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The Role of Community and Housing Environments for Optimizing Function with Aging





Elizabeth Aileen Clarke, 1933-2016

Outline

- Working definition of “function” in the context of disability
- Social models of disability for understanding participation in society
- Research Findings – quantitative and qualitative
- Data Needs

The Role of the Environment for Optimizing Function with Aging

“Function” (WHO 2001) -- means bodily activity, but also social participation in roles and activities in society.

For people with physical, sensory, or cognitive impairments, how does the environment mitigate/exacerbate their ability to participate in society and maintain health?

Health Disparities in People with Disability

Compared to those without disability, adults with disability are:

- twice as likely to be current smokers
- 10% more likely to be obese.

Health conditions are more common in people with disability:

- Prevalence of cardiovascular disease is almost three-fold that of people without disability (10.3% vs. 3.7%, respectively)
- Prevalence of diabetes is twice as high (16% vs. 8%, respectively).

Life Course Perspective (Riley 1979; Elder 1994)

Health problems over adulthood have adverse consequences for stable employment and income accumulations (Jin 1995)



Particularly consequential during “Emerging Adulthood” (ages 20-35)
(Arnett & Tabor 1994; Schulenberg et al., 2004)

advanced
education

early career path

marriage and
family formation

asset
acquisition

Life Course Perspective

Disrupted employment trajectories and career paths have long term consequences for health, asset, and wealth accumulation

(Pavalko, Elder, Clipp, 1993)



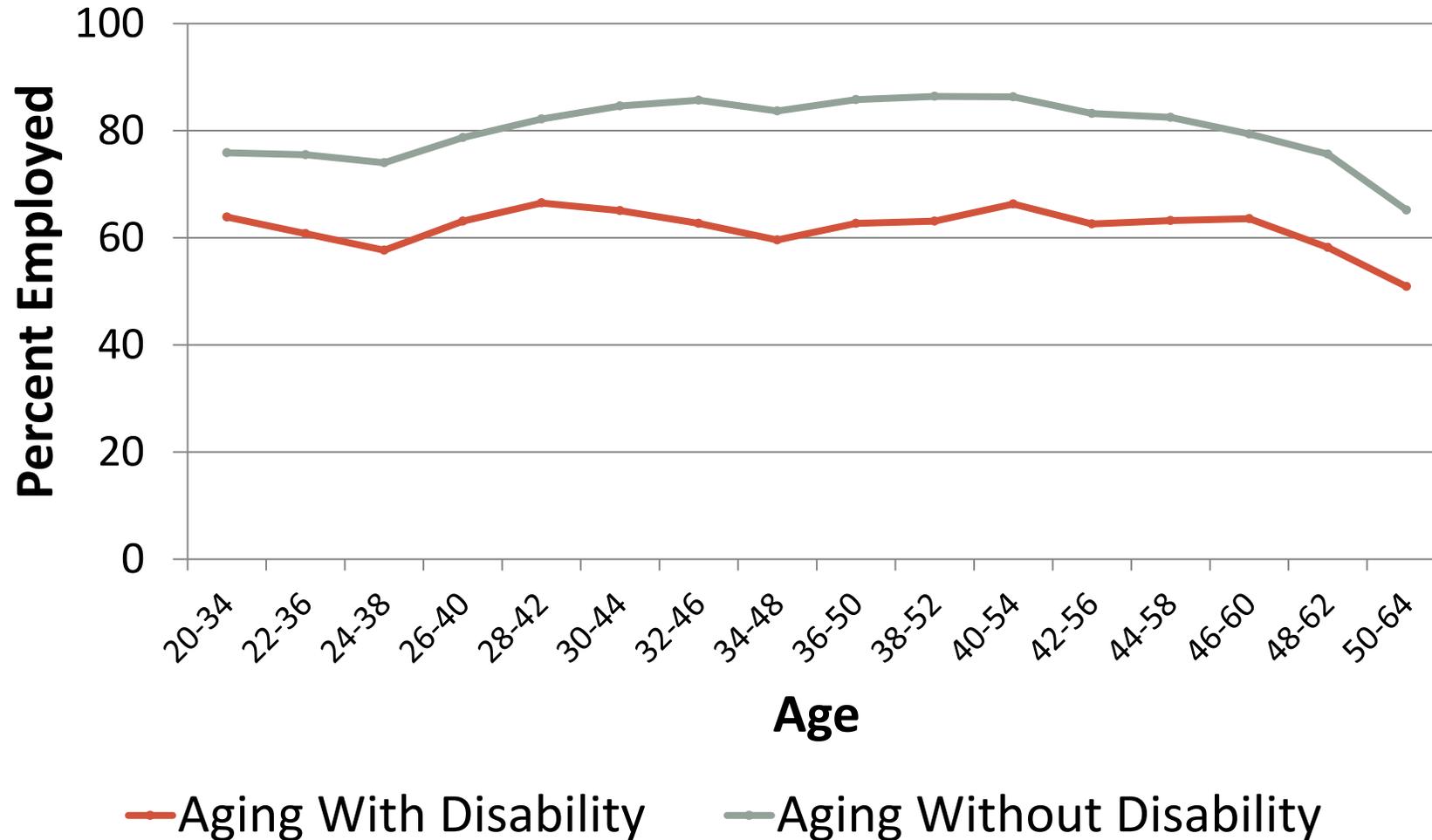
Cumulative disadvantage (Ferraro 2009):

- progression of health problems
- reinforcement of socioeconomic disadvantage throughout the life course

Employment over adulthood by Disability Status

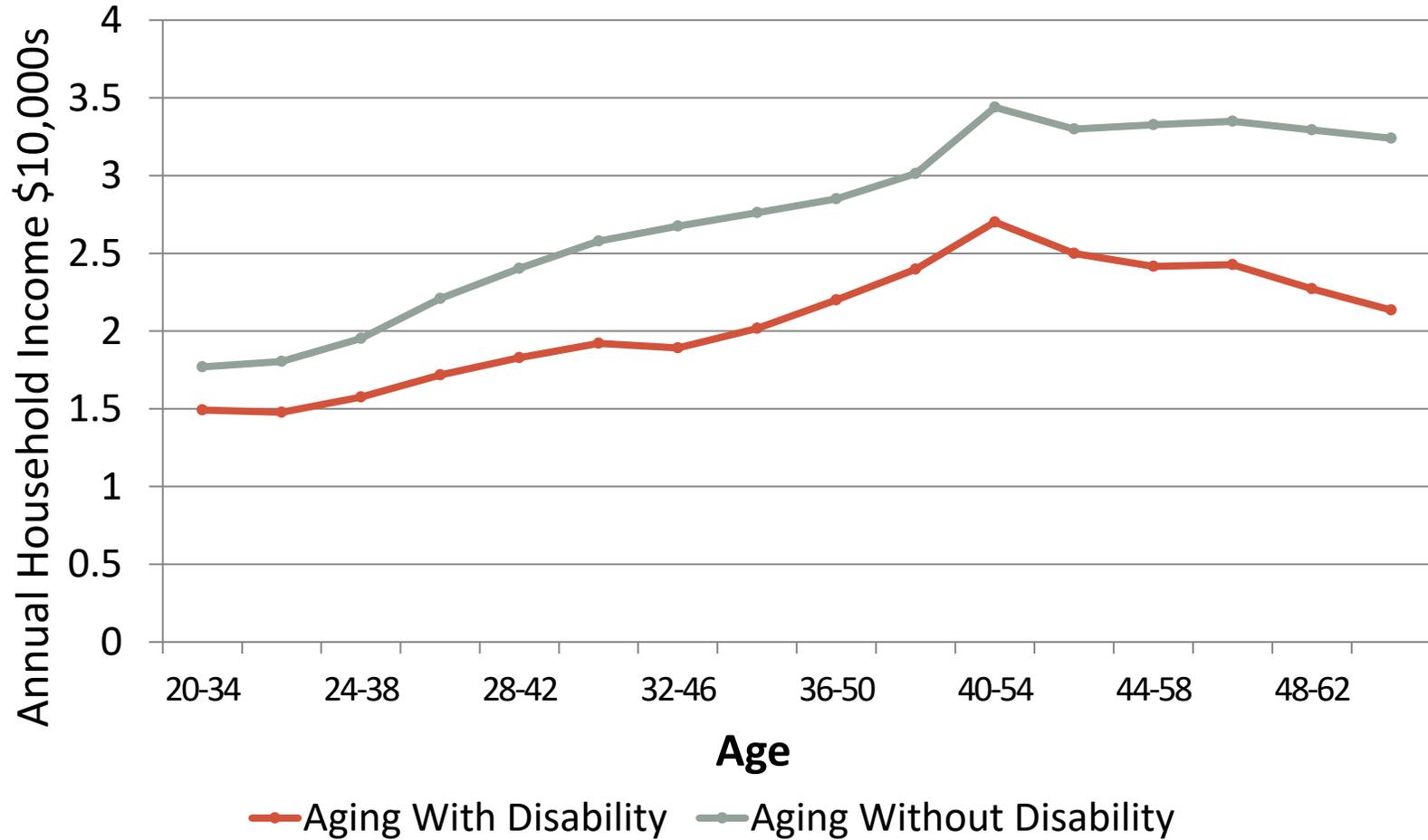
Panel Study of Income Dynamics (1979-2009) (N=4768 age 20-34 in 1979)

