



How Does Transportation Insecurity Compare and Relate to Other Indicators of Material Hardship in the U.S.?

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Abstract

Increasingly, researchers have used measures of material hardship (food, housing, utility, bills, medical) to better understand economic distress. Missing from this literature are hardships related to transportation. This descriptive paper uses recent nationally representative data and a newly validated measure of transportation insecurity to address gaps in our understanding of how transportation insecurity compares and relates to other indicators of material hardship. We find that transportation insecurity is a very common material hardship experienced by U.S. adults. The demographic groups most likely to experience transportation insecurity are also those disproportionately affected by other hardships, especially food insecurity. Additionally, we find that transportation and food insecurity are the hardships most likely to co-occur with other forms of hardship. Finally, we examine the association between these hardships and self-rated health and depressive symptoms, finding that transportation insecurity is similarly associated with these outcomes as food insecurity and unmet medical needs. Overall, these results suggest that transportation insecurity behaves similarly to other hardships, especially food insecurity, and underscores the importance of addressing transportation insecurity in efforts to reduce material hardship and improve overall wellbeing.

Keywords Transportation insecurity · Transport disadvantage · Food insecurity · Material hardship · Poverty · Inequality

1 Introduction

Every year, millions of households in the United States experience material hardship, either foregoing or having inadequate access to essential needs like food and housing (e.g., Finnigan & Meagher, 2019; Rodems & Shaefer, 2020). This is especially true among those living in lower-income households (Garfinkel & Pilkauskas, 2016; Pilkauskas et al., 2017).

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Although correlated with income, material hardship is also distinct in that it measures foregone consumption of basic needs vital to individual wellbeing and thus provides a different window into the experience of deprivation in America (e.g., Fuller et al., 2019; Gunderson & Ziliak, 2015; Siefert et al., 2000; Thornton et al., 2016).

In studying material hardship, researchers use a number of different indicators of hardship.¹ The most common measure whether an individual (or household) has experienced one or more of the following unique forms of hardship: food insecurity, housing insecurity, utility shutoffs, an inability to pay bills, and/or forgone needed medical care (e.g., Beverly, 2001; Heflin et al., 2009; Iceland & Bauman, 2007; Mayer & Jencks, 1989). Missing from this literature is any accounting of hardships related to transportation. This omission is notable given that, in the U.S., transportation ranks as the second biggest household spending category (Bureau of Transportation Statistics, 2022). Moreover, without adequate transportation, people find it difficult to reach destinations critically important to individual wellbeing, including work, the doctor, needed social services, the grocery store, and the homes of friends and family. For these reasons, over the years, researchers have repeatedly pointed out that transportation merits greater consideration in the study of material hardship (Beverly, 2001; Boushey et al., 2001; Campbell et al., 2022; Fletcher et al., 2005; Heflin et al., 2009; Iceland & Sakamoto, 2022; Ouellette et al., 2004). Yet heeding such calls has been difficult because no validated measure of transportation hardship has existed.

To address this, scholars recently developed the Transportation Security Index (TSI): a validated, individual-level measure that captures the experience of transportation insecurity, a condition in which an individual is unable to regularly get from place to place in a safe or timely manner due to an absence of resources needed for transportation (e.g., money for bus fare or car repairs, health for walking, social ties that can provide rides) (Gould-Werth et al., 2018; Murphy et al., 2021, 2024). Using this measure and original survey data, researchers documented that nearly 25% of adults in the U.S. experience transportation insecurity and found that it is highly correlated with poverty, low education, urban living, among other factors (Murphy et al., 2022). Using this same dataset, researchers have also demonstrated that transportation insecurity is associated with poor physical and mental health (McDonald-Lopez et al., 2023). But beyond this, we know little about this form of material hardship, especially in terms of how it compares—and is related—to other, more commonly studied types of hardship.

Building on recent work investigating transportation insecurity and the large body of research on material hardship, in this paper we draw on a unique nationally representative dataset that includes the Transportation Security Index *as well as* indicators of other, more commonly studied forms of material hardship (i.e., food insecurity, housing insecurity, unmet medical needs, utility shutoffs) to consider, broadly, how transportation insecurity both *compares* and is *related* to these other forms of material hardship. In doing so, our aim is to not only help researchers better understand transportation insecurity as a form of material hardship, but also to provide policymakers with insights regarding how different forms of material hardship are inter-related, thereby enabling them to craft policies that more effectively alleviate material deprivation.

To accomplish these aims, we conduct several descriptive analyses. To understand how transportation insecurity *compares* to other forms of material hardship, we examine

¹ There is relatively little agreement on what measures should be included in material hardship, how best to measure them, nor whether questions should specify that hardships are driven by financial constraints specifically (see Ouellette et al., 2004).

how prevalent transportation insecurity is among U.S. adults as compared with other commonly studied indicators of material hardship; whether the sociodemographic subgroups that experience transportation insecurity are similar (or different) to those that experience other forms of material hardship; and whether the correlates of transportation insecurity are similar to the correlates of the other forms of material hardship.

To understand how transportation insecurity is *related* to other forms of material hardship, we first analyze the extent to which individuals who experience transportation insecurity also experience other forms of material hardship (paying special attention to whether transportation insecurity is more likely to co-occur with certain types of material hardship). Because transportation enables people to access destinations like grocery stores, food pantries, doctors, or homeless shelters, transportation insecurity may compound the risks of experiencing other hardships. To examine this possibility, we consider the extent to which transportation insecurity is correlated with other types of material hardship.

Finally, because researchers are often interested in understanding the adverse consequences of material hardship on individual wellbeing, we investigate the association between transportation insecurity, the other forms of hardship studied here, and general indicators of physical and mental health. In prior research, transportation insecurity (McDonald-Lopez et al., 2023) and other hardships have been linked with physical and mental health outcomes (Alley et al., 2009; Desmond & Kimbro, 2015; Gunderson & Ziliak, 2015; Heflin & Iceland, 2009; Huang et al., 2021; Neckerman et al., 2016; Shaw, 2004; Yoo et al., 2009). However, no study has compared the relative association of transportation insecurity with health outcomes compared to other types of hardships. By doing so here, we aim to determine if the magnitude of the association between transportation insecurity and health is similar to that of other types of material hardship, which are typically studied as risk factors for poor mental and overall health.

Our analyses indicate that transportation insecurity is a highly prevalent form of material hardship experienced by U.S. adults. We also find considerable overlap in both the correlates and the sociodemographic subgroups who disproportionately experience transportation insecurity and each of the other forms of material hardship considered here. Additionally, we document a relatively high level of co-occurrence between transportation insecurity and other forms of material hardship. Despite high co-occurrence, we find that the correlations between transportation insecurity and other types of material hardship are low to moderate. This finding is consistent with the notion that transportation insecurity emerges from its own underlying process, capturing a distinct dimension of material deprivation. Finally, we find that transportation insecurity, food insecurity, and unmet medical needs, are the forms of material hardship most strongly associated with negative physical and mental health outcomes. Together, our findings suggest the importance of transportation insecurity as a common but often overlooked form of material hardship. Our analyses also indicate that transportation insecurity shares many similarities with food insecurity (in terms of prevalence, correlates, and associations with health measures)—a type of hardship that is more extensively studied and better understood, both empirically and from a policy perspective. To deepen our understanding of transportation insecurity as a form of material hardship we conclude with suggested future research that builds off these findings, with implications for the study of material hardship more broadly.

2 Background

Material hardship is a term used to capture the foregone consumption of items essential for individual wellbeing, such as food, housing, or medical care. First used in a study by Mayer and Jencks (1989), measures of material hardship were initially embraced by scholars interested in expanding the measurement of poverty in ways that would capture the actual experience of deprivation and thus provide a new perspective on what it means to live in poverty (Citro & Michael, 1995; Federman et al., 1996; Rector et al., 1999; Sen, 1999). Since then, material hardship measures have been used by researchers as indicators of economic distress more broadly.

