses in 2010–2014 for each state and (1) state income limits and (2) state asset limits for SNAP eligibility. We fitted multivariable negative binomial regression models with number of HIV diagnoses specified as the outcome; SNAP policies as the primary explanatory variable of interest; state and year fixed effects; and time-varying covariates related to the costs of food, health care, housing, employment, other SNAP policies, and Temporary Assistance for Needy Families spending.

Results. HIV diagnoses within states had a statistically significant association with state income limits for SNAP eligibility (incidence rate ratio [IRR], 0.94 per increase in the income limit by 35% of federal poverty level; 95% CI, 0.91–0.98), but no association with state asset limits (increased asset limit vs no change: IRR, 1.02; 95% CI, 0.94–1.10; eliminated asset limit vs no change: IRR, 1.04; 95% CI, 0.99–1.10).

Conclusions. State income limits for SNAP eligibility were inversely associated with the number of new HIV diagnoses for states between 2010 and 2014. Proposals to eliminate the use of broad-based categorical eligibility to increase the income limit for SNAP may undercut efforts to end the HIV epidemic in the United States.

Keywords. food insecurity; HIV prevention; social determinants of health; Supplemental Nutrition Assistance Program.

INTRODUCTION

The relationship between food security—defined as access at all times to enough food for an active, healthy life—and HIV risk and HIV-related morbidity and mortality has been well established [1]. Through multiple proposed pathways, food insecurity has been associated with lower adherence to antiretroviral therapy, worse virologic control, high-risk coping strategies like exchanging sex for food or money, and increased risk of mortality [2–14]. In this way, food insecurity may lead to both worse outcomes for people with HIV and an increased likelihood of transmission, with a consequent increase in population HIV incidence.

After years of declining HIV incidence in the United States, the number of new infections has plateaued at around 39,000 per year since 2013 [15]. In 2019, in response to this lack of continued progress, the United States Department of Health and Human Services announced “Ending the HIV Epidemic, A Plan for America”—a 10-year initiative with the goal of reducing new HIV infections to <3000 per year by 2030 through a combination of intensified diagnostic, treatment, prevention, and outbreak response efforts [16]. At the same time, the United States Department of Agriculture has proposed a series of rule changes to the Supplemental Nutrition Assistance Program (SNAP)—the federal food safety-net program that has been proven to reduce food insecurity and provides an average of $1.39 per person per meal to 36 million Americans [17–22]. The Department of Agriculture estimates that these rule changes would result in the removal of nearly 4 million people from the program [23].

The most far-reaching of these proposed changes would modify “broad-based categorical eligibility,” a federal policy that automatically grants SNAP eligibility to families if they qualify...
for a Temporary Assistance for Needy Families (TANF)–funded benefit [24]. TANF is a federally funded block grant that is administered by the states and includes the TANF program itself (commonly referred to as welfare or cash assistance) and in some cases other noncash benefits. The income limit for SNAP eligibility is set at 130% of the federal poverty level (FPL), and the household asset limit is $2250 ($3500 for households with elderly or disabled members). However, because income and asset eligibility requirements for TANF-funded benefits are set by states and often start at higher levels, broad-based categorical eligibility allows some states to increase the income limit for SNAP eligibility to up to 200% of FPL and/or to increase or eliminate the limit on household assets. The proposed rule change would eliminate broad-based categorical eligibility as a way to raise the income or asset limit. The Department of Agriculture estimates that this would lead to a loss of benefits for an estimated 3.1 million people and 9% of participating households [25], with other analyses suggesting even greater decreases in the number of people eligible for SNAP [26].

Given the extensive literature linking food insecurity to HIV risk and HIV-related outcomes, we hypothesized that state-level policy changes that directly influence food insecurity could potentially compromise efforts to reduce HIV incidence in the United States. However, no such policy-relevant studies exist. To address this gap in the literature, we used US data from 2010 to 2014 to estimate the extent to which state-level changes to policy changes that directly influence food insecurity could potentially affect the annual incidence rate of HIV.