Clarke & Latham, 2014



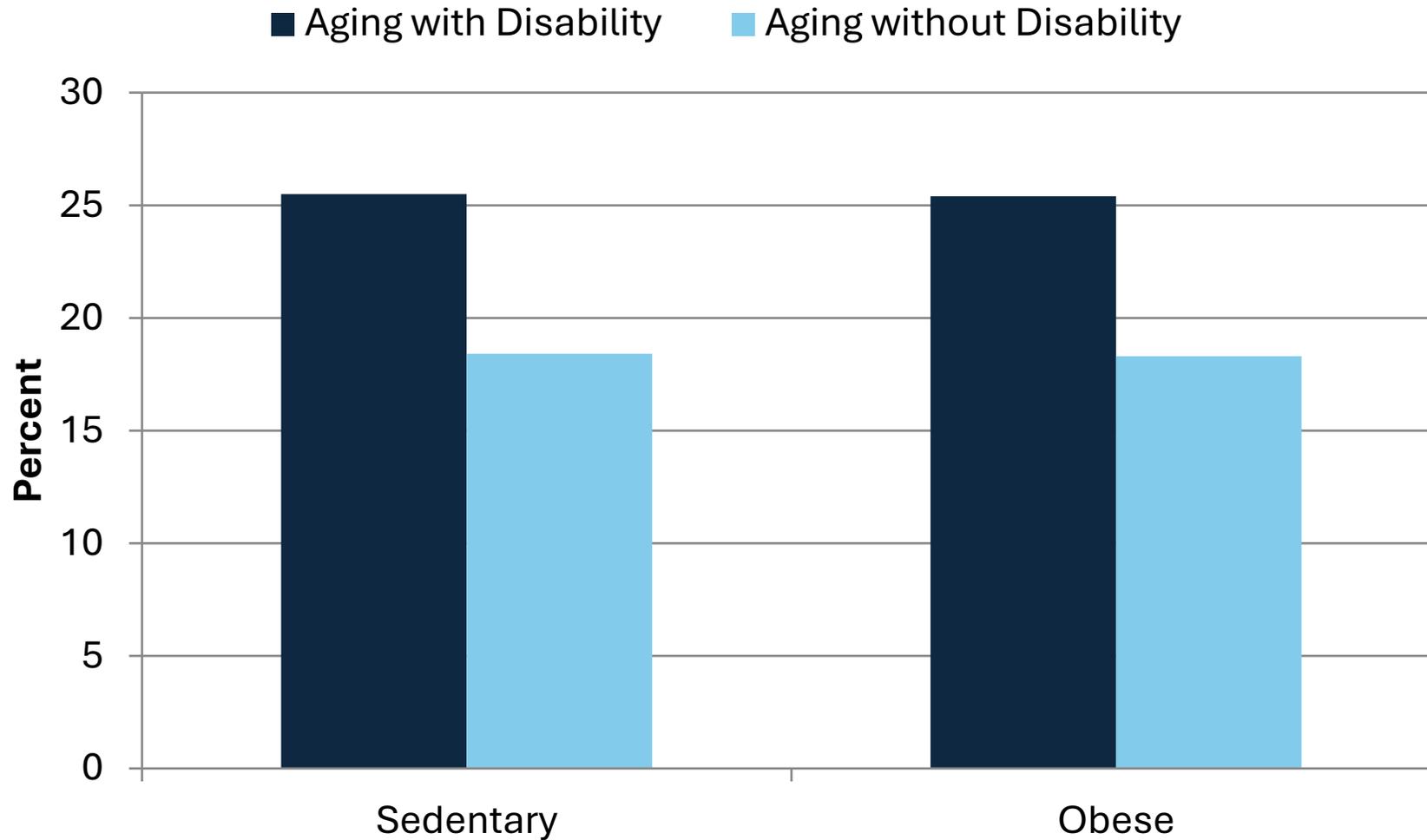
Household Income[†] over adulthood by Disability Status

Panel Study of Income Dynamics 1979-2009



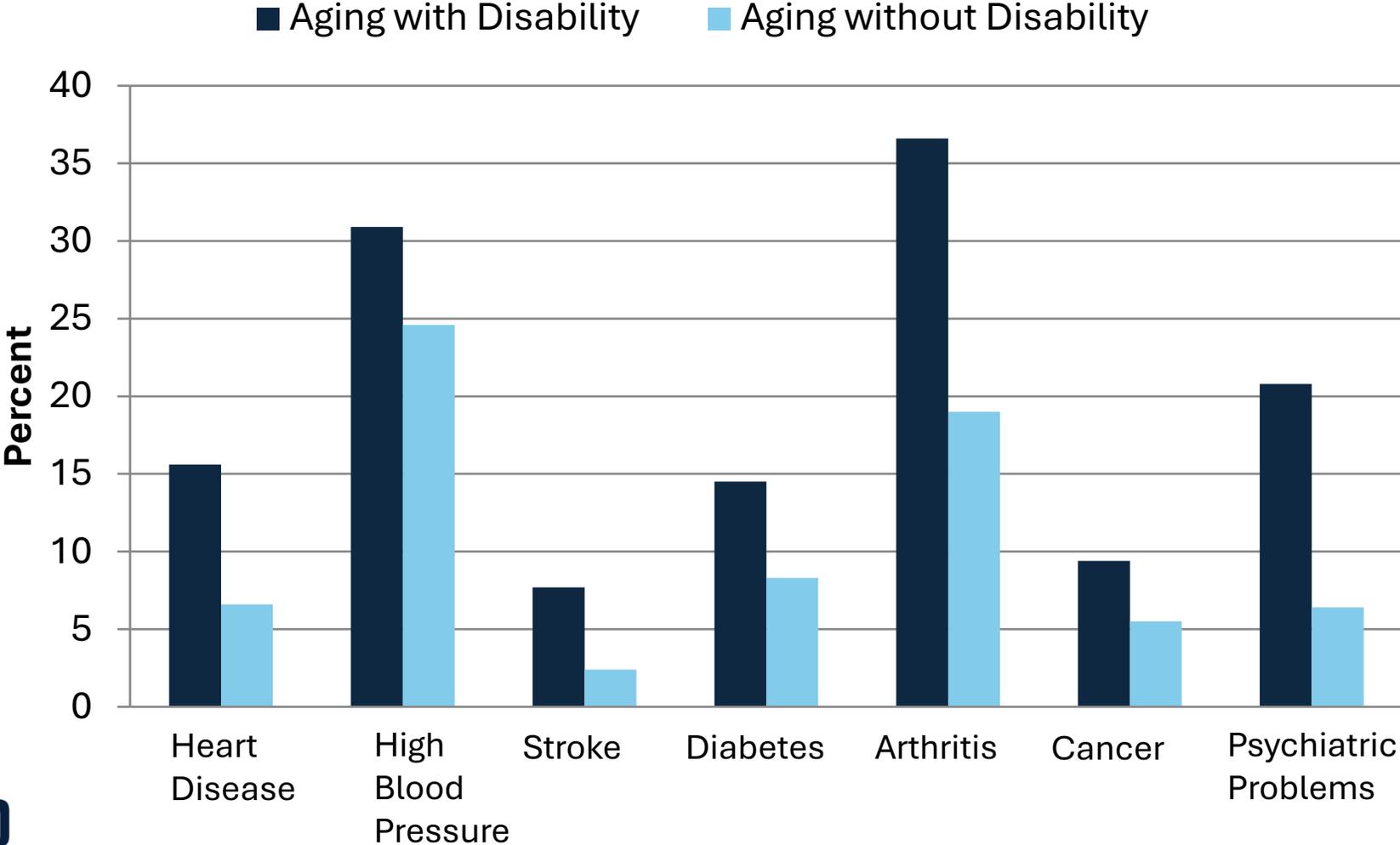
Health Behaviors in mid-life by Disability Status

PSID 1999-2009 (age 40-64)



Health Problems in mid-life by Disability Status

PSID 1999-2009 (age 40-64)



Living with a Disability

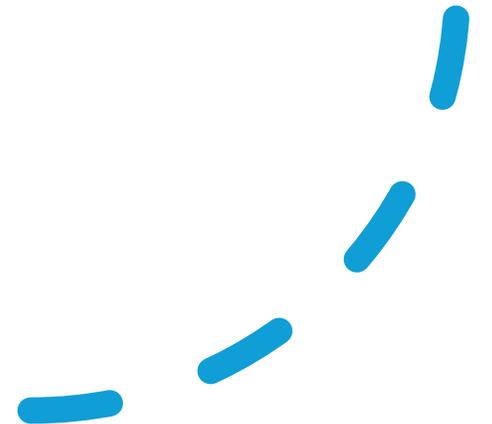
- Over half of adults with disability do not engage in physical activity due to socio-environmental barriers (Rimmer 2004):
 - equipment barriers in recreational facilities
 - negative attitudes by persons without disabilities
 - inaccessible walking paths and sidewalks



Reichard A, et al.
**Prevalence and reasons
for delaying and
foregoing necessary
care by the presence
and type of disability
among working-age
adults.**

*Disability and Health
Journal. 2017;10(1):39-47.*

Adults with disability are more likely than the general population to delay or forego necessary medical care due to financial and physical barriers.



