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UTILITIES AND TRANSPORTATION COMMISSION

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Surviving a Shut-Off: U.S. Households at Greatest Risk of Utility Disconnections and How They Cope

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Abstract

This is the first known study to estimate household characteristics and coping behaviors associated with utility disconnections in the United States. We capitalize on a measure of disconnections available in the Residential Energy Consumption Survey that is administered by the U.S. Energy Information Administration. Using the 2015 panel, we analyzed the prevalence of disconnection notices, disconnection of services, and related coping strategies, including: forgoing basic necessities, maintaining an unhealthy home temperature, and receiving energy assistance. Findings indicate that nearly 15% of U.S. households received a disconnection notice and 3%—more than three million households—experienced a service disconnection in 2015. Our results further demonstrate that more households resorted to forgoing basic necessities than maintaining an unhealthy temperature or receiving energy assistance, though many families used a combination of strategies to prevent or respond to the threat or experience of being disconnected. We discuss implications for future research on material hardships, survival strategies, and the health impacts of poverty.

Keywords

energy insecurity, energy policy, housing, poverty, social policy

Introduction

Social scientists have long been concerned with the realities and impacts of economic hardship and the survival strategies of the poor (Dominguez & Watkins, 2003; Du Bois, 2011; Edin & Lein, 1997; Ehrenreich, 2010; Jarrett & Jefferson, 2004; Newman,

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2009; Roberts, 1994; Stack, 1974; Venkatesh, 2009). It is now well understood that navigating the contours of poverty goes beyond income to include challenges with meeting basic needs such as housing and food (National Research Council, 1995). In fact, housing insecurity and food insecurity have been well integrated into analyses of poverty over the past two decades (e.g., Desmond, 2016; Sullivan, 2017; Tach & Edin, 2017). The identification of these domain-specific hardships has provided a conceptual basis for policy solutions including the expansion of food assistance and housing subsidies. Relatedly, researchers have illustrated the complex web of coping strategies used to manage material hardships such as juggling expenses (Edin & Lein, 1997; Tach & Greene, 2013), skipping meals (Hanson & Connor, 2014), mobilizing social networks (Dominguez & Watkins, 2003), accessing resources through institutional ties (Small, 2010), and doing so in socially acceptable ways (Sherman, 2006) albeit at times skirting formal reporting on family matters (Dodson & Schmalzbauer, 2005).

Within the material hardship literature there is a consensus on the importance of having access to home energy for cooking, lighting, heating, and cooling. The crises and survival strategies associated with energy insecurity—the struggle to avoid a utility disconnection and/or extreme temperatures inside the home—can be difficult to measure and are often conflated with housing insecurity. Like housing, residential energy is an integral part of everyday life. Utility services provide the means by which to heat and cool homes and to power lighting, refrigeration, water heaters, and the use of electronic and medical devices. Along with food and shelter, warmth also appears at the base of Maslow's "Hierarchy of Needs" (McLeod, 2007). The World Health Organization (2006) posits that access to domestic energy is a "prerequisite for good health." According to the U.S. Energy Information Administration (EIA), 37 million (or one in three) U.S. households face a challenge in paying their energy bills or sustaining adequate heating or cooling in their homes. This number is staggeringly high, particularly when compared with the number of food insecure households, which is estimated at 14 million (or 11%) of U.S. households (Coleman-Jensen et al., 2019). In addition to knowing very little about the experience and prevalence of "energy insecurity," we also lack an understanding of related coping strategies.

In this study, we use a nationally representative dataset to analyze the prevalence of utility service disconnection notices, termination of service due to nonpayment, and strategies for coping with such phenomena, including: forgoing basic necessities, maintaining an unhealthy home temperature, and receiving energy assistance. In so doing, this article makes an important and timely contribution to the social science literature by broadening our understanding of the landscape of economic hardship and the burdens of keeping up with household utility services.

Energy Insecurity as a Material Hardship and Matter of Survival

The concept of "*energy insecurity*" is defined as the "inability to adequately meet household energy needs" (Hernández, 2016b) which include heating, cooling, cooking, lighting, and the use of technological and medical devices. Hernández (2016b)

describes three dimensions of energy insecurity: economic, physical, and coping. First, the economic burden of paying utility bills in full and on time may be a consequence of low income, competing expenses, and/or energy inefficiencies that increase operational costs. Second, physical deficiencies in the home or its energy systems may negatively affect the comfort and cost of operating household appliances and energy-dependent equipment. Third, the coping aspect relates to mitigation strategies used to address the physical and economic aspects of energy insecurity. Other research has shown that energy insecurity is strongly linked to respiratory health symptoms, poor sleep, food insecurity, and adverse mental health outcomes (Cook et al., 2008; Hernández, 2016b; Hernández & Siegel, 2019).

Researchers have consistently overlooked or lumped together utility costs with other household expenditures. This has occurred even as advances in the social stratification research have led to an understanding of poverty that is based not on a discreet measure of income, but on a more nuanced appreciation of challenges in meeting a variety of basic needs. Notably, the definition and measurement of what constitutes a "material hardship" has varied substantially between studies (Heflin, 2016) and, as we will argue, critical omissions persist. For instance, Heflin et al. (2009) tested several models and concluded that a model with four distinct dimensions—housing, food, health, and bill paying—was most fitting to explain common, though unique, forms of material hardship. This is consistent with the broader literature where there is consensus across three domains: food, housing, and health care. However, the fourth category of needs, often referred to as "bill paying" or "essential expenses," has remained far more nebulous compared with the three aforementioned areas.

In the material hardships literature, there is little agreement across studies about what constitutes an essential need and this wide-ranging field consolidates consumables, commodities, and the economic penalties of poverty. Previous work suggests that these categories include, for example, clothing, transportation, household energy, telephone bills, childcare costs, credit card debt, student loans, and even criminal justice fees. Heflin et al. (2009) caution that conflating dimensions of hardship is misleading. This is especially true within the "bill paying" or "essential expenses" category, particularly as it relates to household energy. Ironically, Heflin et al. (2009; Heflin et al., 2011) define bill paying and utility hardship in the same way; both categories include housing costs (rent or mortgage) along with utility, telephone, and other household bills. We make a case that household energy services, namely—electricity, gas, and fuel oil—deserves independent examination given that they are (a) nondiscretionary and (b) as important as housing, food, and medical expenses given their critical role in supporting daily activities and sustaining health and well-being.