Researchers who use material hardship measures generally consider them to tap into distinct aspects of wellbeing, beyond income-based measures. For one, unlike measures of income, measures of material hardship capture foregone consumption, or the experience of a material deprivation. As a result, they may better capture other non-earnings-based resources that are critical to making ends meet, such as assistance from family and friends or in-kind governmental transfers like housing or childcare assistance. In other words, two households with the same income may have different experiences of material hardship if one has help from family or savings and the other does not, a dynamic that cannot be captured with income-based measures alone. In addition, measures of material hardship capture experiences with deprivation that are not always tied to income in straightforward ways. Indeed, research shows that those who are income poor may not be consumption poor (Meyer & Sullivan, 2003, 2011) and that many individuals who do not live in poverty still experience material hardship (Boushey & Gunderson, 2001; Neckerman et al., 2016). Several studies show that the correlation between income and hardship is relatively low (as defined by Pearson's correlation; Beverly, 2001; Boushey & Gunderson, 2001; Mayer & Jencks, 1989; Sullivan et al., 2008), though longer spells of poverty are associated with more material hardship (Iceland & Bauman, 2007). Recent research on unconditional cash transfers has also found surprisingly small effects of providing cash on reductions in material hardship (e.g., Gennetian et al., 2024; Liebman et al., 2022; Pilkauskas et al., 2024), suggesting a complicated relationship between income and material hardship.

Although the experience of material hardship is not always related to income in straightforward ways, research investigating the prevalence of material hardship in the U.S. does find that those individuals with lower incomes are more likely to experience hardship than those with higher incomes (Heflin, 2017; Sullivan et al., 2008). Moreover, research has shown that those demographic groups that are more likely to experience poverty are, similarly, more likely to face material hardship. For instance, similar to poverty, adults who are younger, have less education, and are not White, typically face higher rates of material hardship (Iceland, 2021; Iceland & Sakamoto, 2022; Neckerman et al., 2016; Rodems & Shaefer, 2020). The same is true among people with disabilities (Heflin, 2017; Heflin et al., 2012; Parish et al., 2009; She & Livermore, 2007). Immigrant households also face elevated risks of material hardship, especially in terms of food insecurity (Chilton et al., 2009; Hernandez et al., 2016; Iceland, 2021; Rabbit et al., 2016). Single households, and in particular single mothers, are more likely than married couples to experience material hardship (Heflin, 2017; Lerman, 2002; Osborne et al., 2012; Rodems & Shaefer, 2020). Studies also find that urban households have a higher risk of experiencing hardship, particularly food insecurity (Conrad & Ronnenberg, 2022; Heflin, 2017).

While studies of the prevalence of material hardship demonstrate how common the experience of material hardship is, especially among certain demographic groups, studies

also show that hardship is associated with poorer outcomes. For example, children who are exposed to material hardships are at greater risk of behavioral problems (Gershoff et al., 2007; Schenck-Fontaine & Panico, 2019; Schenck-Fontaine & Ryan, 2022; Schenck-Fontaine et al., 2020; Zilanawala & Pilkauskas, 2012). Material hardship is also associated with poorer individual mental and physical health (see, e.g., Heflin & Iceland, 2009; Huang et al., 2021; Neckerman, et al., 2016; Yoo et al., 2009), and these associations remain net of poverty or income (Alley et al., 2009). That material hardship is linked with individual health outcomes is one reason why material hardship has received significant attention within public health circles recently (Braveman et al., 2011). Indeed, public health initiatives aimed at reducing health disparities have increasingly focused on addressing material hardship and other key social needs (Horwitz et al., 2020; Thornton et al., 2016; U.S. Department of Health & Human Services, 2025), and in healthcare settings, screening for different forms of hardship (such as food, housing, utilities, transportation) has become increasingly commonplace (Fraze et al., 2019).

Despite increased interest in the use of material hardship measures in the study of economic, physical, and emotional wellbeing, importantly, what exact constellation of indicators should be considered in such studies is not a settled matter (Beverly, 2001; Carle et al., 2009; Heflin, 2006; Heflin et al., 2009; Lerman, 2002; Ouellette et al., 2004; Short, 2005). For instance, researchers typically measure material hardship by considering whether an individual has experienced one or more of the following unique forms of hardship: food insecurity, housing insecurity, going without necessary medical care, and problems paying bills like utilities or telephone services (e.g., Beverly, 2001; Heflin et al., 2009; Iceland & Bauman, 2007; Mayer & Jencks, 1989). However, some studies also include consumer durables, housing quality, household crowding, or neighborhood conditions and crime as measures of material hardship (e.g., Iceland, 2021; Iceland et al., 2020; Schenck-Fontaine & Ryan, 2022), while others do not (e.g., Campbell et al., 2022; Shaefer & Gutierrez, 2013).

Another unresolved issue in this field of study is whether measures of material hardship should explicitly—and exclusively—tie the experience of hardship to financial constraints. While financial constraints surely play a critical role in foregone consumption, some researchers argue that it is important to understand individuals' material conditions, whether they arise because of a lack of income or other reasons (Ouellette et al., 2004). As much is reflected in the differences in the wording of different measures used by material hardship scholars. For instance, as Ouellette et al. (2004) point out, measures of material hardship that appear in the Survey of Income and Program Participation (SIPP), one of the most commonly used data sources for studying material hardship, do not explicitly tie hardship to economic constraint.² In contrast, another commonly used dataset in the study of material hardship, the Future of Families and Child Wellbeing study (FFCWS), includes wording that specifies that the hardships measured arose due to financial constraints. In short, it is still an open question about which measures of material hardship, and which approaches to measuring hardship, are the most appropriate and accurate for capturing the lived experiences and material needs of individuals.

As noted earlier, generally missing from most studies of material hardship are indicators of transportation-related hardship. Given that transportation-related costs make up a significant portion of household budgets (Bureau of Transportation Statistics, 2022) and the evidence that problems with transportation have adverse consequences on individual

² The one exception are questions derived from the USDA's validated food security index which ties symptoms of food insecurity to the inability to afford the costs of food.

wellbeing (e.g., Dobbs et al., 2018; Graboyes et al., 2022; McDonald-Lopez et al., 2023; Syed et al., 2013; Tadmon & Bearman, 2023; Ward & Walsh, 2023; Wolfe et al., 2020), several researchers have proposed that transportation merits greater consideration in the study of material hardship (Beverly, 2001; Boushey et al., 2001; Campbell et al., 2022; Fletcher et al., 2005; Heflin et al., 2009; Iceland & Sakamoto, 2022). In fact, a major 2004 report on the measurement of material hardship by the U.S. Department of Health and Human Services proposed that incorporating transportation might provide a “more complete picture of material hardship in the U.S.” (Ouellette et al., 2004, p. 17). However, despite this insight from two decades ago, following the recommendation to incorporate transportation-related hardship into studies of material hardship has been difficult for two reasons: First, no validated measure of transportation hardship has, until recently, existed. And second, almost none of the surveys that scholars typically rely upon to study material hardship include information on transportation-related hardship (see, e.g., the SIPP or FFCWS).³

Recognizing the importance of transportation, several material hardship scholars have added their own transportation hardship questions to original surveys (see, e.g., Yoo et al., 2009; Conrad & Ronnenberg, 2022; Jacob et al., 2022; Pilkauskas et al., 2024). However, each study varies in its approach and to the transportation questions used, making comparisons across studies challenging. Additionally, none of these studies compare or relate transportation hardship to other forms of material hardship. Thus, we have little insight into transportation insecurity as a component of material hardship.