Social Models of Disability

Disablement Process (Verbrugge and Jette 1994)

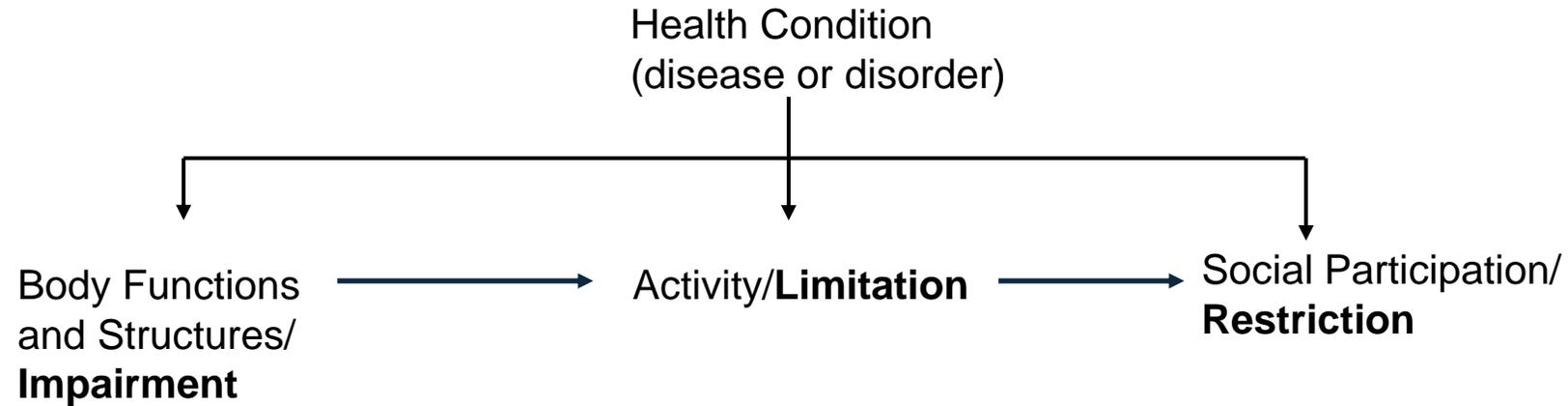
The Social Model of Disability (Oliver 1983)

Press-Competence Model (Lawton & Nahemov 1973)

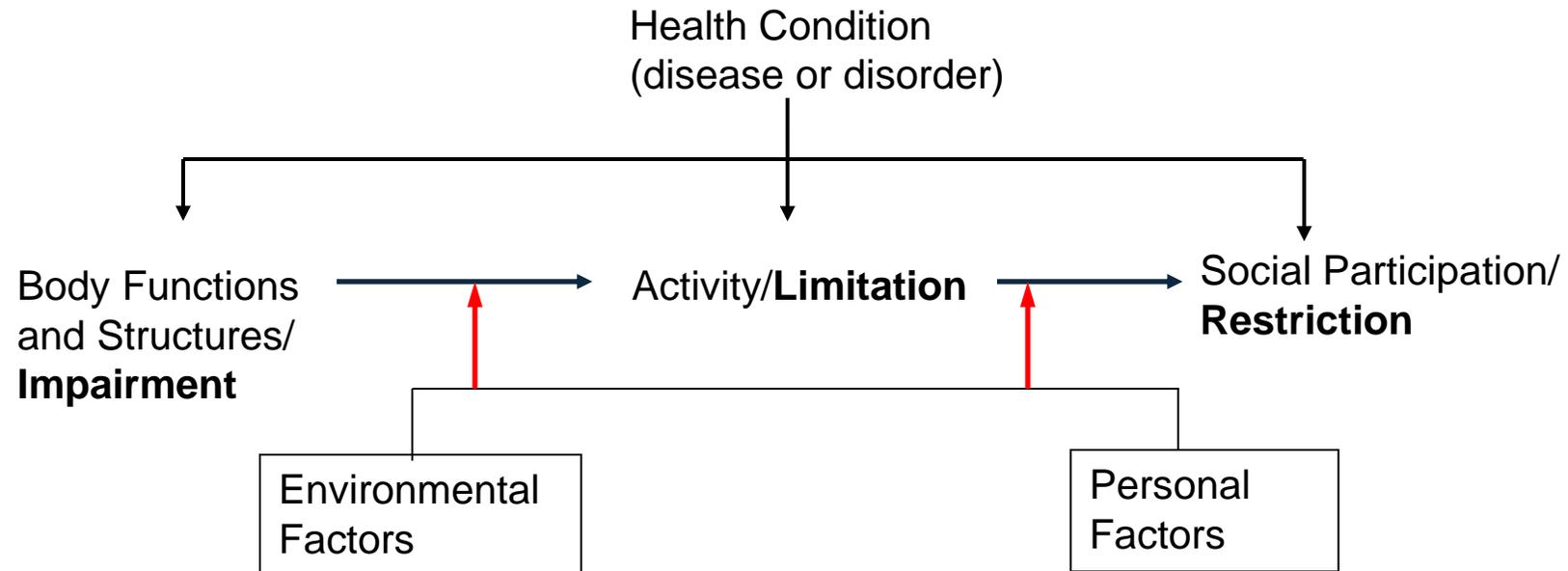
International Classification of Functioning, Disability and Health (WHO 2001)

International Classification of Functioning, Disability and Health (ICF) (WHO, 2001)

The ICF captures functioning at 3 levels:



International Classification of Functioning, Disability and Health (ICF) (WHO, 2001)



- Products & Technology
- Attitudes & Stereotypes
- Services & Policies
- Natural and Human-made Environments

Maintaining Health with Disability: The role of the built environment

RESEARCH FINDINGS

Khan, et al., 2024.

National Institute on Disability, Independent Living, and Rehabilitation Research
(90RTHF0001)

Density of Neighborhood Resources and 3-Year Incident Cardiometabolic Disease Among Adults With Physical Disability



Data: Administrative Claims from Commercial Insurance

- De-identified administrative claims for large commercial and Medicare Advantage health plans in the US: *Optum Clinformatics Data Mart (2007-2018)*
- N=15,467 adults with diagnosis of (ICD-9 CM code):
 - Cerebral palsy or spina bifida
 - Multiple sclerosis
 - Spinal Cord injury (plegia)
- Age
 - 18-30 (20%)
 - 31-40 (22.5%)
 - 41-50 (33%)
 - 51+ (24.6%)

Measures



Outcome: Incident cardiometabolic disease (ICD-9 or ICD-10 CM code)

Cardiovascular conditions (eg, hypertension, heart failure, cardiac dysrhythmias)

Type 2 Diabetes Mellitus

Chronic Kidney Disease



Exposure: Neighborhood Context

Residential ZIP code linked to area level ZIP Code tabulation area (ZCTA)

Linked to data in the National Neighborhood Data Archive (NaNDA)

The National Neighborhood Data Archive

<https://www.icpsr.umich.edu/web/ICPSR/series/1920>



- A publicly available data archive containing measures of neighborhood characteristics at multiple spatial scales (eg, census tract, ZCTA, county) across the United States
- NaNDA contextual measures can be linked with other data sources (eg, survey data, cohort studies, electronic medical records, claims data, or other microdata) via geographic identifiers.
- Years covered (1990-2023)
- Constantly updated



Measures of Neighborhood Context (ZCTA)

Recreation Environment

- Recreational facilities (eg, gyms, fitness centers, pools)
- Parks

Food Environment

- Grocery stores (includes markets, warehouse clubs selling food)

Transportation

- Public transit stops

Broadband Internet

- Number of households with high-speed broadband connections

Healthcare Establishments

- Ambulatory care, Hospitals, Residential care, Pharmacies

Analyses for 3-year Incident Cardiometabolic Disease

- Cox regression models
 - Time (days) to incident disease
- Free of any previous cardiometabolic disease
- Adjusting for covariates
 - Age
 - Sex/gender
 - Comorbid conditions (Elixhauser Comorbidity Index – ICD9 codes)
 - Neighborhood SES
 - Population Density

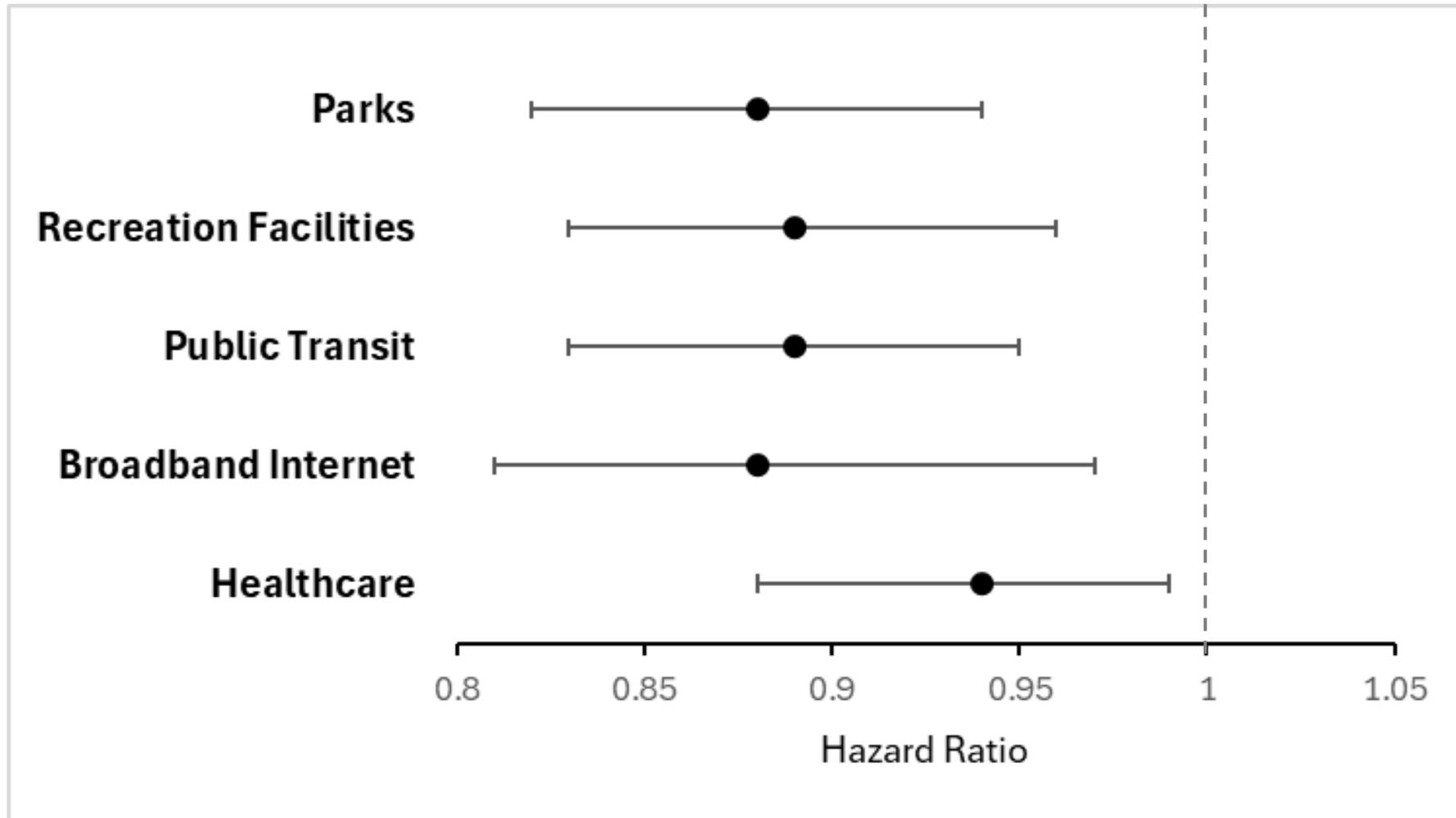
Incidence of Cardiometabolic Disease (3-year)