Extant literature has established that the need to satisfy basic needs can lead to complex survival strategies composed of formal and informal approaches to making do among the poor (Edin & Lein, 1997; Venkatesh, 2006). The seminal work of Edin and Lein (1997) on economic survival strategies explored income and expenditures among low-income families in the wake of welfare reform. The authors demonstrated that employment and benefits-based wages often fell short of covering most household expenses. In order to compensate for the shortfall, the single mothers in the study

relied on several strategies to supplement their income by leveraging resources from local agencies and personal networks, including doubling-up, sharing costs, and pooling resources across two or more families in high-rent markets. In addition to keeping up with the costs of everyday needs (Edin & Lein, 1997; Tach & Greene, 2013), the survival strategies framework has been used to explore how families maintain safety (Jarrett & Jefferson, 2004), retain social standing (Sherman, 2006), and manage economic pressures to produce income (Bourgois, 1995; Contreras, 2013; Venkatesh, 2006). Referring specifically to utilities, Heflin et al. (2011) found that families primarily relied on individual strategies such as bill juggling and partial payments to manage household energy bills. According to the authors, some families sought doctors' notes or secured discounts and other forms of assistance to avoid shut-offs for gas and electric services. On occasion, families caught up on arrearages using tax returns from the Earned Income Tax Credit. People also turned to family support when facing an imminent termination of utility services; others let their telephone services lapse for months at a time. It is nearly impossible to live without electricity and gas services for extended periods of time without facing severe consequences including limited food preservation and preparation options, loss of telecommunications access, and inability to heat, cool, or light one's home.

Hernández (2016b) further outlined energy-related coping strategies noting that families that encounter energy insecurity rely on alternative heating strategies such as using the oven or space heaters. They are also vigilant about the thermostat, often keeping the temperature at uncomfortable, inconvenient, or unhealthy levels to save on bills. Additionally, families negotiated payment plans with utility companies and also leveraged medical vulnerabilities to obtain shut-off protection letters from health care providers.

Klinenberg's (2001) study about the impacts of the 1995 heatwave in Chicago painfully details how older householders perished in their hot homes. According to medical examiner notes, some residents nailed their windows shut because of safety concerns, others relied solely on fans, still others had air conditioners in the off position as temperatures rose. Klinenberg's work illustrates how access to utility services can be a matter of life and death. While these preliminary studies are insightful, it is clear there is much to be learned about survival strategies of the poor when it comes to household energy issues, given its potentially fatal consequences.

Emerging Evidence on the Salience of Utilities Hardship

For many Americans, the ability to afford energy is a growing concern. Over the past four decades, U.S. households have become more reliant on electricity, natural gas, and other fuels and the costs for these energy services have increased. In 1975, the average retail price of residential electricity was 3.5 cents per kilowatt hour (kwh) and by 2005, it increased to 9.45 cents per kwh and has peaked at 12.89 cents in 2018 (EIA, 2019). At this rate, and with an average consumption of 867 kwh, the average American household receives an electricity bill of $111.67 per month. The confluence of rising costs and more intense energy uses presents new challenges for households

with low incomes. In their study of U.S. household energy expenditures from 1999 to 2017, Bohr and McCreery (2020) found that households spending at least 10% of their income on heating and electricity services experienced a 150% to 200% greater risk of transitioning into poverty than households spending less than 10% of their income on energy services. As both the consumption and the financial burden of energy increases, it is becoming more imperative for social scientists to understand the prevalence of disconnections and the coping strategies households use to keep the lights on, the stove hot, and the furnace running.

Social scientists have recognized household energy as a source of indebtedness for families with low incomes. For instance, when considering the sources and prevalence of household debt among low-income families, Tach and Greene (2013) found that 42% of participants reported utility arrearages averaging $873 for gas, electric, and phone bills. Utility arrearages, second only to credit card debt, were among the smallest sources of household debt, which typically ranged from $50 to $3,500, much less than mortgages, medical bills, or unpaid student loans. In one of the few studies looking at gas, electric, and water bills as distinct from rent or mortgage and telephone services, Finnigan and Meagher (2018) examined the prevalence and persistence of housing and energy burdens among low-income households. Their longitudinal assessment of the Survey of Income and Program Participation established that, compared with housing hardship, utility hardship was more common and persistent and impacted families that were more socioeconomically disadvantaged. Across various urvey of Income and Program Participation panels, the estimated prevalence of having missed a utility payment in the past year was between 5.8% and 6.9%, compared with having missed a rent or mortgage payment (2.5% to 4.1%) or both (4.1% to 5.7%). Importantly, those that faced utility hardships were more disadvantaged and more likely to be lower income, unemployed, renters, have children in the household, be unmarried, and be Black. Results further indicated that having a householder in poor health most often led to falling behind on utility payments, whereas income losses preceded missed housing payments. While this study identifies the antecedents of utility hardship, it does not go further to describe the consequences of utility hardship, including shut-offs, evictions, and foreclosures.

Disconnections (or shut-offs) are to utility hardship what evictions are to housing hardship—a crisis point. In fact, while studying evictions, Desmond (2016) demonstrated that shut-offs were a common occurrence among poor families. Unlike the tossing of one's property into the open for everyone to see during an eviction, energy service disruptions are often a private matter that can be shielded from public view. For this reason, it is a uniquely invisible social problem. Furthermore, compared with fixed housing costs, household energy costs can be controlled by managing consumption. However, an important aspect of utilities hardship is the limited predictability of monthly bills due to seasonal variation, rate changes, home efficiency levels, faulty appliances, and heating/cooling equipment. As a result, a householder may receive an unexpectedly high bill that can throw off their budget and lead to nonpayment. If they fall behind, the arrears can trigger a proximal crisis (a disconnection) and/or more distal crises (eviction or foreclosure), and present challenges

in the rehousing process. For instance, utility arrearages and past delinquencies can be a barrier to establishing a service account on relocation and missed utility payments can lead to bad credit scores. Though we have learned about the realities of eviction through Desmond's (2016) groundbreaking work, we still know very little about disconnections in the United States.

This study fills a critical gap as it examines the frequency of energy service disconnections and the factors that contribute to their occurrence. We analyzed a nationally representative data set and provide estimates of prevalence rates of disconnections—both notices and service interruptions due to nonpayment and examine their demographic, housing, and regional correlates in the United States. We further assessed the prevalence of strategies households use to prevent or respond to disconnections including trade-offs, conservation methods and seeking assistance. Unlike previous work on this topic, we explore the sacrificial strategies with physiological implications (i.e., extreme home temperatures, forgoing food and medicine) among energy insecure households. Doing so allows us to not only make the link between energy insecurity and disadvantage but also to explore its links to health. We later discuss the implications of our findings for future research on poverty, material hardship and survival strategies.