Recognizing the need for a validated instrument that can measure transportation hardship, Gould-Werth, Murphy, and Griffin recently developed (2018) and validated (2021) the Transportation Security Index (TSI). Modeled after the Food Security Index (FSI) (National Research Council, 2006), the TSI was designed to measure transportation insecurity at the individual level based on the way people experience it qualitatively, regardless of mode of transit or geography. It does so by asking respondents whether, in the past 30 days, they have experienced several unique symptoms of transportation insecurity as observed in qualitative research. Symptoms include material aspects that reflect the difficulties people have getting from place to place in a safe or timely manner (e.g., skipping trips, arriving at destinations late). They also include relational symptoms that reflect the social strains and emotional toll of experiencing transportation insecurity (e.g., worrying about inconveniencing ride givers, feeling left out).⁴

³ To the extent that any of these surveys *do* include questions about transportation, it is usually a single binary question about car ownership (see, the FFCWS, for example). Yet as Gould-Werth et al. (2018) have pointed out, car ownership is not an adequate measure of transportation insecurity. Although cars are one way that people get around, even those with cars may not always afford repairs, gas, or insurance, and may forego needed travel.

⁴ Like the material hardship measures used in the SIPP, and in line with recommendations made by Ouellette et al. (2004) to measure material deprivation regardless of cause, none of the questions in the TSI tie the experience of these symptoms to costs or an inability to afford transportation. This decision reflects cognitive interviews conducted by the TSI research team that found that respondents did not always view their lack of transportation as a reflection of cost (see <https://poverty.umich.edu/research-funding-opportunities/data-tools/the-transportation-security-index/> for more information). For instance, a respondent might say bus fare is affordable, but they are still late or unable to get where they need to go because those buses are late or cancelled. The need to rely on a bus system that is un dependable, and to not have alternative transportation, however, also likely taps into an underlying lack of economic resources. Although the TSI does not specify if cost drove the experience of transportation insecurity, most of the other measures of hardship in our study do specify cost. Thus, there is some inconsistency across the hardship measures in this study. We are unclear how or whether this might affect our results but, as we note in the conclusion, exploring this may be a fruitful area for future research.

To date, the TSI has been used to generate prevalence estimates of transportation insecurity (nationwide and by subgroup) and examine its correlates (Murphy et al., 2022). It has also been used to assess the association between transportation insecurity and both physical and mental health (McDonald-Lopez et al., 2023). Yet without studying transportation insecurity alongside other commonly studied forms of material hardship in the same sample, it is difficult to determine if transportation insecurity is like other material hardships. Studying how transportation insecurity compares and relates to the other commonly studied forms of material hardship will help us better address this empirical question.

3 Data and Methods

3.1 Data

To understand how transportation insecurity is compared—and related—to other forms of material hardship, we use data from an original survey that was fielded in November 2022 using Ipsos' nationally representative panel, the Knowledgepanel®. Knowledgepanel® members are recruited through probability-based sampling methods, covering approximately 97 percent of all U.S. households. Ipsos provides free Internet service and a Web-enabled device to individuals without Internet access or a computer. The panel aligns with U.S. Census benchmarks (Yeager et al., 2011) and has been widely used in various social science and health peer-reviewed journals (e.g., Adler et al., 2025; Pedulla & Pager, 2019; Rowhani-Rahbar et al., 2022). The KnowledgePanel® sample frame's coverage of minority racial and ethnic groups and households with low incomes, groups of interest in this study, is better than that of most random-digit-dialing samples (Dennis, 2010).

The sample used for this study was restricted to U.S. adults aged 25 years and older to help ensure that the estimates for material hardship, including transportation insecurity, were not affected by the unique behaviors of college-aged adults. Because people living in poverty experience high rates of material hardship, individuals living at or below 100% of the federal poverty line were oversampled. In total, 5701 respondents were offered the opportunity to take the survey, 2702 completed the screening survey (47% response rate), and 2224 met the eligibility criteria for the study.⁵ After excluding missing data on our analytic variables, the final sample includes 2139 cases. To produce estimates that are nationally representative we apply Ipsos designed weights to account for the survey design.

3.2 Measures

3.2.1 Transportation Insecurity

To measure transportation insecurity, we utilize the Transportation Security Index (TSI), a validated survey instrument that was designed to capture experiences of transportation

⁵ To identify an initial oversample of adults with household incomes at or below 100% of the federal poverty line, Ipsos used already collected income data it had on file. Given that household income can easily fluctuate, Ipsos re-administered their standard household size and income questions at the beginning of the survey to ensure that respondents were screened on current—not dated—household income. Any panel members in the initial oversample who did not meet the income threshold for the oversample at the time of survey administration were screened out.

insecurity at the individual level irrespective of transit mode or geographic location (Gould-Werth et al., 2018; Murphy et al., 2021). The TSI asks respondents how often, in the past 30 days, they have experienced several unique symptoms of transportation insecurity as observed in qualitative research (e.g., skipping trips, being unable to leave the house when one wants to, feeling left out, worrying about inconveniencing one's social networks because of a need for help with transportation). None of the questions in the TSI explicitly asks whether respondents experienced these symptoms because of an inability to pay the costs of transportation (see Table 6 in the Appendix for full question wording). Following previously identified and validated methods for scoring the TSI (Murphy et al., 2021), TSI scores are calculated by summing responses across items (where often=2, sometimes=1, and never=0), with higher scores indicating higher levels of transportation insecurity. In this study, we use the TSI to construct a binary indicator of whether the respondent reports experiencing any transportation insecurity in the past month. We also use previously identified and validated cutpoints of TSI scores (McDonald-Lopez et al., 2023; Murphy et al., 2024) for capturing different categories of transportation insecurity in the general population.⁶

3.2.2 Other Material Hardships

Alongside transportation insecurity, we analyze five different forms of material hardship that have been commonly analyzed in the material hardship literature: (1) food insecurity, (2) housing insecurity, (3) unmet medical needs, (4) difficulty paying bills, and (5) utility shutoffs. Questions in our survey about hardship have been used in prior studies (e.g., Pilkauskas et al., 2023) and are derived from those used in the FFCWS (which were derived from the SIPP). Each question about hardship refers to experiences over the “past 30 days” (consistent with our questions about transportation insecurity) and most tie the experience of hardship to financial constraints. For each type of hardship, we create a binary indicator to categorize exposure.

Food insecurity is measured with the USDA's validated 6-item short-form food insecurity index (Blumberg et al., 1999; USDA, 2024). Scores range from 0 to 6, with higher scores indicating greater levels of food insecurity. We follow the USDA's recommendation and generate a binary indicator of the presence of food insecurity for scores of two or higher.

Housing insecurity is based on five survey questions that ask respondents whether they (1) moved in with other people because of a financial problem, (2) stayed in a shelter, (3) stayed in a place not meant for regular housing (e.g., an abandoned building, car), (4) were evicted or forced by a landlord to leave a home or an apartment due to not paying rent/mortgage, or (5) did not pay their rent or mortgage in full (response categories for the final question include “yes/paid the bill in full,” “no/paid some,” “no, skipped paying this bill,” and “NA/I don't pay this bill”). We create a binary indicator for housing hardship that captures an affirmative response to any of the first four questions or a response of “no”

⁶ Since an additional aim of the survey was to validate an abbreviated version of the TSI, approximately half of the respondents completed a 6-item short-form (with scores ranging from 0 to 12 and a defined cut point of 2 or higher for identifying transportation insecurity) while the other half of the respondents completed a 16-item long-form (with scores ranging from 0 to 32 and a defined cut point of 3 or higher for identifying transportation insecurity). Originally developed and validated as a 16-item measure (Gould-Werth et al., 2018; Murphy et al., 2021), the shorter 6-item measure was recently defined and validated on a nationally representative sample and has been shown to perform as effectively as the long-form at identifying those experiencing transportation insecurity (Murphy et al., 2024).