Results: Neighborhood Resources for Adults with Physical Disability (N=15,467)

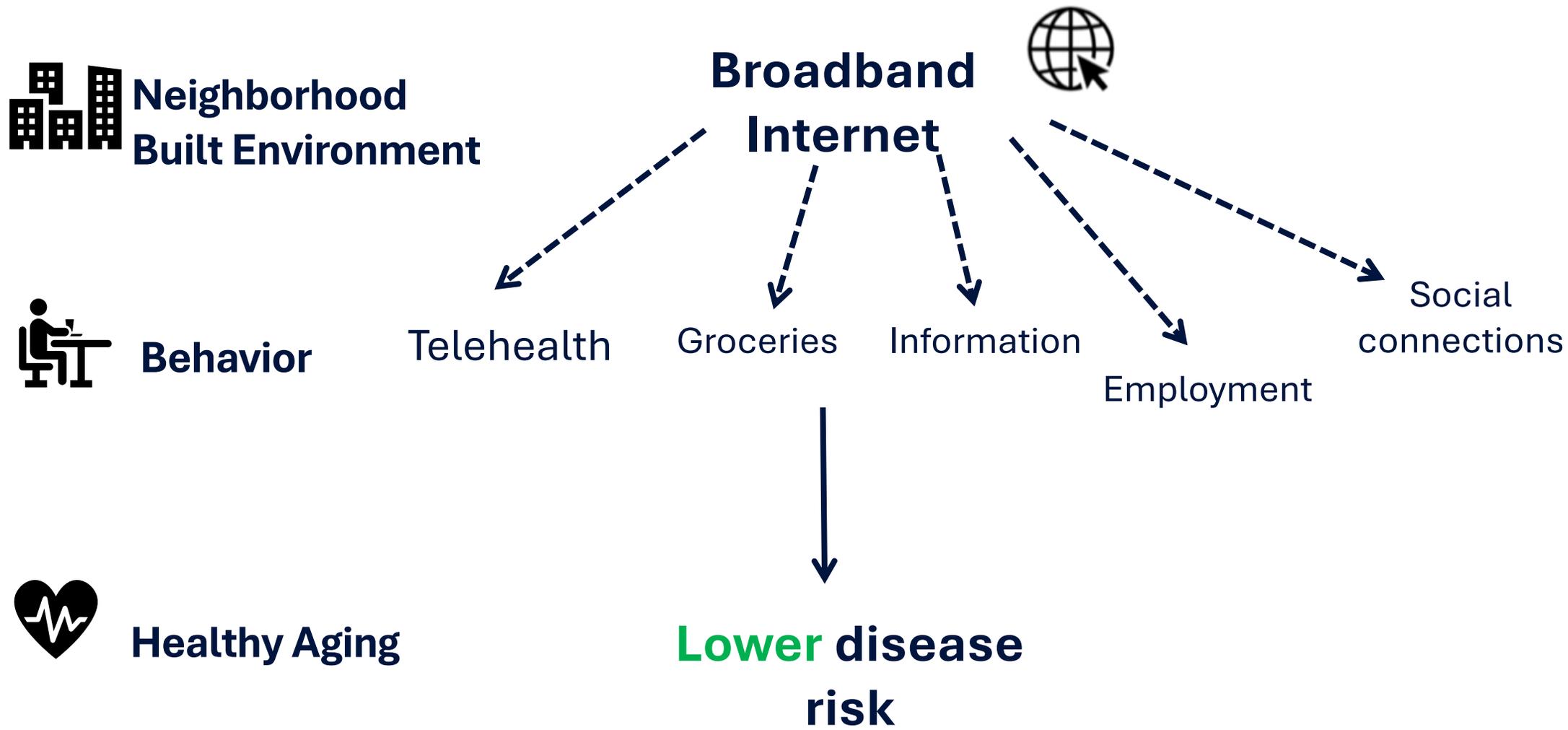
| Resources in ZCTA | Mean (SD), per 1000 population |
|---|---------------------------------------|
| Recreational Facilities | 0.5 (0.9) |
| Parks | 0.6 (0.8) |
| Grocery Stores | 1.3 (1.9) |
| Public Transit Stops | 2.2 (3.5) |
| Healthcare Establishments | 5.5 (7.1) |
| | Mean (SD) number of Households |
| Broadband Internet Connections (Households) | 272.6 (14.1) |

Neighborhood Resources and 3-Year Incident Cardiometabolic Disease Among Adults With Physical Disability: Optum Claims Data

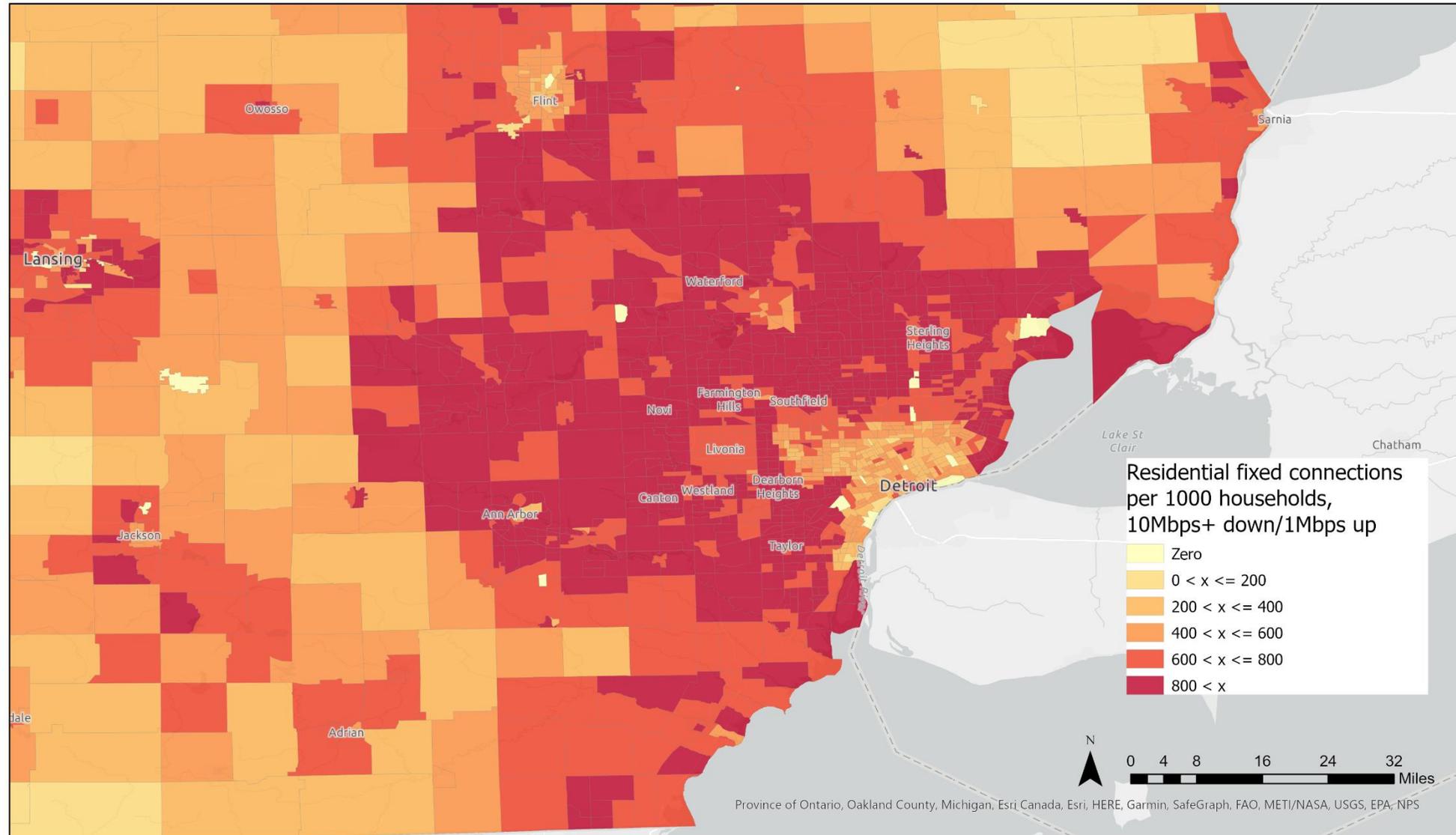


Models adjust for age, sex/gender, comorbidity, neighborhood SES, and population density.