Data and Method

In 2017, the EIA (2018c) established that one in three (or 37 million) households in the United States was energy insecure. EIA categorizes households as energy insecure if the household reduced or went without basic necessities such as food or medicine to pay an energy bill, received a disconnection notice, or kept the home at an unsafe or unhealthy temperature. By this measure, EIA found that energy insecurity varied by region, urbanicity, housing type, fuel source, and perceived adequacy of insulation. Low-income, Black and Latino households, renters, and families with children were the most likely to be energy insecure. The energy insecurity indicators available in the Residential Energy Consumption Survey (RECS) differ from previous conceptualizations of the term in that rather than focusing on the three primary dimensions (physical, economic, and coping), they measure a proxy for economic hardship—disconnection notices—and two coping strategies regarding home temperatures and trade-offs in basic necessities. Despite this disjuncture, we capitalize on the 2015 RECS data set to provide a rare look the nationwide prevalence of energy service disconnections, the frequency of disconnection notices, and households' coping responses to the threat and experience of disconnection (EIA, 2018a).

RECS is a periodic study conducted by the EIA that collects data on energy-related characteristics and usage patterns from a nationally representative sample of housing units. The most recent RECS includes household data from 2015 ($N = 5{,}686$). Due to small sample sizes, no state level estimates are available for the 2015 RECS. All questionnaires were completed between August 2015 and April 2016. The survey uses a multistage area probability design to select a representative sample of U.S. households. The population for the 2015 RECS sample design included all housing units occupied as primary residences in the 50 states and the District of Columbia. To

produce population estimates, the sample cases are weighted to represent all households, including those not in the sample.

The 2015 RECS response rate was 51%. After the data were collected, the EIA conducted a nonresponse bias study (EIA, 2018b). The study compared response rates by subgroups and compared demographic variables with American Community Survey. The EIA concluded that final weighted RECS estimates—which include adjustments for nonresponse—are not statistically or practically different from the population. The EIA used a hot-deck process to impute missing data, replacing missing values with values from similar donor cases. Of all the variables used in this analysis, imputation rates range from a minimum of 0% (housing type, region) to 9.2% (income). Among the dependent variables used in this analysis, imputation rates do not exceed 1.7% (insulation).

We categorize a household as disconnected if the household reported not being able to use their main source of heat in the past year because at least one of the following three events happened: (a) the household "couldn't pay for electricity and it was disconnected;" (b) the household "couldn't pay for natural gas and it was disconnected;" or (c) the household "ran out of fuel oil, propane, kerosene, or wood because the household couldn't afford a delivery" (these are responses to a "select all that apply" question about potential reasons the household was unable to use the main source of heat). We next consider a household to be disconnected if, in response to a multipart question about whether there was a time the household was unable to use air conditioning and why, the household reported that they were unable to use their air conditioner or other cooling equipment because "you couldn't pay for electricity and it was disconnected." We do not condition our measure of disconnection based on the receipt of disconnection notices.

Those at risk of disconnection are measured by the frequency of disconnection notices. RECS reports the frequency of disconnection notices as "never," "1 or 2 months," "some months," and "almost every month." We combine "1 or 2 months" and "some months" into a single category—"some months."

Finally, we examine three coping strategies used by households who are struggling with energy insecurity: (a) reducing or forgoing expenses for basic household necessities, such as medicine or food, in order to pay an energy bill; (b) keeping the home at a temperature that the respondent feels is unsafe or unhealthy; and (c) applying for and receiving energy assistance to pay an energy bill, fix broken equipment, or to restore heating or cooling.[1] We further analyze combinations of these coping strategies to assess the prevalence of the following scenarios: (a) Strategies 1 and 2; (b) Strategies 2 and 3; (c) Strategies 1 and 3; (d) all three coping strategies; and (e) none of the three coping strategies. Therefore, our analysis of coping includes eight possible outcomes.

Modeling the Likelihood of Disconnection Notices and Disconnection

To understand whether demographic differences in the likelihood of disconnection notices and disconnections are altered once other correlates are controlled, we

estimate separate Bayesian logistic regressions predicting the probability of receiving disconnection notices and of being disconnected. We estimate the models using the stan glm function in the rstanarm package in R (Goodrich et al., 2020).[2]

Covariates in the model include household income,[3] race, and composition (children or elderly head present); education level of the household head; type of building (mobile home, single detached, single attached, apartment in two-four-unit building, apartment in 5+ unit building); unit characteristics (insulation level, built before/after 1980); and household location (Census region and rural/urban status)[4].

We measure race and ethnicity of the household head using a four-category variable: non-Hispanic White, non-Hispanic Black, Hispanic (any race), and non-Hispanic other race. In the RECS data, the fourth "other" race/ethnicity category includes those identifying as Asians (57%), multiracial (27%), and Native Americans (13%).

Based on findings from the eviction literature (Desmond, 2016; Sullivan, 2017), we expect those living in mobile homes to have a higher than average likelihood of receiving notices and experiencing disconnections. Prior literature suggests that households with children (Hernández et al., 2016) and the elderly (Klinenberg, 2001) are at particular risk of energy insecurity.

The risk of a disconnection is not only tied to the inability to pay; it is also a function of energy efficiency.[5] Based on results from the 2015 American Housing Survey, homes built in or before 1980 (at least 35 years prior) were more prone to inadequate heating capacity, poor insulation, and reports of being uncomfortably cold for 24 hours or more; all concomitants of the physical dimension of energy insecurity. Accordingly, we use 1980 as the cut off for analysis. We also include self-reported adequacy of insulation.[6] We predict that inadequate insulation will increase the likelihood of being disconnected because insulation reduces the marginal costs associated with both heating and cooling. American Housing Survey indicates that the presence of air conditioning is lowest among low-income groups. Low-income households are also more likely to use individual units or not use air conditioning at all compared with other income groups, which has implications for reliability, comfort, cost, and health. Previous regional studies have indicated that households in the South are more likely to experience economic burdens associated with energy (Drehobl & Ross, 2016; Hernández et al., 2014). Likewise, urban and rural disparities in energy burden have previously been explored with variations due to housing stock and demographic factors (Drehobl & Ross, 2016; Ross et al., 2018).