(which includes “no/paid some” or “no, skipped paying this bill”) to the last question about paying rent/mortgage in full.

Unmet medical needs is a binary indicator set to one if respondents affirmed any of the three following questions: (1) difficulties getting a prescription filled due to cost, (2) missed visits to see a doctor due to cost, or (3) missed visits to see a dentist due to cost.

Difficulty paying bills is based on three questions about whether the respondent was able to pay the following bills in full: (1) water, (2) gas, oil, or electric, and (3) phone or internet. Response options included “yes,” “no, but I paid some,” “no, skipped paying this bill,” or “NA/I don’t pay this bill.” We create a binary indicator for bill hardship based on whether they said they skipped paying the bill or they only paid some of the bill for any of these three questions.

Utility shutoffs is a binary indicator that captures whether any of the following services were cut off due to financial difficulties: (1) water, (2) gas, oil, or electric, (3) phone or internet.

3.2.3 Demographic and Socioeconomic Characteristics

We examine heterogeneity in the incidence of various types of hardships by key demographic and socioeconomic characteristics that have been shown in prior studies to be correlated with material hardship. These include: race/ethnicity (Black non-Hispanic, White non-Hispanic, Hispanic, or other non-Hispanic); age (25–39 years, 40–65 years, or over 65 years); education (less than a high school diploma, high school diploma, some college, or bachelor’s degree or more); gender; whether a respondent is currently living with any children younger than the age of 18; and nativity (U.S. born). We also consider disability status with an indicator for any hearing, vision, cognitive, ambulatory, self-care or “go-outside-home” difficulties, assessed using the series of 6 questions derived from the American Community Survey. Additionally, we examine differences by urbanicity (urban, suburban, rural) by matching respondents’ residential locations to tract-level information from the Urbanization Perception Small Area Index (Bucholtz et al., 2020). Lastly, we study differences by household income-to-needs ratio based on annual household income relative to the federal poverty level (FPL) that we categorize into five groups: 100% or less of the FPL, 101–200% of the FPL, 201–300% of the FPL, 301–400% of the FPL, more than 401% of the FPL. Table 1 shows the descriptive statistics for our study sample weighted to represent U.S. adults over the age of 25 in 2022.

3.2.4 Health & Wellbeing Outcomes

We examine the association between transportation insecurity, the five other forms of hardship, and two health and wellbeing outcomes that prior studies have shown to be associated with the measures of hardship considered here, including transportation insecurity: (1) self-rated health and (2) symptoms of depression. For self-rated health, respondents were asked the question, “In general, how would you rate your health?” The possible response options were “excellent,” “very good,” “good,” “fair,” or “poor.” We create a binary indicator for poor self-rated health that captures whether the respondent chose either “fair” or “poor” to describe their overall health. To assess symptoms of depression, we use the 7-item version of the validated Center for Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977). This self-report questionnaire asks respondents to rate the frequency of experiencing various depressive symptoms over

the past week. We create a binary indicator to identify individuals with symptoms of depression based on a recommended cutoff of 9 or higher on the CES-D.

3.3 Methods

Our data are cross-sectional. Therefore, rather than making any causal claims, our goal is to provide comparisons between transportation insecurity and other forms of material hardship. Specifically, we compare the prevalence, differences by demographic characteristics, and heterogeneity in the correlates of different forms of hardship and transportation insecurity. We do this to better understand how transportation insecurity compares to other, better-studied material hardships. For the prevalence and differences by subgroups, we present descriptive statistics weighted to be nationally representative of U.S. adults ages 25 and older in 2022 (the year our data were collected). For the correlates analysis, we run linear probability models regressing each type of hardship and transportation insecurity on the demographic characteristics. Although our outcomes are binary, we prefer the linear probability model for ease of interpretation. Logistic models yield similar results.

Next, to consider how transportation insecurity might relate to other forms of hardship, we investigate the overlap across types of hardship. First, we produce simple cross-tabulations to study whether individuals that experience one form of hardship (say food insecurity) also experience other measures of hardship (say housing insecurity). Second, we produce a simple correlation matrix to examine the extent to which the hardship variables (including transportation insecurity) are correlated with each other.

Finally, we use linear probability models to estimate, in turn, the associations between each of the hardship measures (including transportation insecurity) and mental and physical health variables. We do this to compare the strength of the observed association for transportation insecurity with those of other types of hardship. We first regress the two health outcomes on each hardship (including transportation insecurity), controlling for all the demographic covariates described above. Next, we run a single model for each health outcome that adds all of the forms of hardship into a single model, while still controlling for all the demographic characteristics.

4 Results

4.1 How Does Transportation Insecurity Compare to Other Forms of Material Hardship?

4.1.1 Prevalence

In Fig. 1, we begin by examining the prevalence of transportation insecurity as compared to other, more commonly studied forms of material hardship. This exercise helps us to better understand the prevalence of different types of hardship in our sample, based on a recent representative survey of the adult U.S. population. We find that in 2022, 19% of adults reported having experienced transportation insecurity in the past month. The second most commonly reported material hardship was food insecurity (16.4%), followed by unmet medical needs, such as going without needed medical care or prescriptions (13.2%).

Table 1 Sample description

	Percentage or mean
<i>Income-to-needs</i>	
100% or less of FPL	11
101–200% of FPL	14
201–300% of FPL	12
301–400% of FPL	11
More than 401% of FPL	52
<i>Race/ethnicity</i>	
Black non-Hispanic	12
Hispanic	16
White non-Hispanic	64
Other non-Hispanic	8
<i>Age</i>	
25–39 years	27
40–65 years	51
Over 65 years	22
<i>Educational attainment</i>	
Less than high school	9
High school	28
Some college	26
Bachelor's degree or higher	37
Married	61
Female	52
Children under 18 in the household	31
Born in the U.S	90
<i>Urbanicity</i>	
Rural	21
Suburban	52
Urban	27
Any limiting condition	22
<i>N</i>	2139

The sample includes adults aged 25 and older. All results are weighted to be nationally representative. Number of observations are unweighted

Nine percent of adults reported housing insecurity, 6.6% reported bill hardships, and 4.4% reported utility shutoffs.

4.1.2 Differences by Demographic Groups

To better understand if the demographic groups that experience transportation insecurity are the same groups that disproportionately experience other forms of material hardship, in Table 2, we examine the prevalence of different hardships stratified by sociodemographic characteristics (by row). We focus here on general patterns across sociodemographic groups, rather than specific levels of hardship.

We find that across hardships, sociodemographic groups exhibit patterns in line with expectations and prior research, and that those more likely to experience transportation insecurity are similar in terms of sociodemographic characteristics to those experiencing other hardship types. More specifically, we find that adults with lower incomes, less education, who are Black or Hispanic, younger, female, living with children, foreign-born, who have a limiting condition, and who live in urban areas are more likely to report transportation insecurity, as well as each of the various types of hardship.⁷ For example, Hispanic adults are the most likely to experience all forms of material hardship as compared to other racial/ethnic groups, and this result holds true for transportation insecurity. Similarly, we find that as education level increases, the prevalence of transportation insecurity decreases, a pattern that is very similar across different hardship types. Thus, it appears that the groups identified in prior research as disproportionately experiencing other forms of material hardship also experience higher rates of transportation insecurity.

4.1.3 Correlates of Transportation Insecurity and Material Hardships

Moving beyond bivariate associations, in Table 3 we examine the sociodemographic correlates associated with each of the types of material hardship and assess whether the correlates of transportation insecurity mirror those of other material hardships. This analysis is similar to the approach taken in Table 2, except here we study the association between each demographic characteristic, net of other covariates.

