Using the Transportation Security Index to Measure the Impact of Mobility Initiatives

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Simple Premise: **We are each in the business of helping people get to the places they want to go.**

- **How do we know how well we are doing in achieving this objective?**
  - **How do we measure how well our mobility initiatives are doing in getting people to the places they want to go?**
  - **Related, how do we measure the benefits to individuals and the communities where they live and we work of effectively getting people to the places the want to go?**

- **What are the costs of *not* achieving this objective on individuals, communities, and society writ-large?**

In the past 30 days, how often:

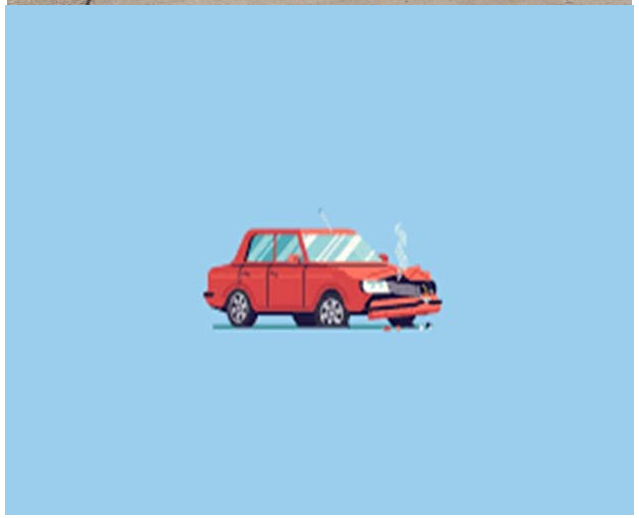
….did you have to **arrive somewhere early and wait** because of the schedule of the bus, train, or person giving you a ride?

…were you **not able to leave the house when you wanted to** because of a problem with transportation?

…did you **worry about inconveniencing** your friends, family, or neighbors because you needed help with transportation?

(Often, Sometimes, Never)

Transportation Insecurity: a condition in which one is unable to regularly move from place to place in a safe or timely manner due to an absence of resources needed for transportation (e.g. money for gas, a friend with a car, the physical health to walk) (Gould-Werth et al. 2018; Murphy et al. 2021)



Proxy measures to capture transportation insecurity:

- Mode of Transit (e.g., car, public transit)
- Travel Behavior (e.g. commute time, activity-based models)
- Neighborhood Accessibility (e.g. proximity to transit, access to destinations, walkability scores)
- 5 As of Access (affordability, availability, accessibility, accommodation, acceptability)

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Proxy measures miss:

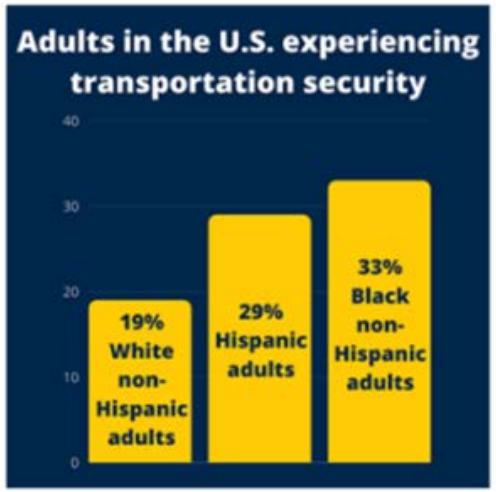
- ✓ Car owners who are transportation insecure when they can't pay for gas
- ✓ Residents living in "accessible neighborhoods" who cannot get around
- ✓ Access to transit ≠ transit use
- ✓ "Unmet demand" (i.e. people who skip trips and are unable to get around)
- ✓ Role of social networks in mobility
- ✓ Different measures used inconsistently makes it difficult to make comparisons and draw general conclusions

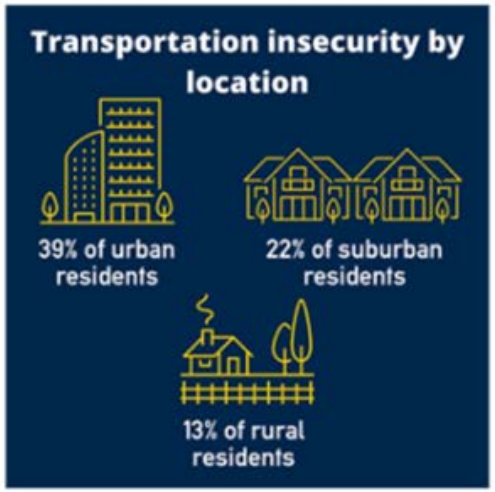
The Problem: Lacking a valid measure of transportation insecurity we cannot fully understand the landscape – or extent - of transportation insecurity in our cities, regions, or states nor can we evaluate whether our interventions, technologies, and investments are effectively moving people from “transportation insecurity” to “transportation security.”