**METHODS**

**Data**

Our primary exposures of interest were 2 TANF policies that varied at the state level and directly impacted SNAP eligibility through broad-based categorical eligibility: (a) the income limit for eligibility as a percentage of the federal poverty level, ranging from 130% to 200%; and (b) the asset limit for eligibility, categorized as baseline ($2250 limit on household assets, $3500 for households with elderly or disabled members), increased, or eliminated [27]. These policies did not change more than once per calendar year in any state, and we included the policy status as of the start of each year in our analysis. Our primary outcome of interest was the number of new HIV diagnoses per state and year, as reported by the US Centers for Disease Control and Prevention (CDC) [28]. We obtained additional time-varying covariates for each state and year that were likely related to changes in policies affecting SNAP eligibility or the number of new HIV diagnoses: gross domestic product (GDP) [29], average cost of a meal for a food-secure household [30], unemployment rate [31], health expenditures per capita [32], housing price index [33], high school graduation rate [34], health uninsured rate [35], federal and state TANF spending (assistance and nonassistance) [36], state spending on SNAP outreach projects [37], and other policies affecting SNAP access included as components of the SNAP Policy Index of the Economic Research Service of the Department of Agriculture: Stigma Index (proportion of SNAP benefits in the state redeemed through electronic benefit transfer, whether there was a fingerprint requirement for SNAP), Outreach Index (whether the state had a federally funded radio or TV ad to raise awareness about SNAP among nonparticipants), and Transaction Cost Index (whether SNAP application can be submitted online, length of recertification periods, and whether there was a simplified reporting option to report change in household circumstances) [38]. For variables that varied on a monthly or quarterly basis, we included the annual mean in our analysis.

**Analysis**

We focused our analysis on 2010 to 2014 because all covariates of interest were available, and state-level policies affecting SNAP eligibility were in flux during this time period. We modeled the relationship between the 2 SNAP policies and the annual number of new HIV diagnoses using multivariable negative binomial (NB) regression models with the following generic form (Supplementary Appendix):

\[
\log(C_{jt}) \sim NB(\mu_{jt}, k_p)
\]

\[
\mu_{jt} = \alpha_j + P_j \beta + X_{jt} \delta + S_j \gamma - O_j t,
\]

where \(C\) is the number of HIV diagnoses for a state \(j\) in year \(t\); \(k\) is the dispersion parameter; \(\alpha_j\) is the year-specific intercept; \(P\) is the policy affecting SNAP eligibility (income limit or asset limit) for a state \(j\) in year \(t\); \(X\) is a vector of time-varying covariates; \(S\) is a state fixed effect; and \(O\) is the natural log of population size for state \(j\) in year \(t\), an offset variable.

The parameter of interest is \(\beta\), which denotes the association between policies affecting SNAP eligibility and the number of new HIV diagnoses. Holding other variables equal, a unit increase in \(P\) would be expected to be associated with a multiplicative change of \(e^\beta\) for \(C\). We calculated 3 effect estimates for each policy, reported as incidence rate ratios (IRRs) with 95% confidence intervals: (1) unadjusted, (2) adjusted for state and year fixed effects, and (3) adjusted for the fixed effects, the other policy (ie, both asset limits and income limits included in the model), and additional time-varying covariates.

**Sensitivity Analyses**

We performed a number of sensitivity analyses. First, we considered the asset limit a binary variable, with increased or eliminated asset limit compared with no change in the asset limit. Second, to ensure temporal ordering whereby the exposures precede the outcome, we fitted lagged models to estimate the relationship between policy changes and HIV diagnoses 1 and
2 years later. Third, because the number of new HIV diagnoses also depends on changes in HIV testing or reporting, we used the estimated annual incidence of HIV by the CDC as our outcome rather than the number of new HIV diagnoses [15]. Fourth, because there was no substantial change in our effect measure estimates with the addition of the time-varying covariates that were only available at 2010 to 2014, we looked at a longer study period, 2008 to 2016, but included only the policies affecting SNAP eligibility along with state and year fixed effects in the regression model. Finally, we excluded the District of Columbia, which was an outlier both in terms of high HIV incidence and average meal cost.

We performed statistical analysis using SAS, version 9.4, and R, version 3.5.2, using the ggplot2 package.

Data Sharing
Data sets are freely available for download from the Harvard Dataverse (https://doi.org/10.7910/DVN/ZED5BZ).

Patient Consent Statement
This study was not human subjects research and thus did not require ethical approval or patient consent.

RESULTS
There were 204 034 new HIV diagnoses in the United States from 2010 to 2014, with an annual incidence rate of 16.8 diagnoses per 100 000 persons in 2010, decreasing each year to a low of 14.9 in 2013 before increasing to 15.1 in 2014 (Figure 1). Within states, the rate of new diagnoses ranged from 1.5 per 100 000 persons in Wyoming in 2012 to 150.5 in the District of Columbia in 2010. The average per-person cost of a meal in a food-secure households increased over time during the study period (Figure 2). By changing their TANF eligibility policies, 8 states increased and 1 state decreased the income limit for SNAP eligibility during the study period (Table 1). Similarly, 15 states increased and 3 states decreased the asset limit for SNAP eligibility. No state increased and then decreased either the eligibility limit during the study period, or vice versa.