We find that income-to-needs remains associated with each hardship, even net of the other covariates, and the association is strongest for those with incomes below 200% of poverty. This association is evident for all six forms of hardship studied here, and we find that the point estimates for those living in poverty (under 100% FPL) are largest for transportation insecurity and food insecurity, suggesting poverty may be an especially strong correlate of these two forms of hardship.⁸

Although prior research suggests that race/ethnicity is associated with both overall hardship and specific hardship types (Iceland & Sakamoto, 2022), we find that only Hispanic adults are significantly more likely to experience transportation insecurity, food insecurity, bill hardship and utility shutoffs, as compared to White adults. However, net of other covariates, race/ethnicity is not associated with unmet medical needs or housing insecurity. Also, counter to our expectations, education is only weakly correlated with material hardship after adjusting for other covariates. Not having a high school degree is associated with a higher probability of experiencing unmet medical needs and housing insecurity (and marginally associated with food insecurity), as compared to having a

⁷ There are some exceptions to this pattern. For example, adults born in the U.S. are slightly more likely to report food insecurity than those born outside the U.S.

⁸ In a supplemental analysis, we also consider the correlation (Pearson's r) between income and each of the types of hardship. We do this because although studies show (as do we) that hardship declines with income, research also finds that the Pearson's correlation between material hardship and income is relatively low (e.g., Iceland & Bauman 2007; Levy 2015; Mayer & Jencks 1989; Rodems & Shaefer 2020; Sullivan et al., 2008). We conducted this supplemental analysis to better understand if we would see a similar relationship with transportation insecurity. We find that the correlation between a continuous measure of income-to-needs and transportation insecurity is 0.26. When we look at the other forms of hardship, we find the highest correlation is for food insecurity (0.29), followed by unmet medical needs (0.24), housing insecurity (0.19), bill hardships (0.19) and utility shutoffs (0.14). All of these correlations, including the one for transportation insecurity, are in line with estimates from prior studies (e.g., Mayer and Jencks (1989) who found that income explained 24% of the variation in material hardship, a correlation they described as "low" (p. 91)) and are considered "low" by common metrics of correlation.

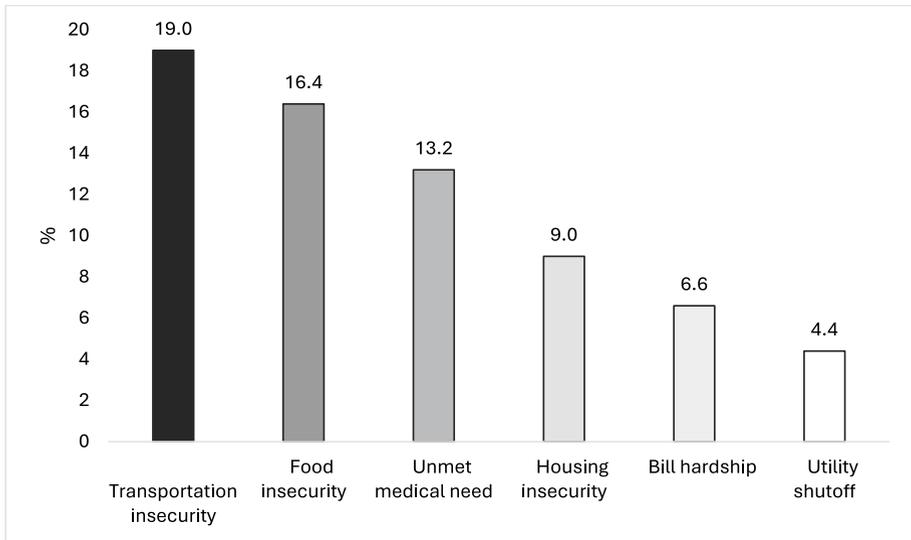


Fig. 1 Percent of adults experiencing transportation insecurity and other forms of material hardship, 2022. Notes: The sample includes adults aged 25 and older. Results are weighted to be nationally representative

college degree, but it is not significantly associated with transportation insecurity, bill hardship, or utility shutoffs.

Adults under age 65 are significantly more likely to experience all forms of hardship, including transportation insecurity, except for utility shutoffs. Foreign-born adults are significantly more likely to experience transportation insecurity, but nativity is not associated with any other hardship—the only statistically significant difference to emerge for transportation insecurity, specifically. Being unmarried is associated with a greater likelihood of experiencing transportation insecurity and food insecurity, but not other hardships. Living in an urban area, as compared to living in a rural area, is associated with greater likelihood of transportation insecurity and bill hardship, but not with other forms of hardship. Lastly, consistent with other research (e.g., She & Livermore, 2007), living with a disability is strongly associated with food insecurity, housing hardship, and unmet medical needs, but not bill hardship or utility shutoffs in these models. Having a disability is also strongly associated with transportation insecurity. In sum, we find that the correlates of transportation insecurity closely mirror those of the more commonly studied forms of hardship; however, it is worth noting that the correlates for transportation and food insecurity are more closely aligned than those for the other hardships. This may suggest that the underlying processes, or drivers, of these two forms of hardship are more similar.

Table 2 Prevalence of transportation insecurity and other forms of material hardship across sociodemographic subgroups (by row)

	Transportation insecurity (19.0%)	Food insecurity (16.4%)	Unmet medical needs (13.2%)	Housing insecurity (9.0%)	Bill hardship (6.6%)	Utility shutoff (4.4%)	N
<i>Income-to-needs</i>							
100% or less of FPL	45	44	26	21	21	12	883
101–200% of FPL	38	32	31	18	12	11	190
201–300% of FPL	19	21	20	10	7	3	153
301–400% of FPL	13	10	5	6	8	4	146
More than 401% of FPL	10	7	6	4	2	2	743
<i>Race/ethnicity</i>							
Black non-Hispanic	28	24	16	10	11	5	313
Hispanic	36	30	20	15	15	12	274
Other non-Hispanic	23	17	11	13	10	5	152
White non-Hispanic	13	11	11	7	3	2	1376
<i>Age</i>							
25–39 years	25	21	14	13	8	6	501
40–65 years	19	18	15	10	8	5	1116
Over 65 years	11	8	8	3	2	2	498
<i>Educational attainment</i>							
Less than high school	45	35	31	27	18	13	228
High school	20	22	18	11	10	6	762
Some college	17	16	12	7	4	2	542
Bachelor's degree or higher	13	8	7	5	3	3	583
<i>Marital status</i>							
Not married	31	25	18	14	9	7	1108
Married	11	11	10	6	5	3	1007
<i>Gender</i>							
Male	18	15	11	8	6	4	971
Female	20	17	15	10	7	5	1144

Table 2 (continued)

	Transportation insecurity (19.0%)	Food insecurity (16.4%)	Unmet medical needs (13.2%)	Housing insecurity (9.0%)	Bill hardship (6.6%)	Utility shutoff (4.4%)	N
<i>Presence of children under 18 in the household</i>							
No children	19	15	12	9	4	4	1465
Children	19	18	16	10	11	5	650
<i>Nativity</i>							
Born in the U.S	18	17	13	8	6	4	1960
Not born in the U.S	33	14	16	15	10	6	155
<i>Urbanicity</i>							
Rural	15	17	13	9	4	4	491
Suburban	15	12	12	6	5	3	1006
Urban	30	24	16	14	12	7	618
<i>Limiting condition</i>							
No limiting condition	14	12	9	7	6	3	1390
Any limiting condition	36	33	28	17	10	9	725

The sample includes adults aged 25 and older. All results are weighted to be nationally representative. Number of observations are unweighted