- How many people and who experiences this condition?
- How is transportation insecurity changing over time?
- What causes transportation insecurity and what might its consequences be for individual financial, social, and physical wellbeing?
- What policies and technologies can effectively ameliorate transportation insecurity? And what are the effects of moving people to transportation security on things like employment, education, health, and child wellbeing?
- How does effectively moving people from transportation insecurity to transportation security benefit communities, helping them thrive economically and socially?

Transportation Security Index (TSI): A validated, individual-level measure explicitly designed to measure transportation insecurity as it is directly experienced qualitatively, regardless of geography or mode of transit (Gould-Werth et al. 2018; Murphy et al. 2021)

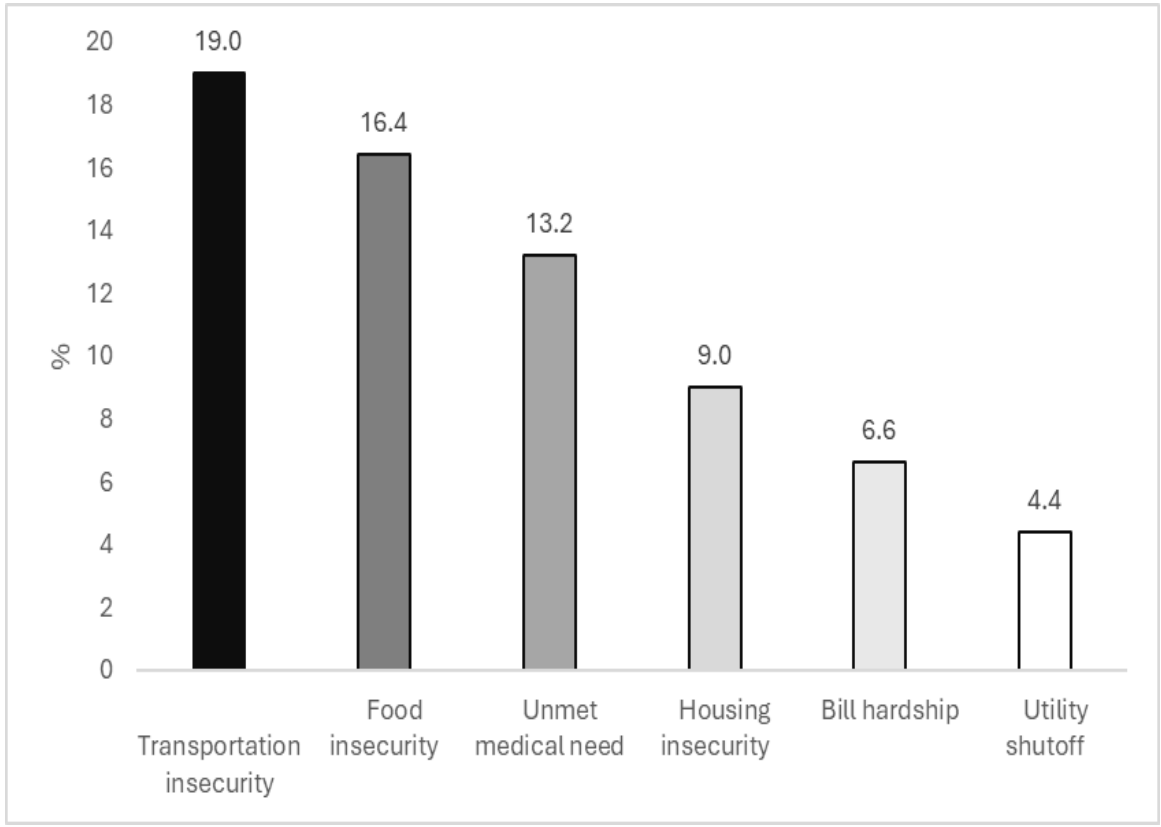
Putting the Transportation Security Index to work: Generated the first prevalence estimates of transportation insecurity in the U.S. and provided a descriptive portrait by subgroup (Murphy et al. 2022)





Putting the Transportation Security Index to work: Conducted a study that shows that transportation insecurity is *the* most prevalent form of material hardship experienced by Americans.