Why does Broadband Internet Access Matter for the Health of Adults with Disability?



Broadband Internet Availability by Census Tract in Michigan (2018)



Risk of type 2 diabetes mellitus among adults aging with vision impairment: The role of the neighborhood environment

Clarke, et al., 2023

National Institute on Disability, Independent Living, and Rehabilitation Research
(90RTHF0001)

National Institutes of Health (UL1TR002240)

Data: Administrative Claims from Commercial Insurance

- De-identified administrative claims for large commercial and Medicare Advantage health plans in the US: *Optum Clinformatics Data Mart (2007-2018)*
- N=22,719 adults with diagnosis of (ICD-9 ICD-19 CM codes):
 - Blindness
 - Low vision
 - Homonymous and heteronymous bilateral field defects
- Excludes anyone with previous diagnosis of diabetes
- Age (mean=68.2 years, SD= 14.6)
 - 18-64 (31%)
 - 65+ (69%)

Measures



Outcome: Incident Type 2 Diabetes Mellitus

(ICD-9 or ICD-10 CM code)

ICD-9-CM codes (250.*0 or 250.*2)

ICD-10-CM code E11



Exposure: Neighborhood Context

Residential ZIP code linked to area level
ZIP Code tabulation area (ZCTA)

Linked to data in the National
Neighborhood Data Archive (NaNDA)

Measures of Neighborhood Context (ZCTA)

Pedestrian Safety and Walkability

- Street Connectivity (intersections per square mile)
- High Speed Roads (roads with 2+ lanes)
- Public Transit Stops

Food and Recreation Environment

- Grocery stores
- Gyms/ fitness centers/pools

Broadband Internet

- Number of households with high-speed broadband connections

Healthcare

- Ambulatory care
- Hospitals
- Optical Goods Stores

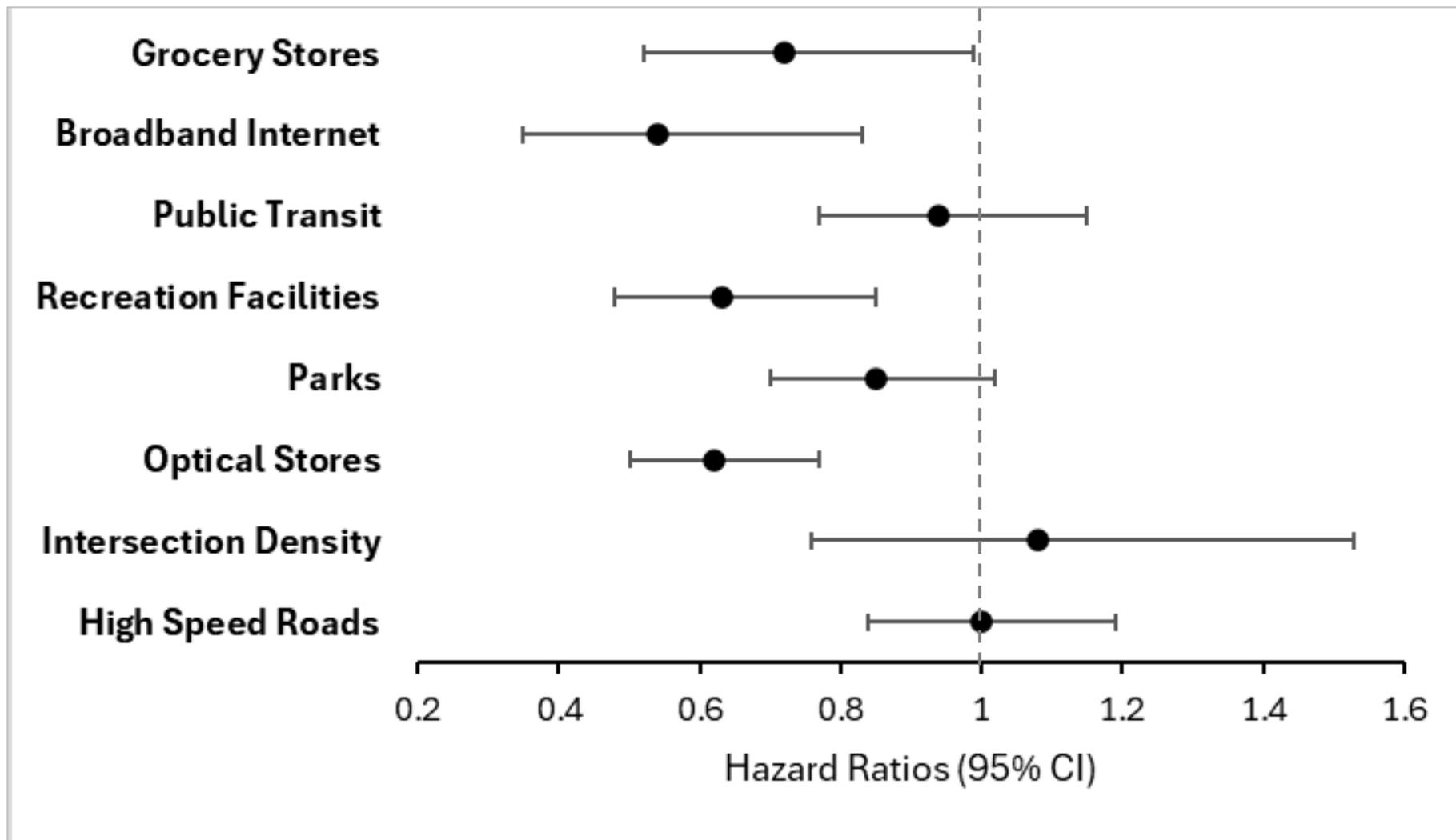
Analyses for 3-year Incident T2DM

- Cox regression models
 - Stratified by age (18-64, 65+)
 - Time (days) to incident disease
- Adjusting for covariates
 - Age
 - Sex/gender
 - Comorbid conditions (Elixhauser Comorbidity Index – ICD9 codes)
 - Neighborhood SES
 - Population Density

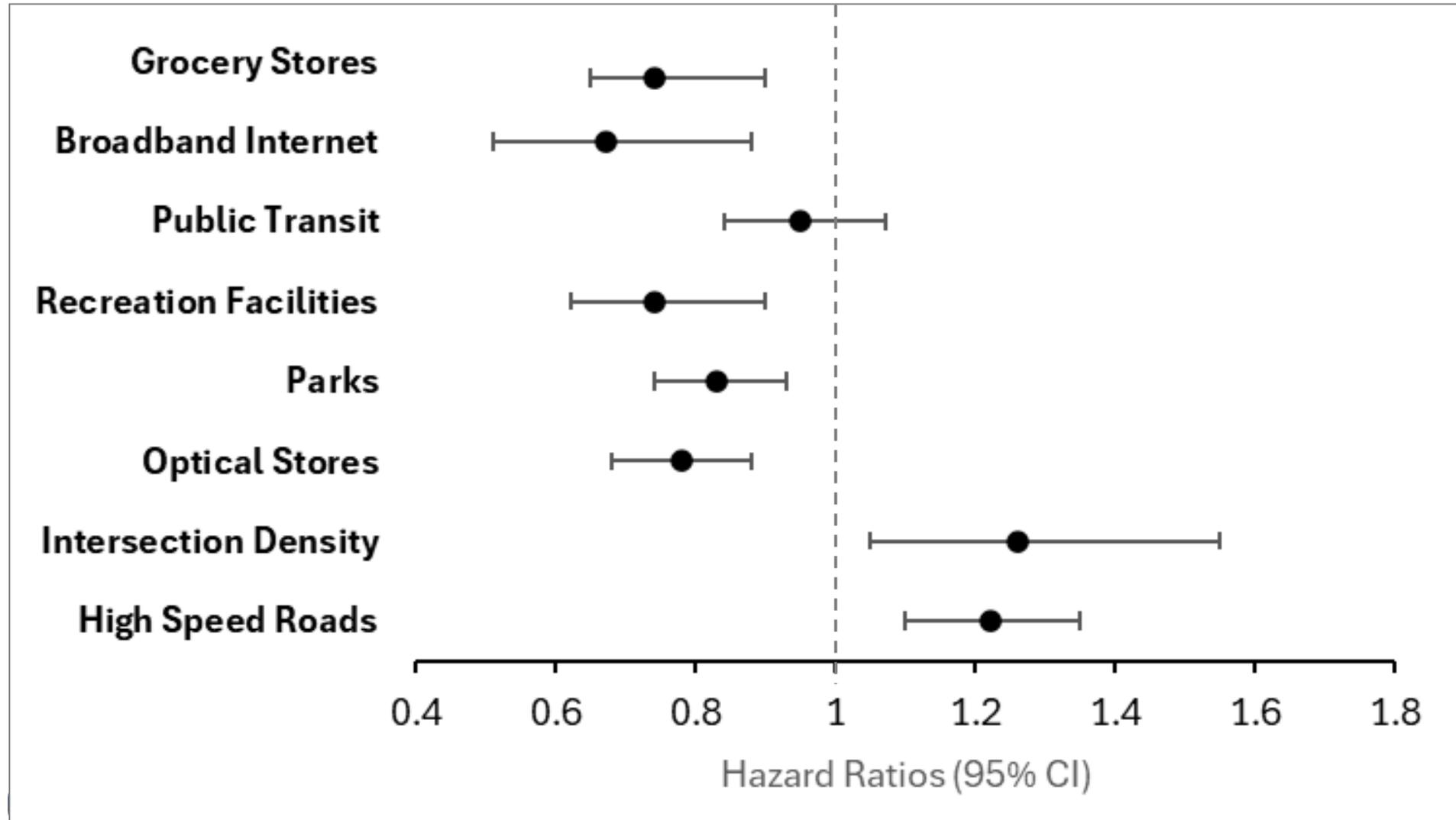
3-Year Incidence of Type 2 Diabetes Mellitus (N=22,719)