Table 3 Correlates of material hardships

	Transportation insecurity	Food insecurity	Unmet medical needs	Housing insecurity	Bill hardship	Utility shutoff
Income-to-needs (referent = 401% or more of FPL)						
Less than 100% of FPL	0.24** (0.04)	0.26** (0.04)	0.11** (0.03)	0.10** (0.03)	0.15** (0.03)	0.07** (0.02)
101–200% of FPL	0.21** (0.04)	0.18** (0.04)	0.19** (0.04)	0.09** (0.03)	0.06* (0.03)	0.07** (0.03)
201–300% of FPL	0.06 (0.04)	0.10** (0.04)	0.12** (0.04)	0.04 (0.03)	0.03 (0.02)	0.00 (0.02)
301–400% of FPL	0.00 (0.03)	-0.01 (0.03)	-0.04 (0.02)	-0.01 (0.03)	0.05+ (0.03)	0.00 (0.02)
Race/ethnicity (referent = White non-Hispanic)						
Black non-Hispanic	0.04 (0.04)	0.04 (0.04)	-0.02 (0.03)	-0.02 (0.03)	0.03 (0.03)	0.00 (0.01)
Hispanic	0.13** (0.04)	0.12** (0.04)	0.01 (0.03)	0.02 (0.03)	0.07* (0.03)	0.07** (0.03)
Other non-Hispanic	0.05 (0.05)	0.08+ (0.04)	0.00 (0.03)	0.05 (0.04)	0.06 (0.03)	0.03 (0.03)
Age (referent = over 65 years)						
25–39 years	0.12** (0.03)	0.12** (0.03)	0.08** (0.03)	0.10** (0.02)	0.03 (0.02)	0.02 (0.02)
40–65 years	0.08** (0.02)	0.10** (0.02)	0.08** (0.02)	0.08** (0.02)	0.03** (0.01)	0.02 (0.01)
Educational attainment (referent = BA or higher)						
Less than high school	0.08 (0.06)	0.05+ (0.05)	0.10* (0.05)	0.12* (0.05)	0.05 (0.04)	0.03 (0.03)
High school	-0.04 (0.03)	0.03 (0.03)	0.04 (0.02)	0.02 (0.02)	0.03+ (0.02)	0.00 (0.01)
Some college	-0.01 (0.02)	0.03 (0.02)	0.00 (0.02)	0.00 (0.02)	0.00 (0.01)	-0.02+ (0.01)

Table 3 (continued)

	Transportation insecurity	Food insecurity	Unmet medical needs	Housing insecurity	Bill hardship	Utility shutoff
Unmarried	0.10** (0.03)	0.05* (0.02)	0.02 (0.02)	0.02 (0.02)	0.01 (0.02)	0.02 (0.01)
Female	-0.01 (0.02)	-0.01 (0.02)	0.01 (0.02)	0.00 (0.02)	0.00 (0.01)	0.00 (0.01)
Presence of children in the household	-0.04+ (0.03)	-0.02 (0.02)	-0.01 (0.02)	-0.02 (0.02)	0.05** (0.02)	0.00 (0.01)
Foreign-born	0.11* (0.05)	-0.06 (0.04)	0.03 (0.04)	0.02 (0.04)	0.00 (0.03)	-0.01 (0.03)
Urbanicity (referent = rural)						
Urban	0.06* (0.03)	0.01 (0.03)	0.01 (0.03)	0.02 (0.03)	0.05* (0.02)	0.01 (0.02)
Suburban	0.01 (0.02)	-0.03 (0.02)	0.02 (0.02)	-0.01 (0.02)	0.01 (0.01)	0.00 (0.01)
Any limiting condition	0.15** (0.03)	0.14** (0.03)	0.15** (0.03)	0.07** (0.02)	0.01 (0.02)	0.03 (0.02)

The results are from linear probability models for adults aged 25 and older. All results are weighted to be nationally representative. The standard errors for coefficient estimates are in parentheses. Results in each column are from a separate regression model. $N=2115$
 + $p < .10$; * $p < .05$; ** $p < .01$

4.2 How is Transportation Insecurity Related to Other Forms of Material Hardship?

4.2.1 Co-occurrence of Hardships

Roughly seventeen percent (17.3%) of adults in our sample reported experiencing more than one type of material hardship.⁹ To understand the overlap between transportation insecurity and other forms of material hardship, in Table 4 we consider the co-occurrence of multiple hardship types in the sample. This table is organized into columns, where each column represents adults who reported experiencing a specific type of hardship. This setup allows us to examine, among adults who reported a particular type of hardship, the share who also simultaneously report other hardships.

Table 4 demonstrates that there is considerable overlap in exposure to different forms of material hardship. Starting with individuals experiencing transportation insecurity, we find that almost half (45.5%) of adults who experience transportation insecurity also face food insecurity, while 36.3% report also having unmet medical needs, 26.4% also experience housing insecurity, 20.4% face bill hardships, and 15.2% had utility shutoffs. When we focus on those who reported experiencing food insecurity, we observe a very similar pattern of overlap as seen with transportation insecurity. About half (52.5%) of those who reported experiencing food insecurity also reported experiencing transportation insecurity. Many also experience unmet medical needs (46%), housing insecurity (24%), bill hardships (27%) and utility shutoffs (19%). For both food and transportation insecurity, the pattern of overlap with the other hardships mirrors their overall incidence, where the prevalence of co-occurrence declines as the overall prevalence of each hardship item decreases. For example, utility shutoffs, the least common form of hardship, were the least prevalent hardship among adults experiencing food and transportation insecurity.

However, when we turn to adults experiencing other (less common) forms of hardship, the pattern of overlap with other hardships does not simply follow their prevalence; rather, the likelihood of experiencing additional hardships is generally very high. For example, among those experiencing housing insecurity, 74% also experience unmet medical needs, 63% experience food insecurity, and 56% face transportation insecurity. Among adults who experience utility shutoffs, 70% are food insecure, 65% transportation insecure, and 58% have an unmet medical need. Thus, although the pattern is less clear and consistent for these less common hardships—unmet medical needs, housing insecurity, bill hardship and utility shutoffs—we find that the likelihood of experiencing the other forms of hardship is generally very high among adults already facing these challenges.

4.2.2 Correlations Across Hardships

Finally, we consider how transportation insecurity is related to other forms of hardship by examining the correlations across hardship types, including transportation insecurity. As Table 5 shows, although many people in our sample reported experiencing multiple hardships, we observe only moderate correlations between the hardship indicators. The strongest correlations are between housing hardship and unmet medical needs (at 0.57), followed by unmet medical needs and food insecurity (at 0.43). With respect to transportation insecurity, the highest correlation observed is with food insecurity, at 0.38. In fact, most correlations are around 0.3, suggesting that although there is some correlation

⁹ In contrast, 15.4% of adults in our study reported experiencing only one hardship.

Table 4 Co-occurrence of transportation insecurity and other forms of material hardship

	Column %					
	Transportation insecurity (19.0%)	Food insecurity (16.4%)	Unmet medical needs (13.2%)	Housing insecurity (9.0%)	Bill hardship (6.6%)	Utility shutoff (4.4%)
<i>Hardships (%)</i>						
Transportation insecurity	–	52.5	52.3	55.6	58.7	64.9
Food insecurity	45.5	–	57.7	62.9	66.7	70.0
Unmet medical need	36.3	46.3	–	74.3	45.0	58.3
Housing insecurity	26.4	34.4	50.6	–	46.3	52.8
Bill hardship	20.4	26.8	22.5	34	–	45.5
Utility shutoff	15.2	18.9	19.6	26.1	30.6	–
<i>N</i>	636	599	411	310	272	183

The sample includes adults aged 25 and older. All results are weighted to be nationally representative. Number of observations are unweighted

across the various types of hardship, the magnitude is not high. The moderate correlation suggests that each form of hardship likely reflects a distinct underlying process.¹⁰

4.3 How Does the Association Between Transportation Insecurity and Physical and Mental Health Compare—and Relate—to Other Forms of Material Hardship?