In unadjusted models (ie, with no fixed effects), the income limit and new HIV diagnoses were positively associated (IRR, 1.11 per increase in the income limit by 35% of the federal poverty level [FPL]; 95% CI, 1.01–1.23) (Table 2). There was no statistically significant relationship between new HIV diagnoses and either an increased asset limit (IRR, 0.92; 95% CI, 0.61–1.39) or an eliminated asset limit (IRR, 1.23; 95% CI, 0.99–1.53), relative to no change in the asset limit. With the addition of state and year fixed effects, the income limit was inversely associated with new HIV diagnoses (IRR, 0.94 per increase in the income limit by 35% of the FPL; 95% CI, 0.92–0.98). Neither increased asset limits (IRR, 0.96; 95% CI, 0.89–1.04) nor eliminated asset limits (IRR, 0.98; 95% CI, 0.94–1.03), relative to no change in the asset limit, had a statistically significant relationship with new HIV diagnoses. In the fully adjusted multivariable model that included both policies, state and year fixed effects, and additional time-varying covariates, new HIV diagnoses were inversely associated with the income limit (IRR, 0.94 per increase
in the income limit by 35% of FPL; 95% CI, 0.91–0.98), but not with either increased asset limits (IRR, 1.02 relative to no change in the asset limit; 95% CI, 0.94–1.10) or eliminated asset limits (IRR, 1.04 relative to no change in the asset limit; 95% CI, 0.99–1.10). Of the other time-varying covariates, unemployment rate, housing price index, and uninsured rate were inversely associated with new HIV diagnoses in the final multivariable model (Supplementary Table 1).

Results from sensitivity analyses were consistent with our primary analyses. Inclusion of the asset limit as a binary variable in the fully adjusted multivariable model again showed no significant relationship for the combination of increased or eliminated asset limit compared with no change (IRR, 1.03; 95% CI, 0.99–1.10). Lagged models showed an inverse relationship between income limit and new HIV diagnoses after 1 year (IRR, 0.97 per increase in the income limit by 35% of the FPL; 95% CI, 0.95–0.99) and 2 years (IRR, 0.97 per increase in the income limit by 35% of the FPL; 95% CI, 0.95–0.99) and no significant relationship between asset limit and new HIV diagnoses (Supplementary Table 2). Using estimated annual HIV incidence as the outcome rather than annual numbers of HIV diagnoses generated similar findings for income limit (IRR, 0.96 per increase in the income limit by 35% of the FPL; 95% CI, 0.91–1.00) and for increased asset limit (IRR, 0.97; 95% CI, 0.88–1.06) and eliminated asset limit (IRR, 0.99; 95% CI, 0.92–1.05) (Supplementary Table 3). Expanding the study period to 2008–2016 and including both SNAP policies and state and year fixed effects (but not the time-varying covariates) yielded similar effect measures for income limit (IRR, 0.95 per increase in the income limit by 35% of the FPL; 95% CI, 0.93–0.97) and for an increased asset limit (IRR, 0.98; 95% CI, 0.91–1.05) or eliminated asset limit (IRR, 1.02; 95% CI, 0.97–1.06) (Supplementary Table 4). Over this longer study period, 21 states changed the income limit and 29 states changed the asset limit for eligibility. Additional exclusion of the District of Columbia attenuated somewhat the relationship between the income limit and new HIV diagnoses (IRR, 0.97 per increase in the income limit by 35% of the FPL; 95% CI, 0.95–0.99) (Supplementary Table 4).

DISCUSSION

In this longitudinal, population-based study of policies affecting SNAP eligibility and new HIV diagnoses during 2010–2014, we found that an increase in the income limit for SNAP eligibility by 35% of the FPL was associated with a 6% decrease in the annual number of new HIV diagnoses. There was no association between changes in the asset limit for SNAP eligibility and HIV diagnoses. Our analysis controlled for unmeasured time-invariant differences between states and over time, in addition to a number of potential time-varying confounders including the cost of food, health spending and insurance, housing and employment, and SNAP outreach and social support spending through TANF. Our findings were robust to a number of sensitivity analyses, including using estimated HIV incidence rather than number of new HIV diagnoses, consideration of a longer study period, and lagged models between our exposures of interest and outcome. Lagged models both ensure temporal ordering and demonstrate persistence of the relationship over time—particularly important in the case of HIV, where diagnosis is often delayed.