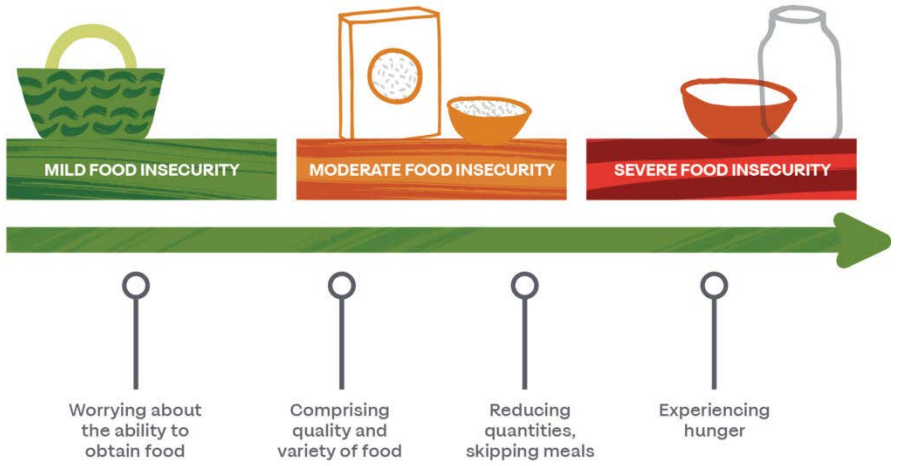
It is *also as strongly associated* with poor self-rated health and depressive symptoms as food insecurity and having unmet medical needs (Paper under review).



Inspiration: The Food Security Index which directly captures the experience of food insecurity by measuring *symptoms* (vs inputs):

"In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?"

"The food that we bought just didn't last, and we didn't have money to get more." Was that often, sometimes, or never true for your household in the last 12 months?



Creating the Transportation Security Index

Phase I: Identifying the *symptoms* of transportation insecurity

- Drew on ethnographic data and 187 interviews conducted in urban, suburban, and rural areas across 3 states to identify the symptoms of transportation insecurity

3 Manifestations of Symptoms of Transportation Insecurity

- **Material:** Physically observable and relate to whether people can get around in a safe or timely manner (e.g. time-consuming travel, being stuck at home, unsafe travel, rescheduling appointments)

- **Relational:** Social strains stemming from using social networks for travel or from the inability to see people because of transportation problems (e.g. worry about inconveniencing ride givers, social isolation)

- **Emotional:** Stress and worry related to problems with transportation (e.g. worrying about transportation, feeling left out, embarrassment)

Creating the Transportation Security Index
Phase II: Brainstorming Items

- Drew on our qualitative data to develop 23 candidate items that captured the material, relational, and emotional manifestations of transportation insecurity

  - We intentionally left out outcomes of interest (i.e. work/employment, doctor/health) so researchers can use the TSI in a causal inference framework to look at the consequences of insecurity on these outcomes

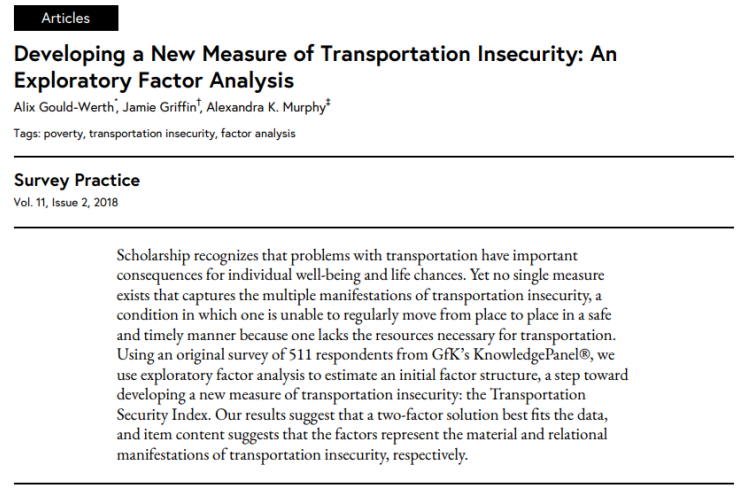
Creating the Transportation Security Index
Phase III: Cognitive Interviews

- Conducted 52 cognitive interviews in urban, suburban, and rural areas
- Coded response for question comprehension, recall, and judgment
- Result:
  - Burdensome items were refined
  - Items generating false positives were dropped
  - Reference to the cost of transportation in each item was dropped
  - New items were developed

Creating the Transportation Security Index

Phase IV: Identifying & Validating the Transportation Security Index

- Identified a preliminary 16-item index by fielding an original survey and conducting exploratory factor analysis
- Validated the 16-item index on a nationally representative sample by fielding an original survey and conducting confirmatory factor analysis.