Neighborhood Characteristics and 3-year Incident Diabetes in Adults with Vision Impairment: Age 18-64



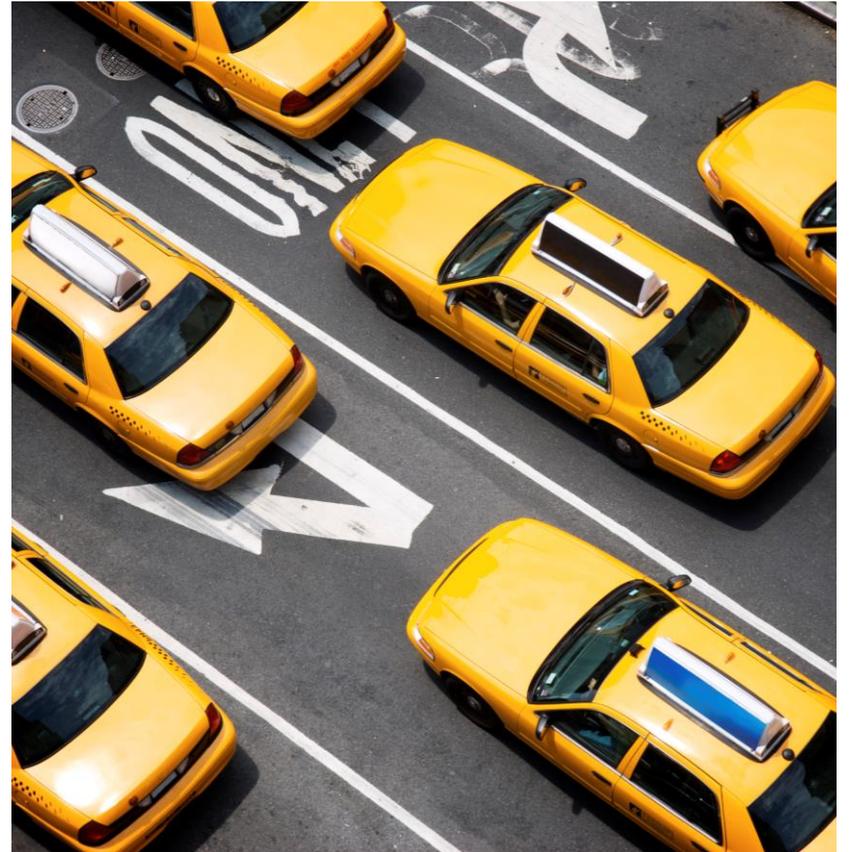
Neighborhood Characteristics and Incident Diabetes in Adults with Vision Impairment: Age 65+



Models adjust for age, sex/gender, comorbidity, neighborhood SES, and population density.

Pedestrian Safety for People with Disability

- Heavy traffic is the most common environmental factor associated with injuries and fatalities among disabled pedestrians (Schwartz, 2022)
- Residence in an area with more high-speed roads and greater intersection density were associated with close to a 25% increased risk of T2DM in older adults with vision impairment
- Greater intersection density may be hazardous if it increases the number of pedestrian crossings that may or may not have audible pedestrian signals and crosswalks



Insights from Qualitative Data

Healthy Aging with Spinal Cord Injury (SCI)

Craig H Neilsen Foundation Psychosocial Research Grant

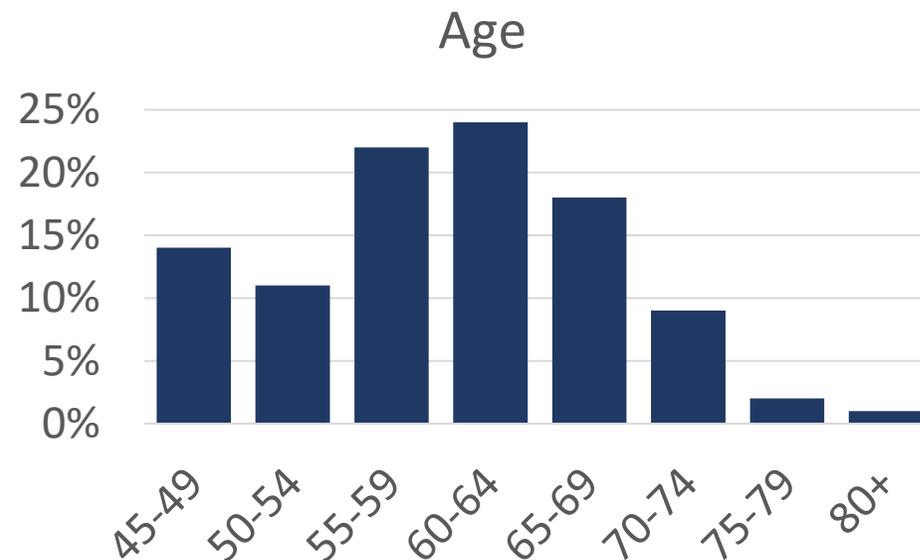
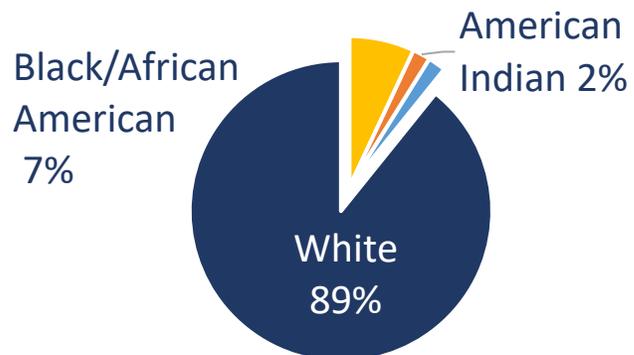
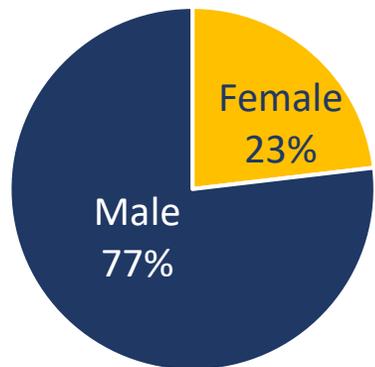
Clarke, PI

Aging with Spinal Cord Injury Study

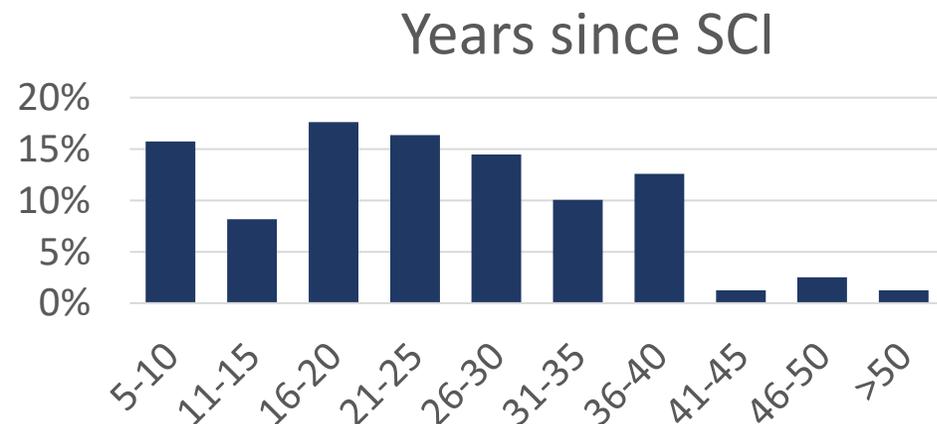
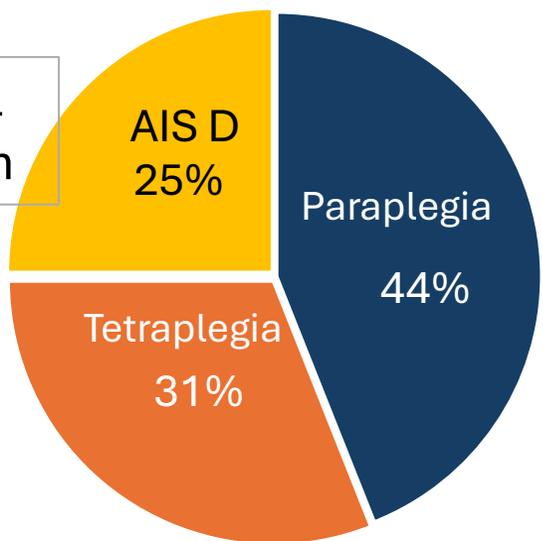
- 182 community-dwelling adults with SCI in 3 Midwestern states (Michigan, Ohio, Indiana)
- Age >45 years
- Living with SCI for at least 5 years
- Mixed methods study (January 2019 to September 2020)
 - Quantitative telephone survey (CATI) (N=182)
 - Qualitative interviews and focus groups (N=23)
 - Photo Voice (N=13)

Study participants were about 60 years of age on average.

Most were male and most were White.