There are currently 31 states with income limits for SNAP eligibility >130% the FPL. With 37,428 new HIV diagnoses in the United States in 2018, our findings imply that, all else being equal, decreasing the state income limits from their current level to 130% of the FPL may be associated with an additional 2,755 new HIV diagnoses, a >7% increase. On the other hand, increasing the income limit to 200% of the FPL for all states may be associated with 1,732 fewer new HIV diagnoses, a nearly 5% decrease. Proposals to eliminate the use of broad-based categorical eligibility to increase the income limit for SNAP eligibility could undermine the stated goal of the United States federal government reducing new HIV infections by 90% by 2030.

There are multiple plausible mechanisms by which restricting SNAP eligibility might increase the number of new HIV infections. In the United States, the communities and households

Table 1. Changes in State-Level Policies Affecting Eligibility for the Supplemental Nutrition Assistance Program (SNAP) from 2010 to 2014

| Income Limit for Eligibility | Asset Limit for Eligibility |
|-----------------------------|-----------------------------|
| Increased                  | DC, FL, HI, IA, MN, MT, NM, NC | AL, CO, DC, FL, HI, IL, IA, KY, LA, MN, MS, NE, NJ, NM, NC |
| Decreased                  | ME                           | ID, MI, PA |

Source: [37] (SNAP data tables).
most affected by poverty also have the highest prevalence of HIV, and SNAP is one of the most important federal programs to address poverty, specifically by targeting food insecurity [39]. Well-designed studies have shown that SNAP improves food security and reduces poverty [17–22, 40]. Treatment of HIV as prevention, also referred to as “Undetectable = Unsustainable” or “U = U,” has become a critical strategy for reducing the incidence of HIV worldwide [41–44]. In both high- and low-income settings, food insecurity has been found to be a barrier to the initiation of and adherence to antiretroviral therapy, as well as to regular clinical follow-up [2, 7, 12, 45, 46]. Food insecurity is also robustly associated with intervening variables that can in turn compromise adherence to antiretroviral therapy and HIV outcomes, including depression [47–51], substance use [52–55], and violence [56–58]. Consequently, a recent meta-analysis of 11 studies found that food insecurity was associated with a 29% lower odds of viral suppression for people with HIV [13]. By improving food security and thus potentially increasing antiretroviral therapy uptake, adherence, and, as a result, virologic control, SNAP may improve the effectiveness of HIV treatment as prevention. In addition, in people with and without HIV, studies have shown that food insecurity is associated with sexual practices that are higher risk for HIV acquisition or transmission, including exchanging sex for food or money [2, 4, 8–10, 14, 59–63].

This study builds on prior work that found that improved HIV outcomes were associated with overall spending on social services in the United States [64]. Our findings are also consistent with a number of other documented health-related benefits associated with SNAP, including a reduction in mortality, better self-assessment of health, and reduced psychological distress [65, 66]. Similar to how food-insecure people with HIV are less likely to regularly take antiretroviral therapy or attend clinical follow-up, families with young children that lose SNAP benefits have a greater odds of forgoing health care for family members [67]. There is some evidence of beneficial health effects for SNAP recipients that persist for decades [68]. While we did not identify a statistically significant association between asset limits and new HIV cases, it is important to note that there are other benefits associated with increased asset limits mediated by modest improvements in savings [24, 69, 70].

This study has several limitations. We use new HIV diagnoses as our primary outcome. New diagnoses are dependent both on new infections and changes in HIV testing coverage and case reporting. There were no major changes in testing or reporting requirements during the study period. However, if changes in the ratio of new infections to reported new diagnoses varied substantially within states over time in a way that was systematically different for states that changed policies affecting SNAP eligibility, our findings may be biased. To account for this possibility, we included measures of health spending and insurance as time-varying covariates and performed a sensitivity analysis using estimates of HIV incidence rather than new diagnoses. Our primary analysis focused on a time period during the Great Recession (during which there was an increase in food insecurity and a concomitant increase in need for SNAP) [71, 72]. This period was also largely before full implementation of the Affordable Care Act and must be interpreted in that context. The policies that we considered in this study also affected eligibility for TANF-funded services, but we controlled for the effect of TANF participation by including changes in TANF spending in our multivariable models. Because many of the covariates were available only on an annual basis, we were not able to assess the relationship between changes in policy and new HIV cases over more discrete time periods. If other unidentified policy changes were differentially associated with changes in broad-based categorical eligibility across states and also with changes in HIV incidence, our estimates could be biased, although the direction of the bias (either toward or away from the null) would depend on the nature of the putative confounding. Exemption from work requirements is a SNAP policy that varies on the substate level and might also have an important association with HIV diagnoses—we were unable to consider this in our analysis because of lack of available data [23].