Modeling Coping Behaviors Based on Disconnection Status

To understand how coping behaviors vary by disconnection status, we use a multinomial model to predict the eight coping behaviors described above based on three categories of disconnection status: (a) never received a notice or experienced a disconnection; (b) received at least one notice, but did not experience a disconnection; and (c) experienced a disconnection. All households who experienced a disconnection fall under the third category; the rest of the households are divided into the first two categories based on whether the household received at least one

disconnection notice. We estimate this model using the brm function in the brms R package (Bürkner, 2017).

Findings

We first present descriptive rates of disconnection notices and disconnections for each of our independent variables. While some might argue that unconditional rates are not useful, we argue that descriptive rates are necessary to understand how the threat of disconnection is unevenly distributed across different subgroups. After the descriptive rates, we show the multivariate results, which allow us to assess differences after controlling for correlates.

The Prevalence of Disconnections

According to RECS data, 3,376,940 households experienced a disconnection at some point during 2015—approximately 3% of all households nationwide. To the extent that the RECS survey questions do not capture all types of disconnections and the experience of disconnection is underreported, our measure of disconnection is likely an underestimate of the true prevalence.

Figure 1 below shows the prevalence of disconnections in the RECS data by demographic and housing characteristics.

In addition to income, the prevalence of disconnections also varies by race, education, family composition, housing type, insulation level, and region. Disconnections are disproportionately high among households with low incomes, a Black head of household, a head who does not have a high school diploma, mobile homes, older homes, poorly insulated homes, rentals, rural homes, and homes in the Northeast. Among those households with an income less than $20,000, nearly 8% have experienced a disconnection—a rate that is about 2.5 times as high as those with incomes between $20,000 and $59,999. Those earning more than $60,000 have a 1% or lower disconnection rate. Households in mobile homes are more than twice as likely to experience a disconnection than households in other housing types, especially compared with those living in larger multifamily buildings and single-family homes.

The Prevalence of Disconnection Notices

A much larger share of the population has experienced the threat of disconnection than actual disconnections. Nearly, 15% of U.S. households received a disconnection notice in 2015. For disconnection notices, the RECS data provide detailed frequency measures. Table 1 below shows the prevalence and frequency of disconnection notices among U.S. households.

More than 17 million households received a disconnection notice, shut-off notice, or nondelivery notice at some point during 2015. Those who live in mobile homes face the highest risk of receiving a disconnection notice—nearly one in three received a

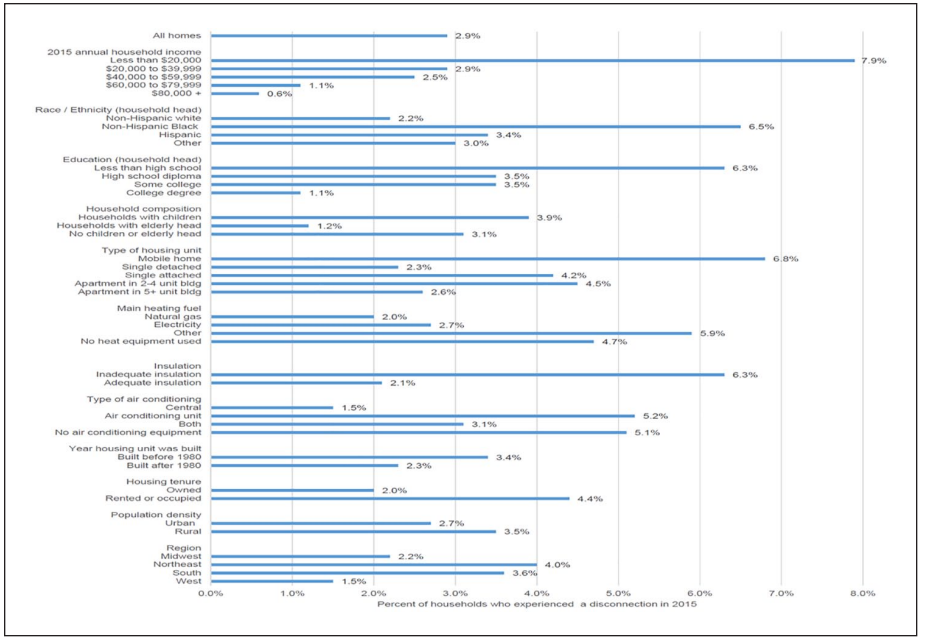

Figure 1. Weighted prevalence of household energy disconnections, 2015 Residential Energy Consumption Survey ($N = 5{,}686$).

notice in 2015. One in five rental households received at least one disconnection notice over the course of the year and those living in the South and Midwest were more likely to receive disconnection notices, which may reflect temperature extremes in these regions. The rural/urban divide was modest; rural dwellers were slightly more likely to receive disconnection notices.

Household heads who are Black, those without a college degree, and those with children are also highly represented among those who received disconnection notices, though disconnection notices are not as common among the elderly. Energy insecurity is not simply a manifestation of poverty or low socioeconomic status, as is evidenced by the fact that 38% of households who received one or more disconnection notices during the year had a gross income of $40,000 or higher and more than half were headed by someone with college experience.

Of all the housing types, mobile homes are most at risk of receiving disconnection notices throughout the year; closely followed by those households in smaller buildings, which may be small investment properties. Both of these housing types were featured prominently in Desmond's work and account for the most typical housing structures of unsubsidized housing for the poor (Desmond, 2016). Residents in larger buildings were the least burdened by disconnection notices, perhaps an indicator that units in larger buildings benefit from the insulating effects of neighboring apartments and/or energy cost-sharing with property owners and fellow residents. Compared with

Table 1. Prevalence of Disconnection Notices Among U.S. Households (Weighted Estimates) 2015 Residential Energy Consumption Survey.