As discussed earlier, both transportation insecurity and material hardship more generally have been found to be related to measures of health in prior research. In this analysis we compare the strength of the relationship between transportation insecurity and health outcomes with that of the other hardship types and health.

In Fig. 2, we show the point estimates for each type of material hardship, where we regress the two health outcomes on each material hardship, controlling for all the covariates listed in Table 1. The top panel shows the point estimates (and 95% confidence intervals) for models where we run the associations for each material hardship separately. The bottom panel shows the regression results after we put all of these hardships, including transportation insecurity, into a single comprehensive model (controlling for other types of hardship). Given the overlap in the experience of different hardships, the point estimates in the bottom panel are smaller in magnitude, but the substantive findings are similar across both approaches: transportation insecurity, food insecurity and unmet medical needs are all significantly associated with

¹⁰ Although we do not use an index or latent construct measure in this paper, in an extension, we also considered a latent construct of material hardship, with and without the inclusion of transportation insecurity, to examine whether inclusion improved the internal reliability or consistency of the measure. We did this by comparing the Cronbach's alpha across the two constructs, as a higher Cronbach's alpha suggests better internal consistency, or a superior measure of the underlying latent construct. We find a Cronbach's alpha of 0.75 for the measure without the inclusion of transportation insecurity. When it is included, the alpha increases to 0.78, suggesting even better reliability or internal consistency with its inclusion.

Table 5 Correlation matrix for forms of hardship

	(1)	(2)	(3)	(4)	(5)	(6)
(1) Transportation insecurity	1.00	–	–	–	–	–
(2) Food insecurity	0.38	1.00	–	–	–	–
(3) Unmet medical need	0.33	0.43	1.00	–	–	–
(4) Housing insecurity	0.29	0.39	0.57	1.00	–	–
(5) Bill hardship	0.27	0.36	0.25	0.35	1.00	–
(6) Utility shutoff	0.25	0.31	0.29	0.33	0.34	1.00

The sample includes adults aged 25 and older. $N = 2,139$

self-rated health and depressive symptoms, with coefficient sizes that are quite similar in magnitude. Specifically, transportation insecurity is associated with a 6-percentage point higher probability of poor self-rated health and a 11-percentage point higher probability of depressive symptoms (net of other hardships). Food insecurity is similarly associated with a 10-percentage point higher probability of poor self-rated health and a 14-percentage point higher probability of depressive symptoms. Unmet medical needs are also linked with both a higher likelihood of reporting poor self-rated health (8 percentage points) and depressive symptoms (14 percentage points). In contrast, housing hardship, utility shutoffs and bill hardships are not associated with the health outcomes (although housing is significantly associated with symptoms of depression when the other forms of hardship are not controlled).¹¹ However, the confidence intervals overlap across almost all hardship types and analyses; thus, the differences by hardship type may not be significant. In sum, our findings suggest that the association between transportation insecurity and health is similar in magnitude to that of food insecurity and unmet medical needs.

5 Discussion

To gain a better understanding of transportation insecurity as a form of material hardship, we descriptively compared and related commonly measured forms of material hardship (food insecurity, housing insecurity, utility shutoffs, bill hardships and unmet medical needs) to transportation insecurity, an understudied but prevalent form of material hardship. Using a nationally representative dataset that includes both traditional measures of material hardship and a newly validated measure of transportation insecurity—the Transportation Security Index—this study is the first to consider the extent to which transportation insecurity is related to other forms of material hardship, providing key insights into this form of material deprivation.

We find that roughly one in five Americans over age 25 experienced transportation insecurity in 2022. Although prior research has established transportation insecurity as a commonly experienced hardship (Murphy et al., 2022), no prior research has been able to compare across multiple forms of hardship to understand how transportation insecurity relates compares to other forms of hardship. We find that, like food insecurity, transportation insecurity is a commonly experienced form of hardship.

¹¹ Note, consistent with other studies (Desmond & Kimbro 2015; Shaw 2004), when we limit our housing hardships to more “extreme” hardships like living in a shelter or being homeless, we also observe a significant association with both health outcomes.

Consistent with other research on material hardship (e.g., Heflin, 2017), our analyses also show that transportation insecurity is experienced by the demographic groups who frequently experience other forms of hardship, such as those with low incomes or a limiting condition. Our correlates analyses further show that having an income below 200% of poverty is highly correlated with experiencing all forms of hardship. Interestingly, we find no evidence that Black adults are more likely to experience any form of hardship relative to White adults, net of other covariates; however, Hispanic adults were more likely to experience transportation insecurity, food insecurity, bill hardships and utility shutoffs. Nor do we find that education is strongly associated with most forms of hardship. These results are counter to prior research (Iceland & Sakamoto, 2022) but may be driven by the fact that we control for poverty-to-needs, which is highly correlated with both education and race/ethnicity.

When we relate transportation insecurity to other types of hardship, we find that those who experience transportation insecurity are more likely to also experience each of the other forms of hardship, a finding that likely reflects transportation insecurity's high prevalence (and similar correlates). Although material hardships often co-occur, we find evidence to suggest that transportation insecurity likely emerges from distinct processes as the correlations across hardships are low to moderate.

Finally, our analyses indicate that transportation insecurity is as strongly associated with physical health and depressive symptoms as food insecurity and unmet medical needs. Although prior research has demonstrated these associations (see, e.g., Gunderson & Ziliak, 2015; Huang et al., 2021; McDonald-Lopez et al. 2023), policy and interventions have traditionally focused less on transportation insecurity as a means of addressing health. That these three forms of hardship are all strongly associated with health suggests that future research should consider how addressing all of these forms of hardship might improve health outcomes.

Taken together, our analyses suggest several striking similarities between food insecurity and transportation insecurity. First, we find that they are both highly prevalent forms of hardship. Second, the pattern of overlap with other forms of material hardship is similar: among adults who experience transportation or food insecurity, many also experience unmet medical needs, whereas fewer experience utility shut offs — a pattern that differs significantly for other hardships. Third, the correlates for transportation and food insecurity are nearly identical, where there are some differences for the other hardships. This suggests that the underlying processes, or drivers, of these two forms of hardship might be similar. Finally, we also find that, along with unmet medical needs, both transportation insecurity and food insecurity are associated with health and depressive symptoms. In contrast, the other forms of hardship are less consistently associated (in terms of strength and statistical significance) with these two health outcomes.

It is also worth noting that the relationship between poverty and both transportation insecurity and food insecurity is stronger than that of other hardships (although they are all correlated). This raises important questions about the causes of different forms of material hardship. Prior research has shown that some hardships that are related to smaller, everyday expenditures, like food insecurity, tend to be sensitive to temporary income fluctuations. In contrast, hardships related to larger and less frequent, or more rare expenditures, like housing insecurity and unmet medical needs, likely arise because of longer-term economic constraints (Heflin et al., 2009; Schenke-Fontaine & Ryan, 2022). The relationship between transportation insecurity and income is less clear. On the one hand, the ability to get around can require people to pay for relatively small, daily expenses (e.g., gas, bus fare, paying friends and family for rides) which may mean that transportation insecurity is driven by small or frequent changes in a person's income that makes it difficult to cover such costs. On the other hand, people's ability to get around may require less