### Table 2. The Relationship Between State-Level Policies Affecting Supplemental Nutrition Assistance Program (SNAP) Eligibility—Income Limit as a Percentage of the Federal Poverty Level and Asset Limit, Either Increased or Eliminated Compared With Baseline—and the Annual Number of New HIV Diagnoses From 2010 to 2014 Using Negative Binomial Regression Models

|                        | Unadjusted IRR (95% CI) | State/Year Fixed Effects IRR (95% CI) | Both Policies, Fixed Effects, and Time-Varying Covariates IRR (95% CI) |
|------------------------|-------------------------|--------------------------------------|------------------------------------------------|
| Income limit (per increase of 35% FPL) | 1.11 (1.01–1.23)         | 0.95 (0.92–0.98)                      | 0.94 (0.91–0.98)                                  |
| Asset limit            |                         |                                      |                                                |
| Baseline               | Ref                     | Ref                                  | Ref                                            |
| Increased              | 0.92 (0.61–1.39)         | 0.96 (0.89–1.04)                     | 1.01 (0.94–1.09)                                |
| Eliminated             | 1.23 (0.99–1.53)         | 0.98 (0.94–1.03)                     | 1.04 (0.99–1.10)                                |

Time-varying covariates include average meal cost in a food-secure household, health expenditure per capita, house price index, high school graduation rate, unemployment rate, uninsured rate, state spending on SNAP outreach, total TANF spending, SNAP Policy Stigma Index, Outreach Index, and Transaction Cost Index.

Abbreviations: CI, confidence interval; FPL, federal poverty level; IRR, incidence rate ratio; SNAP, Supplemental Nutrition Assistance Program.
CONCLUSIONS

In conclusion, we identified an inverse relationship between the income limit for SNAP eligibility and new HIV diagnoses between 2010 and 2014, consistent with prior evidence of broad health benefits from SNAP participation and with prior studies identifying the relationship between food insecurity and HIV infection. We found no significant relationship between the asset limit for SNAP eligibility and new HIV diagnoses. Our findings suggest that the proposed elimination of the use of broad-based categorical eligibility to increase the income limit for SNAP may undercut efforts to end the HIV epidemic in the United States.

Supplementary Data

Supplementary materials are available at Open Forum Infectious Diseases online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyrighted and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

Acknowledgments

Financial support. None.

Potential conflicts of interest. The authors declare no conflicts of interest. All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

Author contributions. A.R. conceptualized the study and designed it with A.C.T. and L.C.I., with critical feedback from J.P.B. A.R. wrote the first draft of the manuscript, which was critically reviewed by all authors.