	Frequency of receiving disconnection notices					
	Almost every month		Some months		Never	
Variables examined	Number	Percentage	Number	Percentage	Number	Percentage
All homes	2,318,301	2.0	14,877,426	12.6	101,012,567	85.5
2015 Annual household income						
Less than $20,000	916,869	4.0	4,381,306	19.2	17,561,018	76.8
$20,000 to $39,999	731,922	2.7	4,666,327	17.1	21,908,269	80.2
$40,000 to $59,999	245,735	1.3	2,648,374	14.4	15,513,089	84.3
$60,000 to $79,999	333,784	2.2	1,457,144	9.6	13,439,840	88.2
$80,000+	89,991	0.3	1,724,275	5.0	32,590,351	94.7
Race/ethnicity (household head)						
Non-Hispanic White	1,206,795	1.5	8,266,327	10.1	72,171,579	88.4
Non-Hispanic Black	640,623	4.9	3,072,677	23.4	9,434,970	71.8
Hispanic	199,562	1.3	2,606,571	17.4	12,221,111	81.3
Other	271,321	3.2	931,851	11.1	7,184,907	85.7
Education						
Less than high school	326,456	3.7	1,837,018	20.7	6,714,837	75.6
High school diploma	815,564	2.8	4,569,516	15.7	23,753,321	81.5
Some college	961,486	2.5	5,738,009	14.8	32,088,496	82.7
College degree	214,795	0.5	2,732,883	6.6	38,455,913	92.9

(continued)

Table 1. (continued)

Variables examined	Frequency of receiving disconnection notices					
	Almost every month		Some months		Never	
	Number	Percentage	Number	Percentage	Number	Percentage
Household composition						
Households with children	1,227,775	3.3	7,452,422	19.8	29,035,515	77.0
Households with elderly head	2,157,675	0.5	13,512,056	4.6	72,917,212	94.9
No children or elderly head	956,272	1.8	6,262,366	11.9	45,245,096	86.2
Type of housing unit						
Mobile home	485,322	7.2	1,588,319	23.4	4,713,400	69.5
Single detached	1,133,081	1.5	8,398,668	11.4	64,339,339	87.1
Single attached	135,120	1.9	949,037	13.5	5,925,977	84.5
Apartment in 2-4 unit building	152,192	1.6	1,725,736	18.4	7,514,307	80.0
Apartment in 5+ unit building	412,586	2.0	2,215,666	10.5	18,519,544	87.6
Main heating fuel						
Natural gas	650,876	1.1	7,325,263	12.7	49,691,376	86.2
Electricity	1,276,075	3.1	5,557,913	13.6	34,098,028	83.3
Other	277,713	1.9	1,428,174	9.9	12,765,213	88.2
Insulation						
Inadequate insulation	873,963	3.8	4,900,503	21.5	17,009,176	74.7
Adequate insulation	1,444,338	1.5	9,976,923	10.5	84,003,391	88.0

(continued)

Table 1. (continued)

Variables examined	Frequency of receiving disconnection notices					
	Almost every month		Some months		Never	
	Number	Percentage	Number	Percentage	Number	Percentage
Type of air conditioning equipment						
Central	1,119,816	1.6	7,149,200	10.1	62,415,949	88.3
Unit	731,971	2.7	4,610,195	17.3	21,374,326	80.0
Both	206,486	3.8	751,284	13.9	4,447,830	82.3
No air conditioning	260,028	1.7	2,366,747	15.4	12,774,462	82.9
Year housing unit was built						
Built before 1980	1,192,233	1.9	9,189,718	14.2	54,168,456	83.9
Built after 1980	1,126,068	2.1	5,687,708	10.6	46,844,111	87.3
Housing tenure						
Owned	967,011	1.3	6,576,389	8.8	66,963,163	89.9
Rented or occupied	1,351,290	3.1	8,301,037	19.0	34,049,404	77.9
Population density						
Urban	1,657,353	1.8	11,964,207	12.6	81,127,390	85.6
Rural	660,948	2.8	2,913,219	12.4	19,885,177	84.8
Region						
Northeast	390,229	1.9	2,337,966	11.1	18,278,356	87.0
Midwest	407,399	1.5	3,375,498	12.8	22,588,847	85.7
South	1,275,530	2.9	6,201,362	14.0	36,965,099	83.2
West	245,143	0.9	2,962,600	11.2	23,180,265	87.8

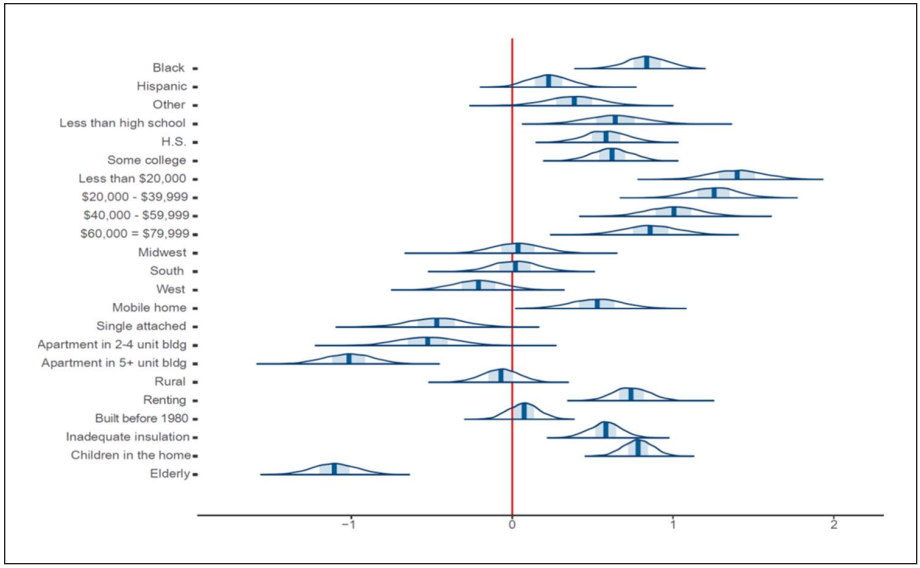

Figure 2. Logit coefficients from a Bayesian logistic regression model predicting receipt of disconnection notices.
Source. 2015 Residential Energy Consumption Survey ($N = 5{,}686$).
Note. References categories are as follows: race: White; education: college degree; income: $80,000+; region: northeast; type of housing: single detached; insulation: adequate; housing tenure: owned; housing year: build after 1980; household composition: no children or elderly.

residents of newer dwellings, households living in older units were more likely to receive disconnection notices some months out of the year.

The prevalence of disconnection is highly stratified based on perceived insulation level. Households reporting inadequate insulation were more than twice as likely to be issued disconnection notices throughout the year. Other energy-related features such as fuel type and type of air conditioning demonstrated higher disconnection notices among those relying on electricity for heat and individual units for cooling.

Predicting the Likelihood of Disconnections and Disconnection Notices

All of the prevalence rates we have reported so far show only bivariate relationships. Many of the nonincome disconnection patterns in Figure 1 and Table 1 might actually be the result of income. To measure the strength of the relationship between household characteristics and the odds of receiving disconnection notices and experiencing a disconnection, we conduct multivariate analyses.[7] Figure 2 below displays the logit coefficients from the Bayesian logistic regression model predicting receipt of at least one disconnection notice.