Articles

Developing a New Measure of Transportation Insecurity: An Exploratory Factor Analysis

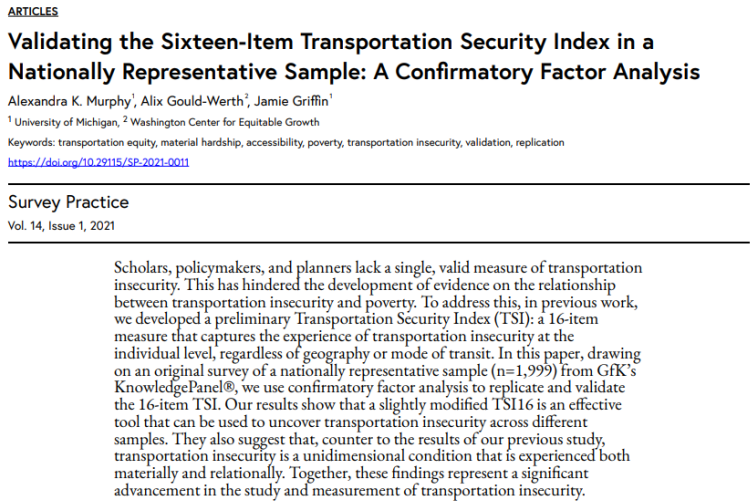
Alix Gould-Werth*, Jamie Griffin†, Alexandra K. Murphy‡

Tags: poverty, transportation insecurity, factor analysis

Survey Practice

Vol. 11, Issue 2, 2018

Scholarship recognizes that problems with transportation have important consequences for individual well-being and life chances. Yet no single measure exists that captures the multiple manifestations of transportation insecurity, a condition in which one is unable to regularly move from place to place in a safe and timely manner because one lacks the resources necessary for transportation. Using an original survey of 511 respondents from GfK's KnowledgePanel®, we use exploratory factor analysis to estimate an initial factor structure, a step toward developing a new measure of transportation insecurity: the Transportation Security Index. Our results suggest that a two-factor solution best fits the data, and item content suggests that the factors represent the material and relational manifestations of transportation insecurity, respectively.



ARTICLES

Validating the Sixteen-Item Transportation Security Index in a Nationally Representative Sample: A Confirmatory Factor Analysis

Alexandra K. Murphy[1], Alix Gould-Werth[2], Jamie Griffin[1]

[1] University of Michigan, [2] Washington Center for Equitable Growth

Keywords: transportation equity, material hardship, accessibility, poverty, transportation insecurity, validation, replication

https://doi.org/10.29115/SP-2021-0011

Survey Practice

Vol. 14, Issue 1, 2021

Scholars, policymakers, and planners lack a single, valid measure of transportation insecurity. This has hindered the development of evidence on the relationship between transportation insecurity and poverty. To address this, in previous work, we developed a preliminary Transportation Security Index (TSI): a 16-item measure that captures the experience of transportation insecurity at the individual level, regardless of geography or mode of transit. In this paper, drawing on an original survey of a nationally representative sample (n=1,999) from GfK's KnowledgePanel®, we use confirmatory factor analysis to replicate and validate the 16-item TSI. Our results show that a slightly modified TSI16 is an effective tool that can be used to uncover transportation insecurity across different samples. They also suggest that, counter to the results of our previous study, transportation insecurity is a unidimensional condition that is experienced both materially and relationally. Together, these findings represent a significant advancement in the study and measurement of transportation insecurity.

Transportation Security Index (TSI)

- Each of the 16-items tap into the symptoms of transportation insecurity and draws on a 30-day reference period. Response options for all items are "Never, Sometimes, Often"