References

1. Weiser SD, Young SL, Cohen CR, et al. Conceptual framework for understanding the bidirectional links between food insecurity and HIV/AIDS. Am J Clin Nutr 2011; 94:1729–38.
2. Chop E, Duggaraju A, Malley A, et al. Food insecurity, sexual risk behavior, and adherence to antiretroviral therapy among women living with HIV: a systematic review. Health Care Women Int 2017; 38:927–44.
3. Tsai AC, Hung KJ, Weiser SD. Is food insecurity associated with HIV risk? Cross-sectional evidence from sexually active women in Brazil. PLoS Med 2012; 9:e1001203.
4. Tsai AC, Weiser SD. Population-based study of food insecurity and HIV transmission risk behaviors and symptoms of sexually transmitted infections among linked couples in Nepal. AIDS Behav 2014; 18:2187–97.
5. Ivers LC, Cullen KA, Freedberg KA, et al. HIV/AIDS, undernutrition, and food insecurity. Clin Infect Dis 2009; 49:1096–102.
6. Feldman MB, Alexy ER, Thomas JA, et al. The association between food insecurity and HIV treatment outcomes in a longitudinal analysis of HIV-infected individuals in New York City. J Acquir Immune Defic Syndr 2015; 69:329–37.
7. Singer AW, Weiser SD, McCoy SI. Does food insecurity undermine adherence to antiretroviral therapy? A systematic review. AIDS Behav 2015; 19:1510–26.
8. Vogenthaler NS, Kushel MB, Hadley C, et al. Food insecurity and risky sexual behaviors among homeless and marginally housed HIV-infected individuals in San Francisco. AIDS Behav 2013; 17:1688–93.
9. Weiser SD, Leiter K, Rangabe DR, et al. Food insecurity is associated with high-risk sexual behavior among women in Botswana and Swaziland. PLoS Med 2007; 4:1589–97; discussion 1598.
10. Whittle HJ, Palar K, Naples T, et al. Experiences with food insecurity and risky sex among low-income people living with HIV/AIDS in a resource-rich setting. J Int AIDS Soc 2015; 18:20293.
11. Weiser SD, Fernandez KA, Brandson EK, et al. The association between food insecurity and mortality among HIV-infected individuals on HAART. J Acquir Immune Defic Syndr 2009; 52:342–9.
12. Weiser SD, Tsai AC, Gupta R, et al. Food insecurity is associated with morbidity and patterns of healthcare utilization among HIV-infected individuals in a resource-poor setting. AIDS 2012; 26:67–75.
13. Aibibula W, Cox J, Hamelin AM, et al. Association between food insecurity and HIV viral suppression: a systematic review and meta-analysis. AIDS Behav 2017; 21:754–65.
14. Ivers LC, Cullen KA. Food insecurity: special considerations for women. Am J Clin Nutr 2011; 94:1740–48.
15. Centers for Disease Control and Prevention. Estimated HIV Incidence and Prevalence in the United States, 2010–2016. HIV Surveillance Supplemental Report. Atlanta: Centers for Disease Control and Prevention; 2019.
16. HIV.gov. About ending the HIV epidemic: plan for America. Available at: https://www.hiv.gov/federal-response/ending-the-hiv-epidemic/overview. Accessed 1 October 2020.
17. Swann CA. Household income, SNAP participation, and food insecurity. Food Policy 2017; 73:1–9.
18. Gunder sen C, Kreider B, Pepper J, Taraskv V. Food assistance programs and food insecurity: implications for Canada in light of the mixing problem. Empir Econ 2017; 52:1065–87.
19. Gunder sen C, Kreider B, Pepper J. Partial identification methods for evaluating food assistance programs: a case study of the causal impact of SNAP on food insecurity. Am J Agricult Econ 2017; 99:875–93.
20. Gregory CA, Smith TA. Salience, food security, and SNAP receipt. J Policy Anal Manage 2019; 38:124–54.
21. Mabli J, Ohls J, Dragoset L, Castner L, Santos B. Measuring the effect of Supplemental Nutrition Assistance Program (SNAP) participation on food security. 2013. Available at: https://www.fns.usda.gov/measuring-effect-snap-participation-food-security-0. Accessed 1 October 2020.
22. Nord M, Prell M. Food Security Improved Following the 2009 ARRA Increase in SNAP Benefits, Economic Research Report, 262242. Washington, DC: US Department of Agriculture, Economic Research Service; 2011.
23. Richterman A, Ivers LC. Misaligned changes to SNAP - defending a public health intervention for the poor. N Engl J Med 2020; 382:1191–3.
24. Rosenbaum D. SNAP’s “Broad-Based Categorical Eligibility” Supports Working Families and Those Saving for the Future. Washington, DC: Center on Budget and Policy Priorities; 2019.
25. US Department of Agriculture. Proposed rules: revision of categorical eligibility in the Supplemental Nutrition Assistance Program (SNAP). Federal Register 2019; 84:35570–81.
26. Gunder sen C. The future of the Farm Bill: millions of people in need face an uncertain future as Congress debates SNAP. Medium. 15 October 2018. Available at: https://medium.com/ende hunger/the-future-of-the-farm-bill-e02341b3e704. Accessed 1 October 2020.
27. Economic Research Service (ERS), US Department of Agriculture (USDA). USDA SNAP policy database. SNAP policy data sets. 2020. Available at: https://www.ers.usda.gov/data-products/snap-policy-data-sets/. Accessed 1 October 2020.
28. Centers for Disease Control and Prevention. NCHHSTP Atlas Plus. 2019. Available at: https://www.cdc.gov/nchs/hatlas/index.htm. Accessed 1 October 2020.
29. US Department of Commerce, Bureau of Economic Analysis. GDP by state. 2020. Available at: https://www.bea.gov/data/gdp/gdp-state. Accessed 1 October 2020.
30. US Department of Labor Bureau of Labor Statistics. Local area unemployment statistics. Available at: https://www.bls.gov/lau/. Accessed 1 October 2020.
31. Centers for Medicare & Medicaid Services. Health expenditures by state of residence, 1991–2014. Available at: https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsStateHealthAccountsResidence. Available at: https://www.bls.gov/data/available-series.jsf?d=0. Accessed 1 October 2020.
32. Federal Housing Finance Agency. Housing Finance and Policy Priorities; 2019. Available at: https://www.fhfa.gov/DataTools/Downloads/Pages/Housing-Finance-Policy-Index.aspx. Accessed 1 October 2020.
33. US Department of Education National Center for Education Statistics. High school graduation rates. Available at: https://nces.ed.gov/fastfacts/display.asp?id=805. Accessed 1 October 2020.
34. US Census Bureau. Uninsured rate by state: 2008 to 2018. Available at: https://www.census.gov/library/visualizations/interactive/uninsured-rate-2008-2018.html. Accessed 1 October 2020.
35. US Department of Health and Human Services Administration for Children & Families, Office of Family Assistance Data & Reports. State TANF Data and Reports. Available at: https://www.acf.hhs.gov/ofa/programs/tanf/data-reports. Accessed 1 October 2020.
36. US Department of Agriculture. SNAP Data tables: national and/or state level monthly and/or annual data. 2019. Available at: https://www.fns.usda.gov/pd/supplemental-nutrition-assistance-program-snap. Accessed 6 January 2020.
37. Economic Research Service (ERS), US Department of Agriculture (USDA). SNAP Policy Database: interactive tool. Available at: https://www.ers.usda.gov/data-products/snap-policy-data-sets/snap-policy-index-interactive-tool/. Accessed 1 October 2020.
39. Denning P, Dineno E; Centers for Disease Control and Prevention. Communities in crisis: is there a generalized HIV epidemic in impoverished urban areas of the United States? Available at: https://www.cdc.gov/hiv/group/poverty.html. Accessed 1 October 2020.