Perhaps not surprisingly, Figure 2 shows that the odds of receiving a disconnection notice increase as income decreases. What is notable about Figure 2 are the predictors

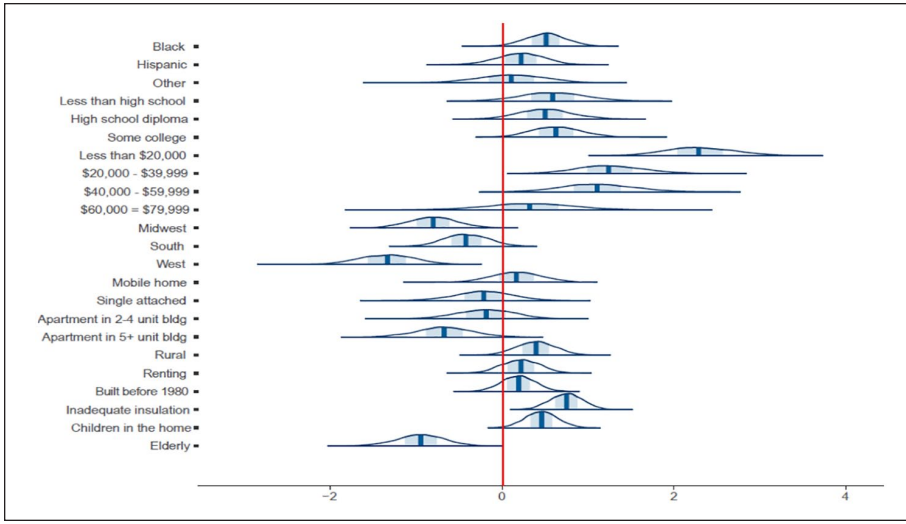

Figure 3. Logit coefficients from a Bayesian logistic regression model predicting disconnections.
Source. 2015 Residential Energy Consumption Survey ($N = 5{,}686$).
Note. References categories are as follows race: white; education: college degree; income: $80,000+; region: northeast; type of housing: single detached; insulation: adequate; housing tenure: owned; housing year: build after 1980; household composition: no children or elderly.

that are significant after controlling for income. Net of the effects of income, having a head of household who is Black or a household head who does not have a college degree are both associated with higher odds of receiving a disconnection notice. The risk of receiving a disconnection notice also remains disproportionately high among those households in mobile homes, those who report inadequate insulation, and households with children. Elderly households and households in large apartment buildings have relatively low odds of receiving a disconnection.

Figure 3 below displays the results of the logistic regression model predicting a disconnection.

The confidence intervals and the range of coefficient values are wider in Figure 3 than they are in Figure 2 because a disconnection is a rarer event than receiving a disconnection notice. After controlling for income, race, and education effects on the odds of experiencing a disconnection are attenuated. While disconnection notices do not vary significantly by region, the experience of being disconnected does. Households in the West are the least likely to experience disconnections; households in the northeast are the most likely to experience disconnections. Net of income and the other predictors in the model, the disadvantage of living in a mobile home and the advantage of living in a large apartment building become substantially smaller. Inadequate insulation (self-reported) remains a significant risk factor for experiencing a disconnection. Elderly households are more protected; households with children are more at risk of experiencing a disconnection compared with those without.

Coping Strategies

We next analyze how disconnection—both the threat and the experience—is associated with all possible combinations (eight combinations in total) of the three coping strategies captured in the RECS: (a) reducing or forgoing expenses for basic household necessities, such as medicine or food, in order to pay an energy bill; (b) keeping the home at a temperature that the respondent feels is unsafe or unhealthy; and (c) applying for and receiving energy assistance to pay an energy bill or to restore heating or cooling. Figure 4 shows the prevalence of the coping outcomes by disconnection status.

As the frequency of disconnection notices increases, there is a steady decline in the share of households with no measurable coping behaviors (bottom left box in Figure 4). Even among those households that have not received a disconnection notice, approximately one in five use one or more of these coping strategies. The number of households that rely on all three coping strategies increases with the escalating threat of disconnection and is highest among those in the disconnection category (bottom middle box in Figure 4). Giving up basic necessities is the most common of the three responses to the threat of disconnection. Whether alone or combined with other approaches, households in each of the disconnection status categories report forgoing basic needs.

Discussion

This is the first known study to estimate household characteristics and coping behaviors associated with utility disconnections in the United States. According to our conservative estimate, 3% of U.S. households—more than three million households—experienced a utility disconnection in 2015. Disconnection notices are more common than actual disconnections; nearly 15% of households received notices some months (12.6%) or almost every month (2%). While disconnections and disconnection notices were most prevalent among households earning less than $20,000, 2.5% to 3% of households earning between $20,000 and $60,000 also experienced a disconnection. Additionally, almost 12% of households earning above $56,516 (the national median income) received disconnection notices at least some months during the year, suggesting that this form of material hardship is not exclusive to the poor. In addition to income, those affected by disconnections and disconnection notices are more likely to be disadvantaged in other ways as well. Energy insecure households are more likely to: be Black, not have a college degree, have children in the household, be renters; or reside in a mobile home or a home that is older and not adequately insulated in the Northeast or Southern regions of the United States. These correlates indicate that energy insecurity is associated with social adversities that may be rooted in discriminatory housing policies and practices that have led to persistent racial residential segregation (Desmond, 2016; Massey & Denton, 1993). This segregation also affects utility costs because residents often endure inefficiencies due to poor housing quality (e.g., drafty windows, inadequate insulation, lack of repairs and upgrades) that drive higher costs. Given the disproportionate impact on Black renters in particular, more needs to be done to ensure that at-risk households have better access to energy efficient