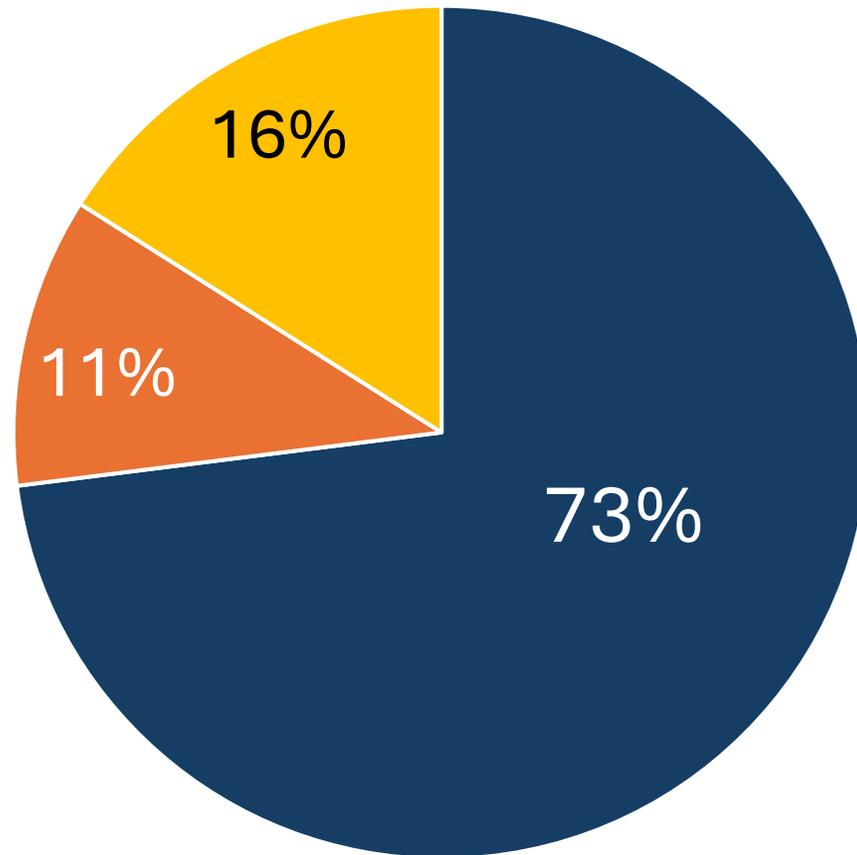


Neurological Classification



The average number of years since SCI was 24.

Labor Force Participation



- Not Employed
- Working Part Time
- Working Full Time

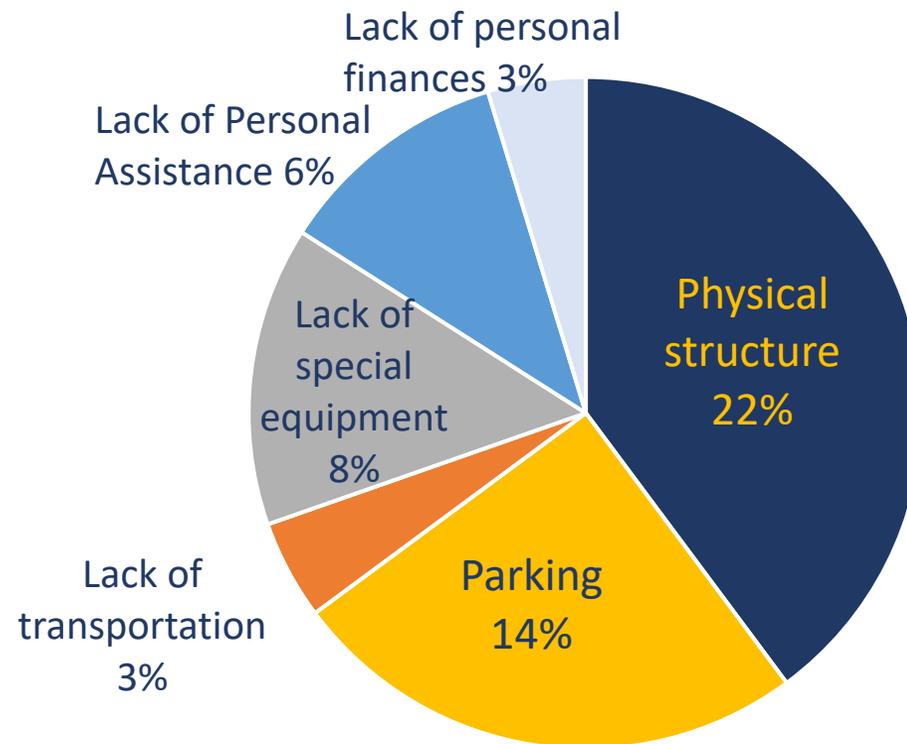
Facilitators and Barriers Survey / Mobility (Gray 2008)

- Asks about environmental features that limit the usability of 13 community buildings or sites (e.g. grocery stores, doctor's office, restaurants, movie theaters)
 - E.g., physical structure, parking, transportation
- Asks how community environmental features influence participation in activities in the community.
 - E.g., Curb cuts, ramps, automatic doors

What are the most common environmental features that limit participation in everyday activities?

- the physical structure of buildings
- limitations in parking

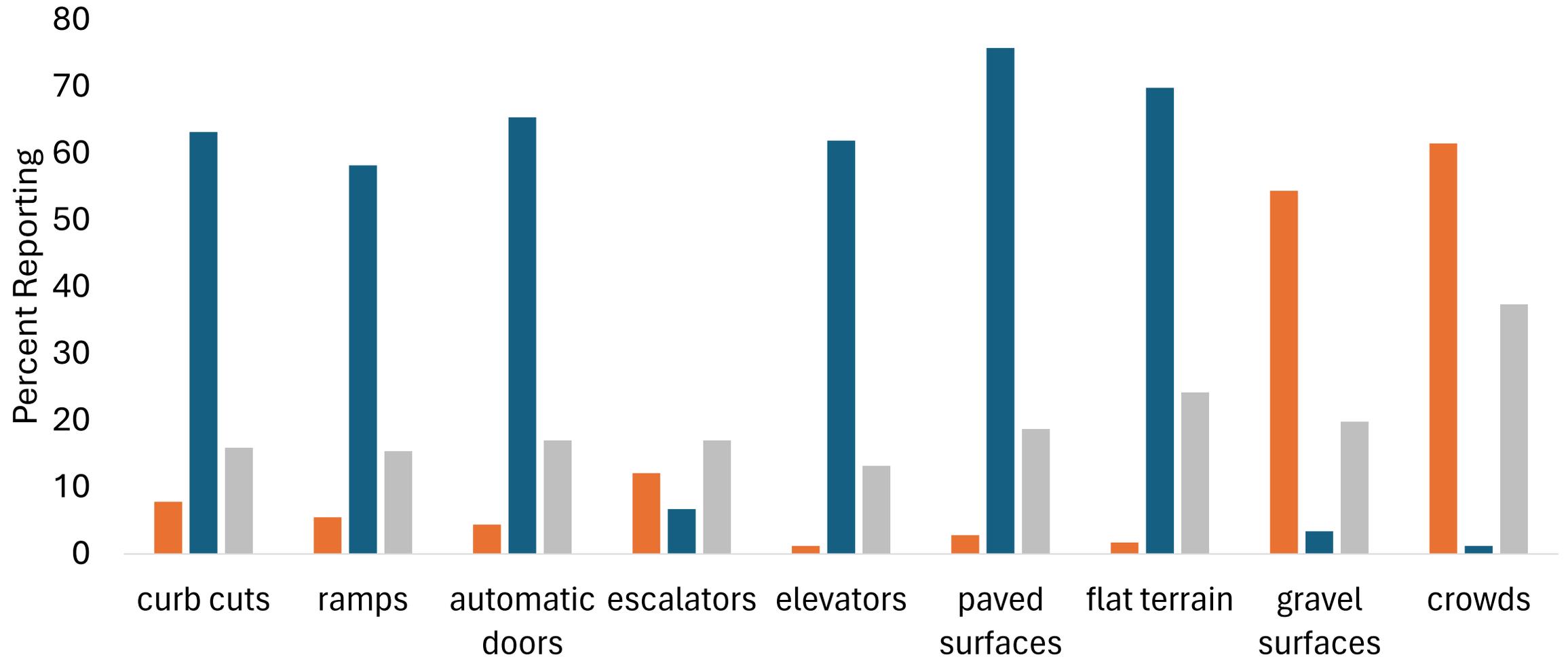
FABS-M



When asked what they would improve in their community, nearly every participant asked for more van accessible parking spots.