40. National Academies of Sciences, Engineering, and Medicine. A Roadmap to Reducing Child Poverty. Washington, DC: National Academies Press; 2019.

41. Centers for Disease Control and Prevention. Evidence of HIV treatment and viral suppression in preventing the sexual transmission of HIV. 2018. Available at: https://www.cdc.gov/hiv/pdf/risk/art/cdc-hiv-art-viral-suppression.pdf. Accessed 11 May 2020.

42. Bavinton BR, Pinto AN, Phanuphak N, et al; Opposites Attract Study Group. Viral suppression and HIV transmission in serodiscordant male couples: an international, prospective, observational, cohort study. Lancet HIV 2018; 5:e438–47.

43. Cohen MS, Chen YQ, McCauley M, et al; HPTN 052 Study Team. Antiretroviral therapy for the prevention of HIV-1 transmission. N Engl J Med 2016; 375:830–9.

44. Rodger AJ, Cambiano V, Bruun T, et al; PARTNER Study Group. Risk of HIV transmission through condomless sex in serodifferent gay couples with the HIV-positive partner taking suppressive antiretroviral therapy (PARTNER): final results of a multicentre, prospective, observational study. Lancet 2019; 393:2428–38.

45. Ivers LG, Chang Y, Gregory Jerome J, Freedberg KA. Food assistance is associated with improved body mass index, food security and attendance at clinic in an HIV program in central Haiti: a prospective observational cohort study. AIDS Res Ther 2010; 7:33.

46. Lamb MR, El-Sadr WM, Geng E, Nash D. Association of adherence support and outreach services with total attrition, loss to follow-up, and death among ART patients in Sub-Saharan Africa. PLoS One 2012; 7:e38443.

47. Nagata JM, Palar K, Gooding HC, et al. Food insecurity is associated with poorer mental health and sleep outcomes in young adults. J Adolesc Health 2019; 65:805–11.

48. Dewing S, Tomlinson M, Le Roux JM, et al. Food insecurity and its association with co-occurring postnatal depression, hazardous drinking, and suicidality among women in peri-urban South Africa. J Affect Disord 2013; 150:460–9.

49. Tsai AC, Bangsberg DR, Frongillo EA, et al. Food insecurity, depression and the modifying role of social support: evidence from a population-based, prospective cohort of pregnant women in peri-urban South Africa. Soc Sci Med 2016; 151:69–77.

50. Tuthill EL, Sheira LA, Palar K, et al. Persistent food insecurity is associated with adverse mental health among women living with at risk of HIV in the United States. J Nutr 2019; 149:240–8.