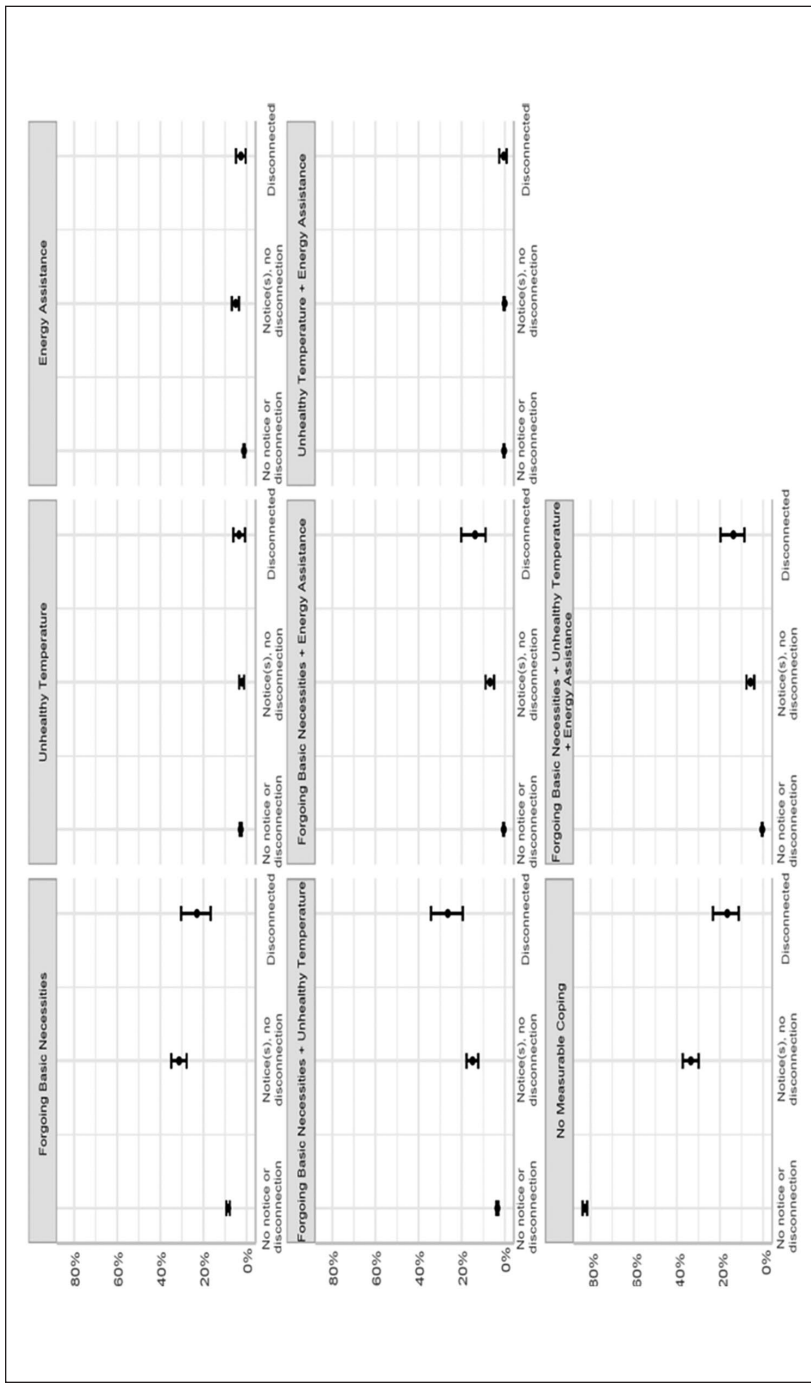

Figure 4. Coping outcome probabilities by disconnection status.
Source. 2015 Residential Energy Consumption Survey ($N = 5{,}686$).
Note. Probabilities estimated using a Bayesian multinominal model.

homes and that housing subsidies incorporate energy efficiency standards (Hernández & Bird, 2010; Lewis et al., 2019).

We analyzed three coping strategies on which families rely to mitigate energy insecurity in response to the experience or threat of disconnection including forgoing basic necessities, keeping an unhealthy temperature, or seeking energy assistance. Our findings indicate that households forgo basic necessities more often than maintaining an unhealthy temperature or receiving energy assistance, a finding that supports earlier evidence regarding trade-offs such as the "heat or eat" dilemma (Cook et al., 2008) and bill juggling as well as privately managing material hardships (Tach & Green, 2013).

Households with children were the most affected by disconnections and disconnection notices, signifying that families may not receive adequate financial support to meet their energy needs. Exposing children to trade-offs between food or medicine and energy, to unhealthy home temperatures, or to disconnections is detrimental to their health and development. When families lose utility service, they are placed at higher risk of investigation by child protective agencies. Energy insecurity may also lead to identity theft when parents or guardians use a child's identification to set up accounts (Hernández, 2016b). Future research should explore the impacts of shut-offs and the onerous pressures of coping with the threat of disconnection for households with children. At the other end of the life course, our results regarding the elderly are inconsistent with qualitative research and media accounts that describe the elderly as especially susceptible to extreme home temperatures (Klinenberg, 2001). We found that the elderly were largely spared from disconnections and disconnection notices. We posit two reasons for this finding. First, many states offer shut-off protections to older householders and those afflicted by particular medical conditions; if enrolled, both age-specific and medically based protections may bar older people from receiving disconnection notices and disconnections. Second, some of these protections are automatically generated with enrollment in energy assistance programs; elderly ratepayers with low income and fixed income are often eligible for these safety net benefits. Additional research, including objective measures of indoor temperature, are necessary to better understand how energy insecurity varies across the life course (Evans, 2004).

From a survival strategies perspective, previous literature indicates that economically fragile families prioritize some bills over others such that housing and food are first-order priorities, followed by other essential expenses including utility payments (Edin & Lein, 1997; Heflin et al., 2009; Heflin et al., 2011; Hernández, 2016a; Tach & Greene, 2013). As a result, many households are perpetually behind on their utility bills. It is known that low-income households commonly juggle bills, use tax refunds to pay down debt, turn to government and nonprofit agencies for subsidies and financial assistance, apply for shut-off protection from doctors, and, often as a last resort, seek help from friends and family (Edin & Lein, 1997; Hernández, 2016b; Tach & Greene, 2013). Our analysis presents a different possibility and a lesser acknowledged survival strategy—that households use their bodies as buffers against the effects of energy insecurity and by extension poverty. This "embodiment of

hardship" entails self-denial of other basic needs and comfort. Rather than seeking outside resources, affected households shield themselves against high costs by going hungry, managing without medication and enduring hotter or colder household temperatures than are comfortable or healthy. These approaches are more readily available and can be managed privately at the individual/household level without external intervention. In this sense, the body is a resource that can be leveraged for survival, as has been noted in other contexts (i.e., survival sex; Greene et al., 1999). The challenge with embodiment of hardship is that sacrificing food and medicine can compromise health and wellness, particularly for those managing chronic health conditions that disproportionately afflict socioeconomically disadvantaged groups (e.g., diabetes and hypertension). By resorting to unhealthy temperatures, households may experience extreme cold or heat, placing them at risk for hypothermia or heat stress. In the most extreme cases, these circumstances may provoke a different type of preventable crisis—death—especially among the elderly and medically vulnerable (Klinenberg, 2001). Energy insecurity and its incumbent survival strategies are thereby a threat to human dignity and life itself.