Community Environments Influencing Participation for Adults Aging with SCI (N=182)



Steps at Entry (Riedman, et al., 2020)

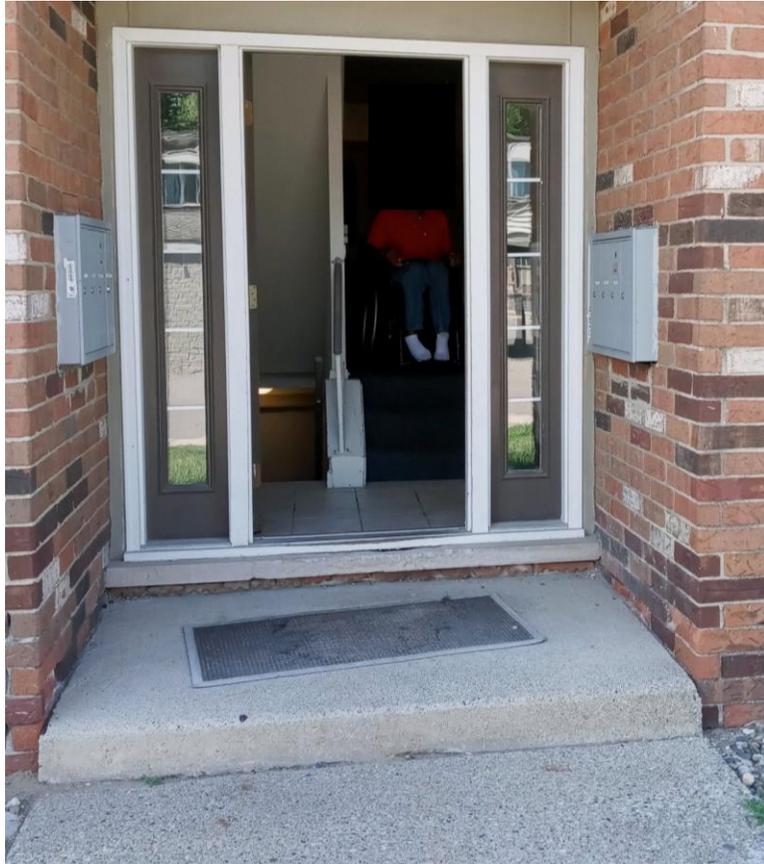
“So, normally for me to get in the house, if I go visit a friend or a house party, ...somebody would just have to pick me up, and throw me over the steps, [to] get in the house.”

- Male, Age 47, 10 years since injury, paraplegia-complete



Photovoice:

Male, age 65, paraplegic, 25 years since injury



“I just turn around and go down backwards...”



Barriers to Employment

Veteran, but injury was not service-related so:

- “it’s hard to get into the system”

Recently got hired as a census taker (2020 Census)

- “I need the money”

But due to restrictions in accessing buildings, needs an in-office position:

- “unless it's a unit or apartment building, it would be an issue as far as getting access”
- “They can't just send you somewhere where there's five flights of stairs and you gotta go in person”

Importance of Socioeconomic Resources (Riedman, et al., 2020)

Insurance:

- Michigan's No-Fault Insurance law for motor vehicle accidents
- Veteran Affairs (VA) benefits to military personnel who sustained SCI on duty

“If you have a service-connected disability, VA also helps out with ...converting your house to be handicap accessible...”

“We gutted the whole house basically, widened all the hallways, ...all the doors. So, all the doorways are 36 inches wide. And ...instead of doorknobs, they have door handles where they turn down. And then ... it's all wooden floors. And then the parts of the house where it's carpeted, I have... a thin carpeting....”

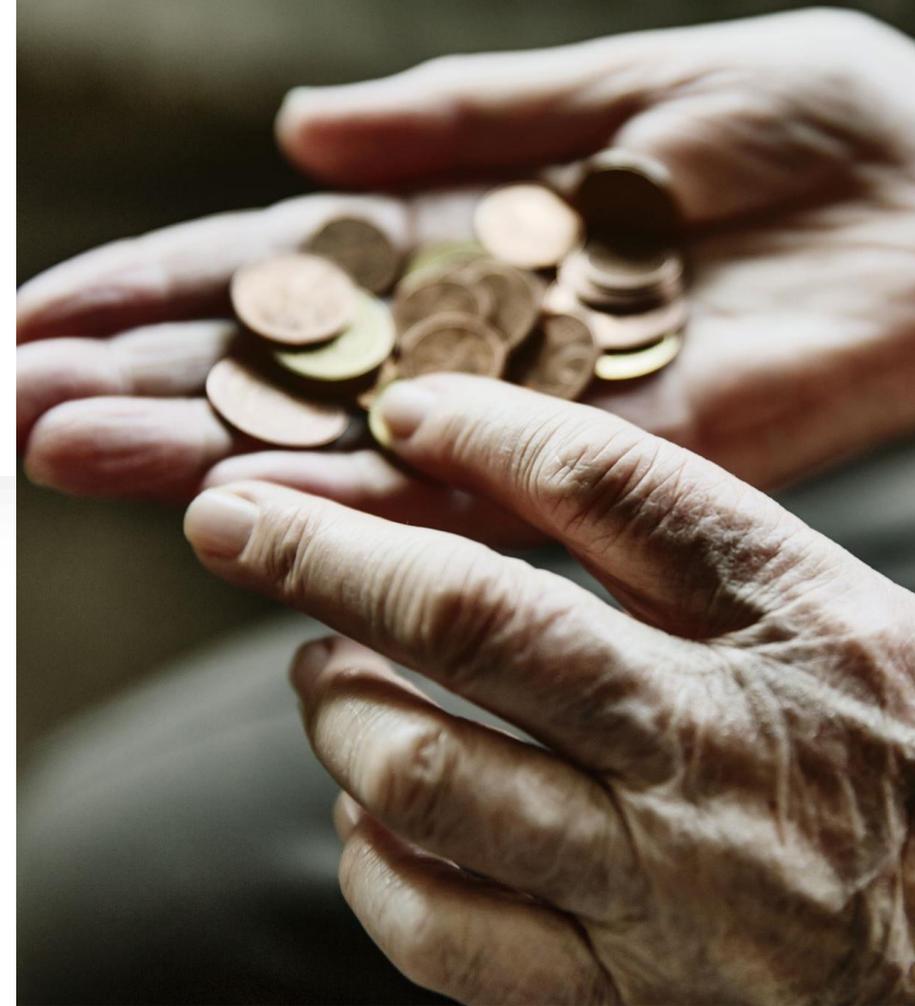
- male, age 47, 15 years since injury, paraplegia-complete

Importance of Socioeconomic Resources

(Riedman, et al., 2020)

“I’m on disability but I’m also eligible for SSI, so that means I’m still needs-based eligible.... that means a very limited income for somebody. You know, so, dealing with that financial limitation, ... **I can’t just go and buy... or I can’t go and pay for somebody to do the metalwork that I need done for my seating.**”

(male, age 56, 31 years since injury, tetraplegia-complete)



Implications for Data Needs

Data to Capture the Role of the Built Environment for Disability



Linked administrative medical claims data



Linked survey data



Self-reported survey data on environmental barriers (FABS)



Qualitative data



Imagery



Sharing Neighborhood Data

No Need to “Reinvent the Wheel”

The Birth of NaNDA (2019)

Public Transit Disability Dashboard (Twardzik, et al. 2024)

<https://disabilityhealth.jhu.edu/transitdashboard/>



JOHNS HOPKINS
UNIVERSITY

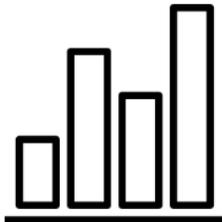
Disability Health
Research Center

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Public Transit Disability Dashboard

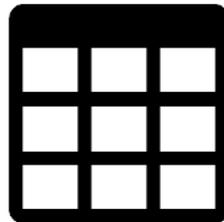
Public Transit

Scores



Public Transit

Methods



Public Transit

Source Links



Using Google Street View



9. Quality of Sidewalks (CHECK ALL THAT APPLY)

1) Sidewalks are in place on both sides of the street

2) Sidewalks are continuous (no missing segments)

3) Snow is visible on sidewalks

4) Sidewalks are smooth/flat/unbroken

5) Sidewalks are free from obstructions

(e.g. poles, signs, shrubs, tree roots, cars, etc.)

6) Sidewalks are wide enough for two people to pass comfortably

Leveraging AI

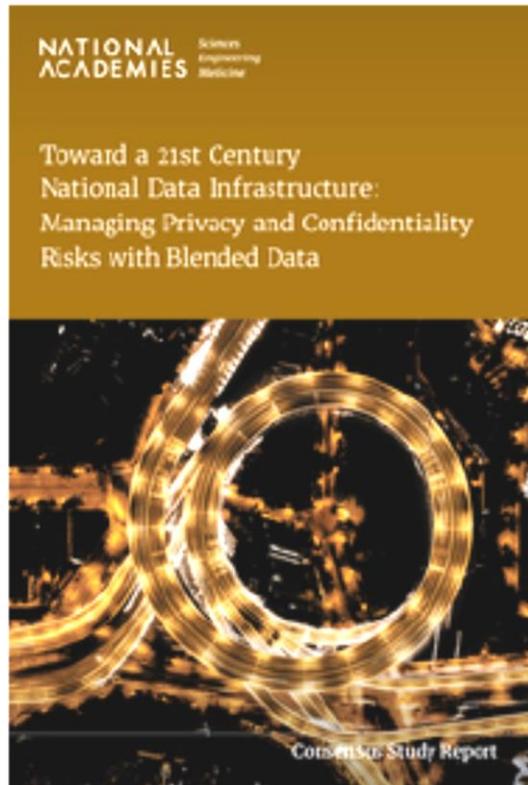
AI offers opportunities for leveraging imagery data to create fine detailed metrics of the environment that matter for people with disabilities.



- Training machine learning with high resolution aerial imagery of intersections nationwide
 - % with sidewalks
 - % with curb cuts
 - % with crosswalks

Moving towards Blended Data

(National Academies of Science, Engineering and Medicine, CNSTAT 2023, 2023a)



- Blended data = combined sources of previously collected data
- Incorporate uncertainty in data linkages
- Management of disclosure risks inherent in blended data

Toward a 21st Century National Data Infrastructure: Managing Privacy and Confidentiality Risks with Blended Data (2024)

A black and white photograph of a person walking up a dark staircase. The person is silhouetted against a bright light source at the top of the stairs, creating a strong backlight effect. The staircase has metal railings on both sides. In the background, a multi-story building with many windows is visible, suggesting an urban or institutional setting. The overall mood is one of ascent and progress.

Integrating environmental
data is so important
because...

“Disability is the expression of a physical or a mental limitation in a social context.”

Saad Nagi, 1965



Thank you



NaNDA



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