

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

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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

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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 the income or asset limit eligibility limits for SNAP 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):

$$\log(C_{jt}) \sim NB(\mu_{jt}, k_{jt})$$

$$\mu_{jt} = \alpha_t + P_{jt}\beta + X_{jt}\delta + S_j\gamma - O_{jt},$$

where C is the number of HIV diagnoses for a state j in year t ; k is the dispersion parameter; α_t 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 β , 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^β 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, 0.95 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

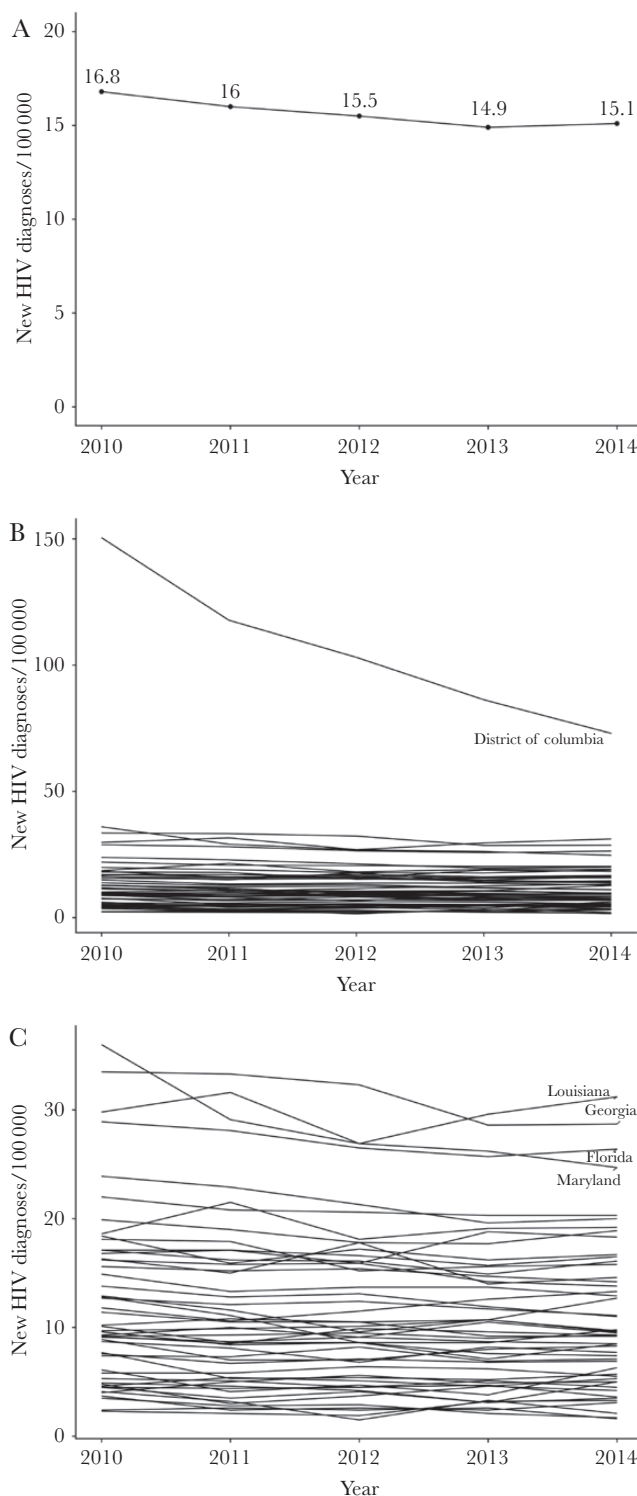


Figure 1. Annual incidence rate of new HIV diagnoses per 100 000 persons in the United States from 2010 to 2014 (A) nationally, (B) by state, (C) by state excluding the District of Columbia. Source: Centers for Disease Control and Prevention [28].

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

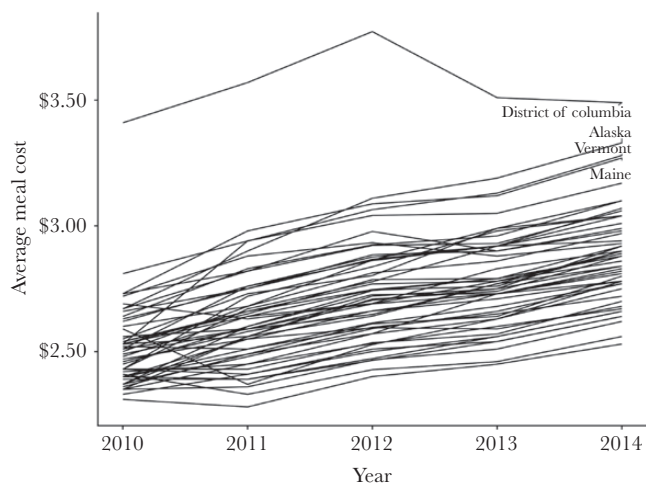


Figure 2. Average cost of a meal in a food secure household from 2010 to 2014 by state. Source: Gundersen et al [30].

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%

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).

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 TANE. 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 2755 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 1732 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 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		State/Year Fixed Effects		Both Policies, Fixed Effects, and Time-Varying Covariates	
		IRR	95% CI	IRR	95% CI	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.

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 = Untransmittable” 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].

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 copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

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