Policy Implications

The low usage of energy assistance in Figure 4 points to the need for a more robust "energy safety net" at the national (Low-Income Home Energy Assistance Program), state (shut-off restrictions), local (retrofit and emergency assistance) and utility (deferred payment plan) levels. Disconnection policies and standards vary widely across states (NAACP Environmental and Climate Justice Program, 2017). Energy providers, which include investor-owned companies, municipally managed utilities, and rural electric cooperatives, also differ in their disconnection practices. Most states require notification and a minimum time period before a disconnection for nonpayment can occur. Despite the notice, many households may not have the funds available to make the payments in time to avoid the crisis. Greater consumer protections are needed, including more resources for emergency assistance and ensuring that those who qualify for shut-off protections on the basis of age and medical status, are indeed enrolled. During the COVID-19 pandemic, many states implemented extended shut-off moratoria, which can serve as the basis for natural experiments examining household and utility outcomes stemming from this policy shift. It is well established that the federal energy assistance programs are underfunded, overextended, and unable to serve but a fraction of those who are eligible and might benefit (Bednar & Reames, 2020). The fact that Low-Income Home Energy Assistance Program dollars are exhausted early and may not be available to households in need throughout the year could explain the lower prevalence of energy assistance as a coping strategy. European scholars have established that energy efficiency upgrades and warm home interventions have many notable physical and mental health benefits while also reducing costs (Boardman, 2013; Howden-Chapman et al., 2012; Thomson et al., 2009). In addition to preserving and strengthening the Low-Income Home Energy Assistance and Weatherization

Assistance Programs, legislators should also consider a "basic energy allotment," akin to universal basic income or lifeline mobile phones, which can be enabled through renewably-generated energy to provide a basic levels of energy access.

Limitations

Our analysis highlights the multiple ways in which the threat of disconnection creates extreme hardships for U.S. families. Our analysis, however, is not without limitations. Our results are based on self-reported assessments of disconnections in the RECS, the best available source for national level estimates of this phenomenon. It is possible that the prevalence of disconnections may be much higher than our data suggest as our estimates rely on self-reported shut-offs and inability to pay for services. The availability of disconnection data directly from energy service providers is critical to more accurately characterize this problem and facilitate appropriate policy measures. Regulation to make these data publicly available will help researchers, advocates and policy makers better understand the true prevalence of disconnections and propose alternative approaches.

A second limitation is that our analysis assumes that forgoing basic necessities, keeping the home at an unhealthy temperature, and receiving energy assistance are responses to the threat of disconnection. Given that the RECS survey design is not longitudinal, we cannot, however, be certain about causality. The probability of reverse causation is low (i.e., it is unlikely that households receive a disconnection notice solely because they forgo basic necessities, keep their home at an unhealthy temperature, or receive energy assistance), but what we refer to as coping strategies may simply be experiences that are concurrent with the receipt of disconnection notices. Additionally, we do not factor seasonal moratoriums or whether households qualify for and are enrolled in shut-off protection programs or have initiated payment plans into our model.

Conclusion

As the cost of household energy rises, low-income households face greater precarity in their ability to meet basic needs. At the same time, the price of other necessities such as housing, food, and other consumables are steadily increasing, driving more competition for limited household economic resources. Using the emerging energy insecurity framework, we analyzed a nationally representative dataset to provide estimates of the national prevalence rate disconnections, disconnection notices, and coping responses, filling a critical gap in the poverty and material hardship literature. We argue that household energy constitutes a discrete material hardship, with corresponding survival strategies that should be further explored in future research and public policy efforts.

Declaration of Conflicting Interests

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Notes

1. Unfortunately the RECS does not identify those who applied for energy assistance but did not receive it. We use four variables in the RECS to create our measure of energy assistance. We consider a household to have received energy assistance if the household reports any of the following: (a) applied for and received energy assistance to help pay energy bills after disconnect notice, (b) applied for and received energy assistance to help restore heating, (c) applied for and received energy assistance to help restore cooling, or (d) participated in home energy assistance program that helps pay energy bills or fixes broken equipment (the last question is asked of everyone). Approximately 5% of the RECS sample (284 out of the 5,686 households in the RECS) report at least one of the four categories of energy assistance. We do not disaggregate our measure of energy assistance because of sample size limitations (e.g., only 14 households in the RECS report receiving energy assistance to help restore cooling). Our measure of energy assistance does not include efficiency upgrades (e.g., variables such as received utility or energy supplier rebate for new appliance or equipment). The RECS questionnaire does not define energy assistance, nor does it specify the programs that are included in energy assistance.
2. R code and data are available on the Open Science Framework (https://osf.io/s3wrd/).
3. In the RECS income data are gathered and reported in categories. The only adjustment we make to the RECS income categories is collapsing the top four income categories ($80,000-$99,999, $100,000-$119,000, $120,000-$139,999, and $140,000 or more) into one $80,000+ category.
4. Housing units in the RECS are classified using criteria created by the Census Bureau based on 2010 Census data. Urbanized areas are densely settled groupings of blocks or tracts with 50,000 or more people; urban clusters have at least 2,500 but less than 50,000 people. All other areas are rural. We consider both urbanized areas and urban clusters to be urban areas. Unfortunately the RECS data do not include state identifiers. A map showing the Census regions and their respective states is available at: https://www.census.gov/prod/1/gen/95statab/preface.pdf
5. We do not include energy assistance in our model predicting disconnections because the specific timing of disconnections and the receipt of energy assistance are not specified in the RECS data. Disconnected households with energy assistance could have received the energy assistance before or after the disconnection. Thus, we cannot measure where energy assistance prevents households from experiencing a disconnection or whether the assistance is secured in response to a disconnection.
6. The RECS insulation question asks respondents to categorize the insulation level of their home into one of four categories: well insulated, adequately insulated, poorly insulated, and not insulated. We collapse the first two categories into “adequate insulation” and the last two categories into “inadequate insulation.”

7. We do not include heating or cooling source characteristics in the model predicting the odds of disconnection because those characteristics could be the result of a disconnection (e.g., a household could report electricity as the fuel source because they are using an electric space heater after the gas has been disconnected).

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