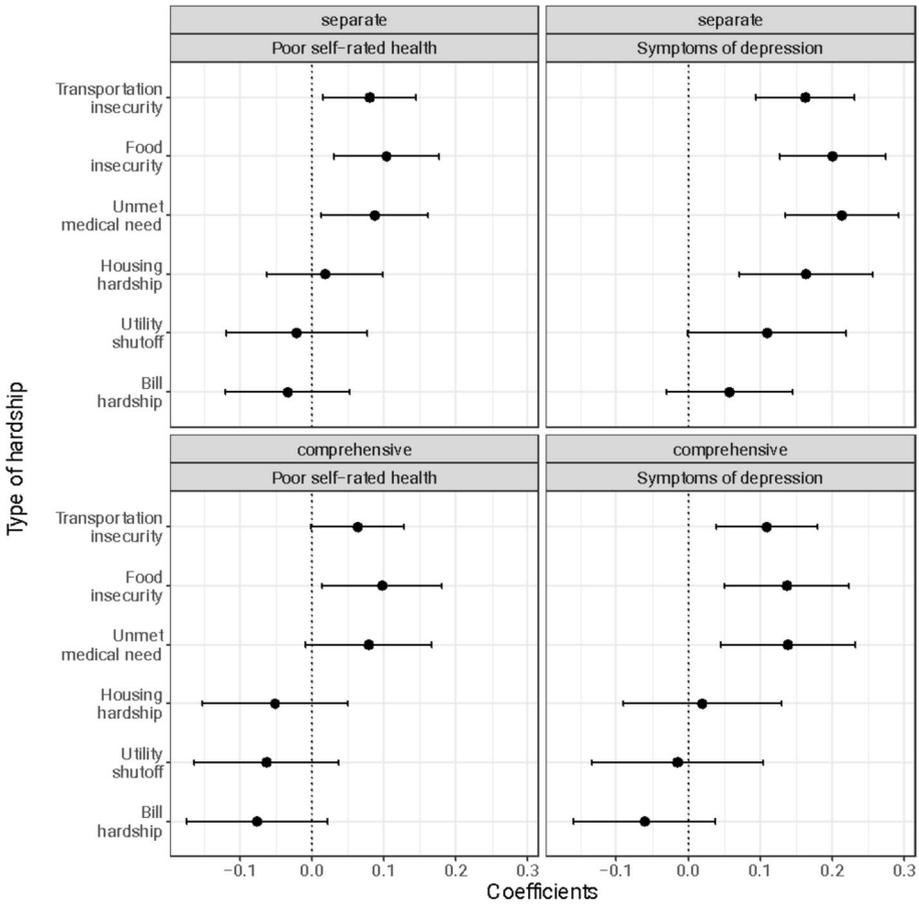


Fig. 2 Regression coefficients for the association between different types of hardship and poor self-rated health and symptoms of depression. Notes: Results in the top panel show estimates for models where we run the associations for each material hardship separately. Results in the bottom panel show the regression results after we put all the hardships into a single comprehensive model (controlling for all of the other hardships). All models include controls for income, race/ethnicity, age, educational attainment, marital status, gender, presence of children in the household, immigrant status, urbanicity, and disability status. All estimates are weighted. Error bars indicate 95% confidence intervals. N = 2059

frequent but more big-ticket expenses (e.g., purchasing a car, paying for car repairs) which might mean that transportation insecurity is, instead, driven by larger, more infrequent income shocks that render a person unable to afford these expenses. Our analyses suggest that the incidence and correlates of transportation insecurity are very similar to those of food insecurity. Given that prior research shows that food insecurity can arise from small changes in income, this suggests that transportation insecurity may be similarly influenced by small income shocks. Future research is needed to better illuminate the types of income shocks that can result in transportation insecurity, which is critical for informing policies aimed at addressing this form of material hardship.

Our findings suggest other avenues ripe for future exploration. For example, it is plausible that one form of hardship leads to another. If, say, an individual is transportation insecure, they may be unable to go to the doctor which could lead to medical hardships. Although we found low to moderate correlations across hardships, we were not able to explore how different forms of hardship might interact with, and lead to, one another. Future research that can disentangle (1) whether experiences with transportation insecurity lead people to experience other forms of material hardship, (2) whether experiencing other forms of material hardship leads people to experience transportation insecurity or, (3) whether people's experience with transportation insecurity and other forms of material hardship arise at the same time, would help policymakers in determining where to target resources to mitigate further experiences of material deprivation.

We also note that the Transportation Security Index does not specify that transportation hardships arise due to lack of finances, because the results of cognitive testing at the measure development stage suggested that such specification limited, rather than enhanced, the precision of measurement. In contrast, the other measures included in our study largely do specify cost as the driver of the hardship, a potential limitation of our study. Given the disagreement among hardship researchers regarding whether costs should be included in survey questions, or whether all incidents of hardship (regardless of how they arose) should be included in measures of material hardship (Ouellette et al., 2004), future research that includes cognitive testing of survey questions and item validation would help shed light on this topic.

The Transportation Security Index was conceptualized and validated as an individual-level measure. Future research that considers how transportation insecurity might operate at the household level would be a useful next step. Because our sample was nationally representative the number of people most vulnerable to experiencing material hardship—those with low incomes—was relatively small. Researchers should consider fielding future surveys with large sample sizes comprised of people at, or below, 200% of the poverty line that include the Transportation Security Index as well as other forms of material hardship. Doing so would enable scholars to build upon this work. For instance, following studies that have shown that traditional measures of material hardship are associated with poorer outcomes for children (e.g., Heflin & Iceland, 2009; Zilanawala & Pilkauskas, 2012), researchers could examine the impacts of a parent's experience with transportation insecurity on the outcomes of children in the household.

Clearly, much remains to be learned about transportation insecurity as a form of material hardship. This descriptive study was the first step in such an endeavor. With the development and validation of the Transportation Security Index, material hardship scholars can now heed their own call for a deeper understanding of transportation as a form of material hardship by incorporating this validated measure into their studies. In doing so, researchers will not only help us better understand transportation as a hardship, but they will also provide us with a “more complete picture of material hardship” experienced by people in the United States (Ouellette et al., 2004, page 17).

Appendix

See Table 6.

Table 6 Full question wording for the 16-item Transportation Security Index**

To get to the places they need to go, people might walk, bike, take a bus, train or taxi, drive a car, or get a ride. In the past 30 days, how often were you late getting somewhere because of a problem with transportation?

In the past 30 days, how often did it take you longer to get somewhere than it would have taken you if you had different transportation?

There are times when we need to wait for transportation to pick us up. In the past 30 days, how often did you spend a long time waiting because you did not have the transportation that would allow you to come and go when you wanted?

In the past 30 days, how often did you have to arrive somewhere early and wait because of the schedule of the bus, train, or person giving you a ride?

In the past 30 days, how often did you have to reschedule an appointment because of a problem with transportation?

In the past 30 days, how often did you skip going somewhere because of a problem with transportation?

In the past 30 days, how often were you not able to leave the house when you wanted to because of a problem with transportation?

In the past 30 days, how often did you worry about whether or not you would be able to get somewhere because of a problem with transportation?

In the past 30 days, how often did you feel stuck at home because of a problem with transportation?

In the past 30 days, how often do you think that someone did not invite you to something because of problems with transportation?

In the past 30 days, how often did you feel like friends, family, or neighbors were avoiding you because you needed help with transportation?

In the past 30 days, how often did you feel left out because you did not have the transportation you needed?

In the past 30 days, how often did you feel bad because you did not have the transportation you needed?

In the past 30 days, how often did you worry about inconveniencing your friends, family, or neighbors because you needed help with transportation?

In the past 30 days, how often did problems with transportation affect your relationships with others?

In the past 30 days, how often did you feel embarrassed because you did not have the transportation you needed?

**Items that appear in bold font comprise the abbreviated, validated 6-item Transportation Security Index

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Declarations

Conflict of interest This work was supported by Mcity at the University of Michigan. The authors have no competing interests to declare that are relevant to the content of this article. The researchers declare that they have complied with all the ethical requirements for this type of study. The University of Michigan's Institutional Review Board reviewed and approved all materials and protocols for data collection relevant to this study.

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