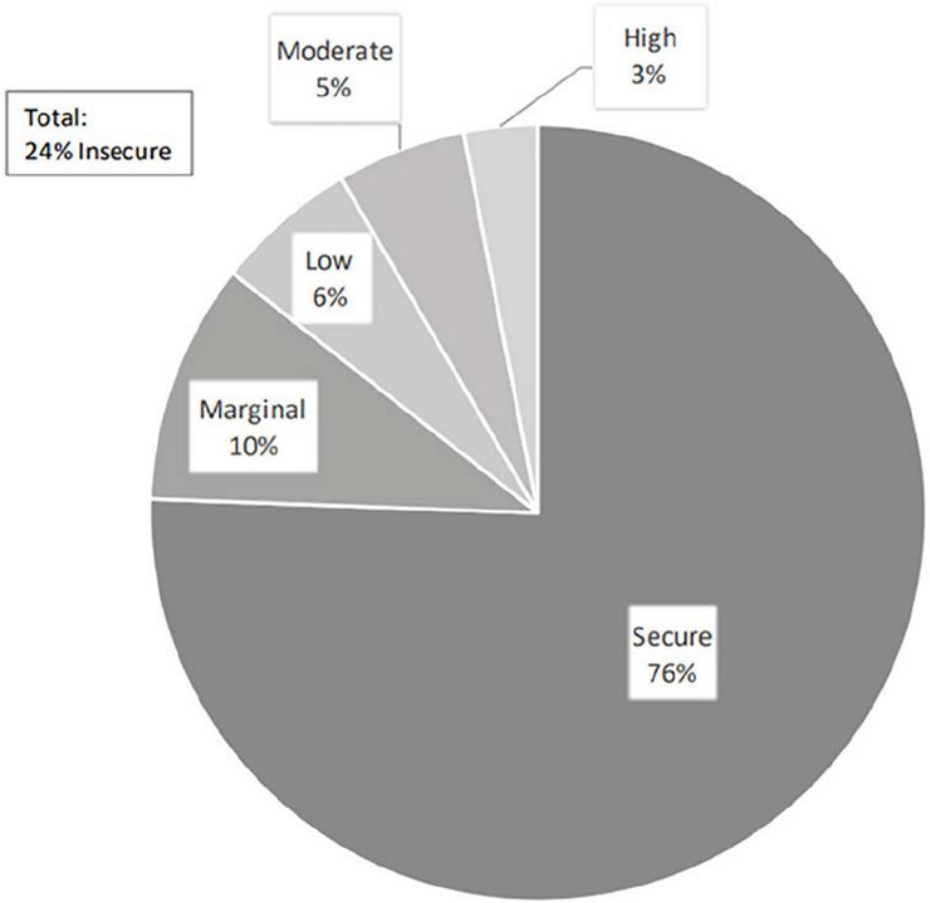
For example, "In the last 30 days how often…

- did you have to ***reschedule*** an appointment because of a problem with transportation?
- Were you ***late*** getting somewhere because of a problem with transportation?
- did you feel ***stuck at home*** because of problems with transportation ?

- Items are scored 0=never; 1=sometimes; or 2=often; thus, possible cumulative scores ranged from 0 to 32

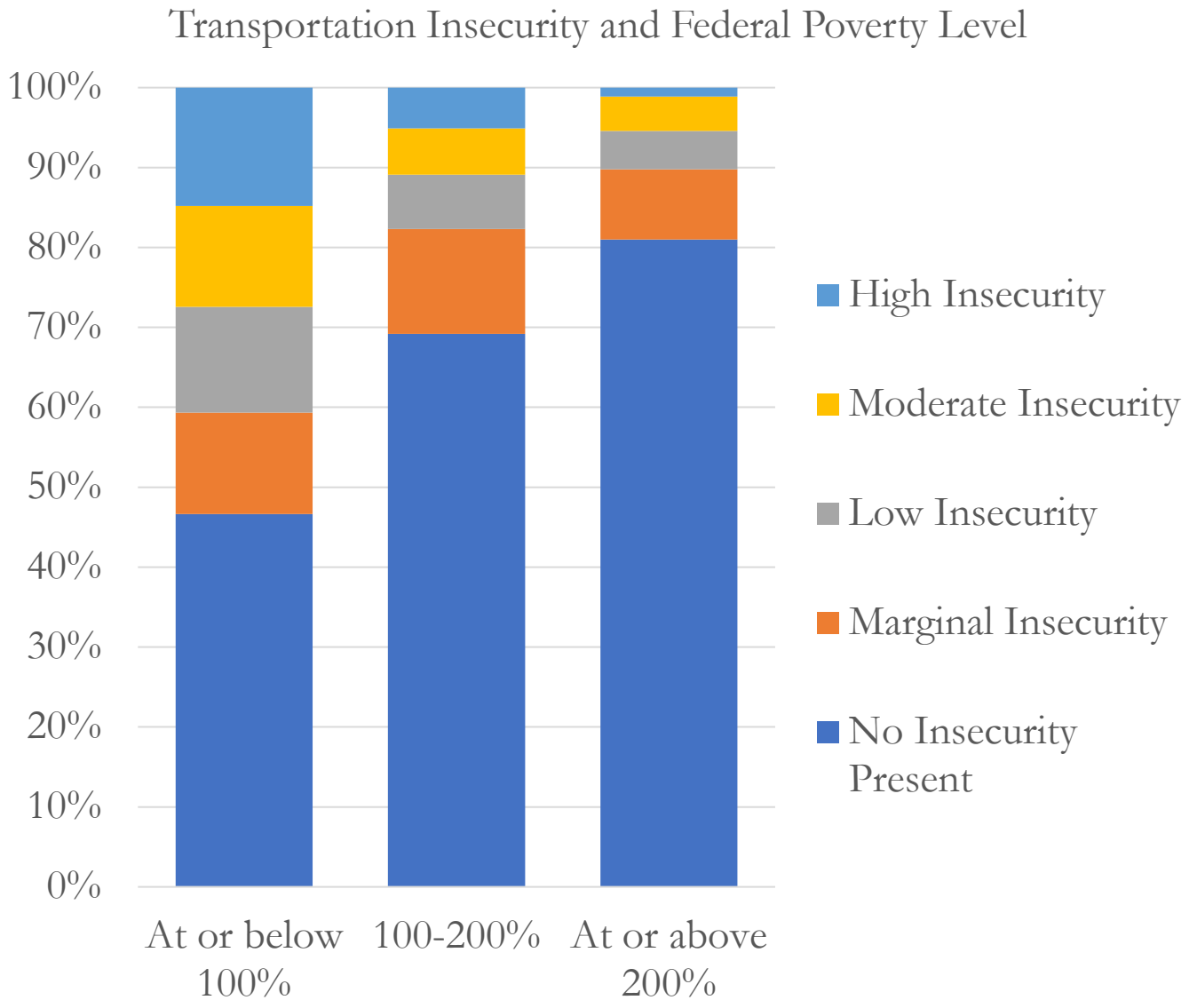
Creating the Transportation Security Index:
Phase V: Identifying Categories of Insecurity