51. Chen Y, Kalichman SC. Synergistic effects of food insecurity and drug use on medication adherence among people living with HIV infection. J Behav Med 2015; 38:397–406.

52. Anema A, Wood E, Weiser SD, et al. Hunger and associated harms among injection drug users in an urban Canadian setting. Subst Use Misuse Treat Prev Policy 2010; 5:20.

53. Normén I, Chan K, Braithwaite P, et al. Food insecurity and hunger are prevalent among HIV-positive individuals in British Columbia, Canada. J Nutr 2005; 135:820–5.

54. Whittle HI, Sheira LA, Frongillo EA, et al. Longitudinal associations between food insecurity and substance use in a cohort of women with or at risk for HIV in the United States. Addiction 2019; 114:127–36.

55. Conroy AA, Cohen MH, Frongillo EA, et al. Food insecurity and violence in a prospective cohort of women at risk for or living with HIV in the U.S. PLoS One 2019; 14:e0213365.

56. Diamond-Smith N, Conroy AA, Tsai AC, et al. Food insecurity and intimate partner violence among married women in Nepal. J Glob Health 2019; 9:010412.

57. Miller CL, Bangsberg DR, Tuller DM, et al. Food insecurity and sexual risk in an HIV endemic community in Uganda. AIDS Behav 2011; 15:1512–9.

58. Eaton LA, Cain DN, Pitpitian EV, et al. Exploring the relationships among food insecurity, alcohol use, and sexual risk taking among men and women living in Southern African townships. J Prim Prev 2014; 35:253–65.

59. Raiford JL, Herbst JH, Carry M, et al. Low prospects and high risk: structural determinants of health associated with sexual risk among young African American women residing in resource-poor communities in the South. Am J Community Psychol 2014; 54:243–50.

60. Oyefara JL. Food insecurity, HIV/AIDS pandemic and sexual behaviour of female commercial sex workers in Lagos metropolis, Nigeria. SAHARA J 2007; 4:626–35.

61. Dunkle KL, Jewkes RK, Brown HC, et al. Transactional sex among women in Soweto, South Africa: prevalence, risk factors and association with HIV infection. Soc Sci Med 2004; 59:1581–92.

62. Loosier PS, Haderxhanaj I, Beltran O, Hogben M. Food insecurity and risk indicators for sexually transmitted infection among sexually active persons aged 15–44, National Survey of Family Growth, 2011-2017. Public Health Rep 2020; 135:270–81.

63. Talbert-Slagle KM, Canavan ME, Rogan EM, et al. State variation in HIV/AIDS health outcomes: the effect of spending on social services and public health. AIDS 2016; 30:657–63.

64. Keith-Jennings B, Llobrera J, Dean S. Links of the supplemental nutrition assistance program with food insecurity, poverty, and health: evidence and potential. Am J Public Health 2019; 109:1636–40.

65. Helfin CM, Ingram SJ, Zilak JP. The effect of the supplemental nutrition assistance program on mental health indicators for sexually transmitted infection among sexually active persons aged 15–44, National Survey of Family Growth, 2011-2017. Public Health Rep 2019; 134:765–73.

66. Bailey MJ, Hoynes HW, Rossin-Slater M, Walker R. Is the social safety net a long-term investment? Large-scale evidence from the food stamps program. National Bureau of Economic Research Working Paper Series No. 26942. Available at: https://www.nber.org/papers/w26942. Accessed 1 October 2020.

67. Ettinger de Cuba S, Chilton M, Bovell-Ammon A, et al. Loss of SNAP is associated with food insecurity and poor health in working families with young children. Health Aff (Millwood) 2019; 38:765–73.

68. Bailey MJ, Hoynes HW, Rossin-Slater M, Walker R. Is the social safety net a long-term investment? Large-scale evidence from the food stamps program. National Bureau of Economic Research Working Paper Series No. 26942. Available at: https://www.nber.org/papers/w26942. Accessed 1 October 2020.

69. Nam Y. Welfare reform and asset accumulation: asset limit changes, financial assets, and vehicle ownership. Soc Sci Quart 2008; 89:133–54.

70. Powers ET. Does means-testing welfare discourage saving? Evidence from a change in AFDC policy in the United States. J Public Econ 1998; 68:33–53.

71. Coleman-Jensen A, Nord M, Singh A. Household Food Security in the United States in 2012. Washington, DC: US Department of Agriculture; 2013.

72. Gunderesen C, Ziliak JP. Childhood food insecurity in the U.S.: trends, causes, and policy options. Fut Children 2020; 7:33.