1. **No insecurity/Transportation Secure** (0-2): People who can regularly get from place to place in a safe or timely manner
2. **Marginal insecurity** (3-5): People who are inconvenienced by transportation and experience transportation-related worry but can regularly access essential destinations
3. **Low Insecurity** (6-10): People who experience constrained travel that impacts daily life
4. **Moderate Insecurity** (11-16): People who experience even greater constrained travel and affirm items that measure negative feelings about their transportation situation
5. **High Insecurity** (17+): People who experience extremely constrained travel behavior with some reporting not being able to go places at all or being severely limited in the places they can go

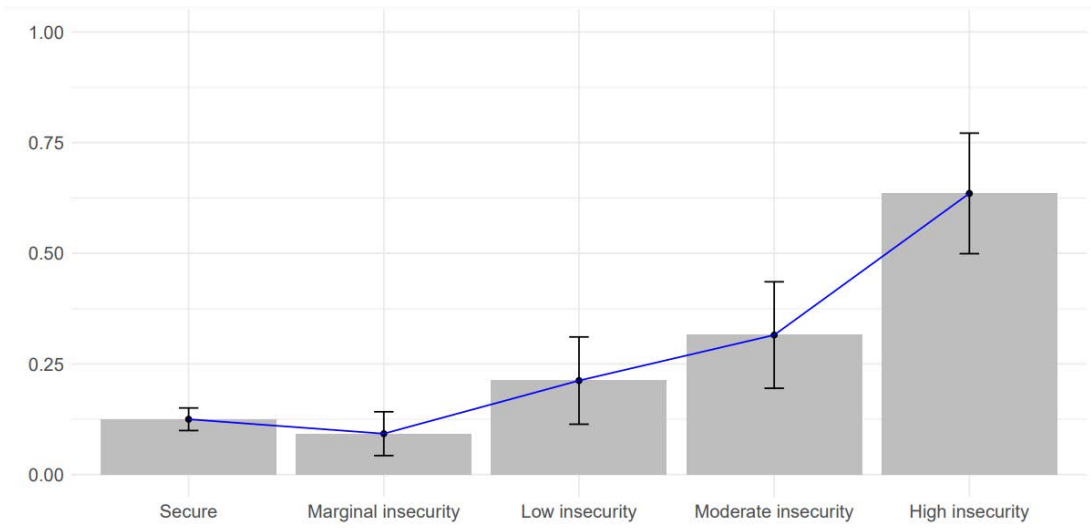


McDonald-Lopez, Karina et al. 2023. "A Driver in Health Outcomes: Developing Discrete Categories of Transportation Insecurity." *American Journal of Epidemiology,* 192(11): 1854-1863.

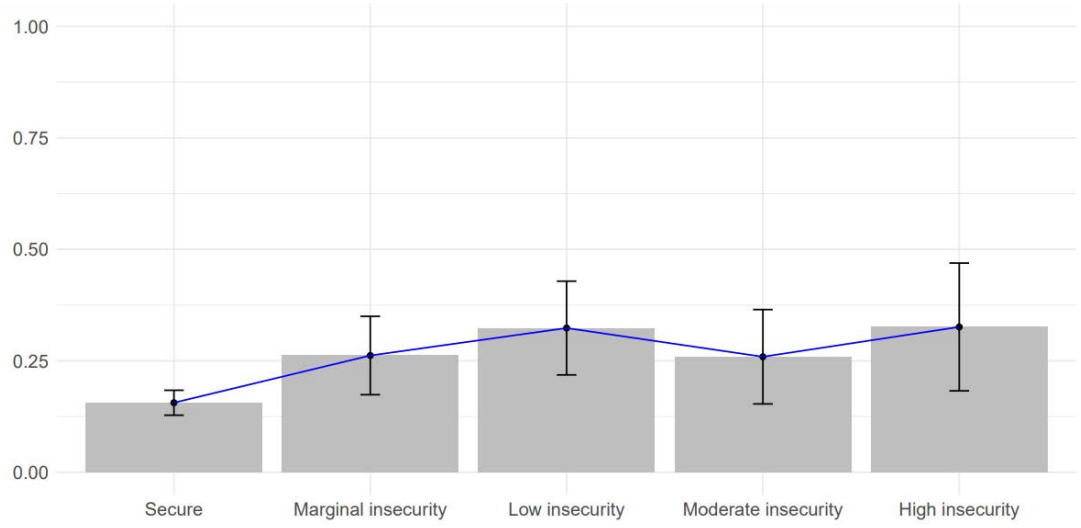
Prevalence of transportation insecurity by poverty level



Identifying Different Nonparametric Associations Between Transportation Insecurity & Outcomes of Interest



Relationship between transportation insecurity and **depressive symptoms**
"Dose-Response Relationship"



Relationship between transportation insecurity and **physical health**
"Threshold Relationship"

McDonald-Lopez, Karina et al. 2023. "A Driver in Health Outcomes: Developing Discrete Categories of Transportation Insecurity." *American Journal of Epidemiology,* 192(11): 1854-1863.

Challenge: 16-items is too long for many surveys where questionnaire real estate is constrained

Creating the Transportation Security Index:
Phase VI: Identifying and Validating Abbreviated Indices

Validated 6-Item Abbreviated TSI
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 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?

Preliminary 3-Item Abbreviated TSI (Validation in progress)
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 problems with transportation affect your relationships with others?

Use #1: Create a baseline to document and track. To understand the scope of the issue we are trying to address, evaluate how effective our mobility initiatives are, and calculate the ROI of our investments, we need a baseline understanding of transportation insecurity nationally, at the state level, within regions, cities, and suburban and rural communities. Once a baseline has been established, by including the TSI on re-occurring surveys, we can track how transportation insecurity is changing over time, compare rates with that of others, and assess our progress.

Examples:

- The TSI was used in the 2024 Minnesota Department of Transportation's Omnibus Survey
- The TSI has been included on the Detroit Metropolitan Communities Area Survey and the Baltimore Area Survey to document city-level prevalence
- Snohomish County Transportation Coalition included the TSI on their Regional Mobility Survey for Priority Populations
- The state of Michigan has funded our work with plans to use the TSI on their state-wide household travel survey

DEPARTMENT OF TRANSPORTATION

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DMACS DETROIT METRO AREA COMMUNITIES STUDY
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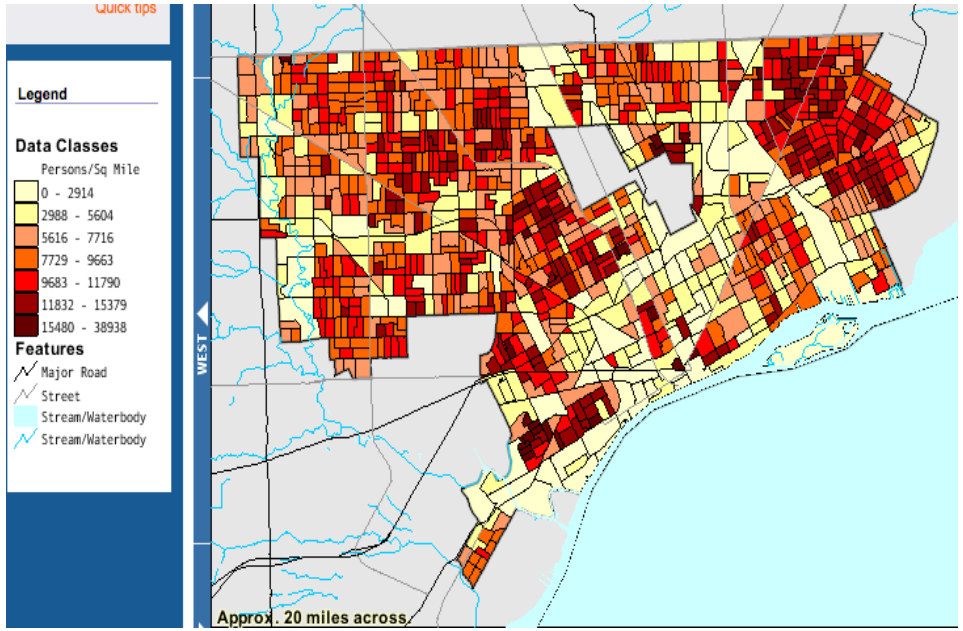
Use #2: Identify geographic "hot spots" of insecurity where mobility initiatives could be deployed. Some initiatives may aim to address transportation insecurity where it is most spatially concentrated with the goal of helping communities of transportation insecurity (not just people who are transportation insecure). The TSI can be used to identify such "hotspots," highlighting opportunities for deployment.



- No one has used the TSI in this way to date. The biggest challenge here is collecting data with sufficient sample sizes at fine enough spatial scales.

Use #3: Evaluate the effectiveness of mobility initiatives. To determine whether specific initiatives are achieving the goal of moving people from "transportation insecurity" to "transportation security," the TSI can be administered to participants in the pre- and post-testing phases of the initiative.

Examples:

- The U.S. Department of Transportation's Mobility, Access, and Transportation Insecurity Demonstration Program
- Washington DC's free public transit fare pilot program
- South Bend's Commuter's Trust Program
- Feonix Mobility Rising's Mobility Wallet Program
- Urban Institute and Open Research's respective studies of the impact of a Universal Basic Income Program

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MOBILITY RISING

Use #4: Screen potential participants for inclusion in specific initiatives. For those initiatives that want to enroll participants who are transportation insecure, the TSI can be used as a screening tool.

Mobility initiative examples featured on previous slide. In addition:

- Recognizing that transportation is an important social determinant of health, the TSI is being encoded as a screener in the LOINC database, the standard for identifying health measures, observations, and documents that that data can be collected and exchanged across health care systems worldwide.

LOINC® from Regenstrief

Use #5: Evaluate the causal impacts on outcomes of interest at the individual and community level. To understand whether improving insecurity has positive impacts on outcomes of interest related to individual wellbeing (educational attainment, health, employment, financial security, etc..), evaluations can include the TSI as well as measures that assess such outcomes. Such analyses could be scaled up to the community-level to assess how ameliorating individual insecurity impacts community outcomes of interest (tax revenue, employment, costs of public services).

ELSEVIER

Contemporary Clinical Trials
Volume 125, February 2023, 107037

Contingency Management and Pre-Exposure Prophylaxis Adherence Support Services (CoMPASS): A hybrid type 1 effectiveness-implementation study to promote HIV risk reduction among people who inject drugs

Minhee L. Sung [a b p 1], Adam Viera [c d 1], Denise Esserman [e f], Guangyu Tong [e f], Daniel Davidson [d], Sherry Aiudi [f], Genie L. Bailey [g h], Ashley L. Buchanan [i], Marianne Buchelli [j], Mark Jenkins [k], Betsey John [l], Jennifer Kolakowski [m], Albana Lame [n], Sean M. Murphy [o], Elizabeth Porter [p], Laura Simone [f], Manuel Paris [q], Carla J. Rash [r], E. Jennifer Edelman [b c d p]

Show more

Mobility initiative examples featured on previous slide. Non-mobility initiative examples include:

- Researchers at the Yale School of Medicine have registered a Randomized Control Trial that will use the TSI to evaluate medication adherence among HIV patients who use drugs
- Researchers at the Stanford University School of Medicine are using the TSI to look at whether transportation insecurity predicts colonoscopy completion &
- Researchers at UC Davis are using the TSI to evaluate how transportation insecurity impacts dialysis treatment outcomes.

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Thank You!

For more information, contact murphyal@umich.edu
https://poverty.umich.edu/research-funding-opportunities/data-tools/the-transportation-security-index/