urban science

MDPI

Article

When It Rains, It Pours: Compounding Housing Issues and Precarity Among Disabled Adults in the United States, 2019–2022

Chloe M. Sellers [1], Daniel S. Pasciuti [2], Madelief L. Tilder [1,2], Lauren B. Leeder [2] and Raeda K. Anderson [1,2,*]

[1] The Virginia C. Crawford Research Institute, Shepherd Center, Atlanta, GA 30309, USA; chloe.sellers@shepherd.org (C.M.S.); madelief.tilder@shepherd.org (M.L.T.)
[2] Department of Sociology, Georgia State University, Atlanta, GA 30303, USA; dpasciuti@gsu.edu (D.S.P.); lleeder1@student.gsu.edu (L.B.L.)
* Correspondence: raeda.anderson@shepherd.org

Abstract: The multi-decade housing crisis has emerged as a critical aspect of both the ability of individuals to remain housed within the community as well as a critical health concern that impacts the long-term well-being through the presence or absence of both physical space and facilities in the home. We employ national state-level data from the American Community Survey (ACS) and aggregated measures from the Annual Disability Statistics Compendium to analyze six housing metrics—complete kitchen and plumbing access, overcrowding, housing cost burden, old housing, and poor housing. Using a lagged time-series regression analysis, we found the prevalence of cost burdened households in 2022 when accounting for individual and compounding housing metrics, and housing types, from 2019 to 2022, across community-living adults by disability status. Ultimately, we demonstrate that the carryover effects of housing issues is a greater contributor to housing cost burden than concurrent housing issues. This compounding and multi-faceted crisis further demonstrates that housing conditions and affordability need to be considered primary factors in the study and support of people with disabilities. Additionally, there is an urgent need for inclusive housing policies that address the challenges faced by disabled individuals to promote equitable access to sustainable, quality housing as a fundamental component of public health.

Keywords: housing affordability; disability; social determinants of health; housing inequality; housing issues; housing type

Citation: Sellers, C.M.; Pasciuti, D.S.; Tilder, M.L.; Leeder, L.B.; Anderson, R.K. When It Rains, It Pours: Compounding Housing Issues and Precarity Among Disabled Adults in the United States, 2019–2022. *Urban Sci.* **2024**, *8*, 251. https://doi.org/10.3390/urbansci8040251

Academic Editor: Thomas W. Sanchez

Received: 7 November 2024
Revised: 7 December 2024
Accepted: 11 December 2024
Published: 13 December 2024

1. Introduction

Housing costs have become a major public health concern, which is a situation rooted in the affordability crisis from the Great Recession of 2008 and further intensified by the COVID-19 pandemic [1]. Broadly, high-income countries have been experiencing a prolonged and multifaceted housing crisis leading to increasing rates of housing inequality due to both rising housing costs and declining housing welfare policies [2]. This global affordability crisis has predominantly focused on overall housing affordability [3] with limited research on the specific consequences to vulnerable populations.

Housing cost burden and disability have most commonly been examined outside of the United States but has been largely circumscribed to forms of public housing or with disability grouped into older adults or socially vulnerable groups [2,4]. Some limited research has examined housing cost burden and disability. In the United Kingdom, research has found that housing costs are significantly higher for disabled adults [5]. In Korea, these higher housing cost burdens experienced by disabled adults are associated with poorer mental health [6]. Analysis of over two dozen EU countries showcased that when people fall behind in housing payments, their health deteriorates substantively for everyone, including people with disabilities [7]. In attempts to reduce the effect of housing cost burden, Sweden has gone so far as to generate a substantive amount of public housing for disabled adults [8].

In the United States, the intersection of housing and health manifests itself most dramatically where housing burdens disproportionately impact minority groups and individuals with disabilities [1]. The prevalence of older and inadequately maintained housing further exacerbates social exclusion and health risks for disabled individuals [9–11]. Thus, secure housing is not only vital for meaningful community engagement for disabled individuals but also serves as a significant social determinant of health [1].

Thus, research must consider the multi-dimensional nature of housing through cost burdens, upkeep and maintenance, renting vs. ownership, and types of housing, which create a continuous crisis of precarity for adults with disability that intersects with long-term health disparities for adults with disabilities in the United States.

1.1. Housing as a Social Determinant of Health for Disability

Social determinants of health are defined by the World Health Organization as 'non-medical factors that influence health outcomes. They are the conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life' [12,13]. Some of those systems are social norms, economic policies, and political systems. Social determinants of health account for between 30 and 55% of health outcomes [12,13]. These factors are often distributed unequally through discriminatory systems and can therefore have a drastic impact on a person's quality of life [14,15].

Due to this unequal distribution, social determinants of health are even more impactful for quality of life for those with disabilities. Social determinants of health deficits are associated with a significant increase in disability based on the current literature [16–18]. However, those with disabilities are still less visible than other social groups despite the major impact social determinants of health have on this population [19–21]. It is also important to note that not all disability is the same, and "scholars caution against generalizing from such research to a population with a substantially different health profile" [22]. While avoiding generalization, it is key to understand the intersectionality of those with disabilities.

While housing is understood as a social determinant of health in relation to the general population, the role of disability has generally been left unexplored in the United States. There are very few studies that focus on housing as a social determinant of health for those with disabilities The work surrounding housing and social determinants of health has been a keen focus of rehabilitation scholars examining the role of housing in terms of community and resource access [23–25]. The intersectionality of disability has often been left behind. When researched, housing is often marginal and not the primary focus of the study [16,18]. Friedman conducted a study on disparities in social determinants of health amongst people with disabilities. They found that multiple characteristics were correlated with lower social determinants of health, one of which was residence type [16]. Frier also found that there was a compounding effect for those with disabilities when it came to a lack of employment and the increased cost burden of housing [18]. These studies move us in the right direction to illustrate the multi-faceted impact that housing has on an individual's social determinants of health; however, neither were conducted in the United States, nor was the primary focus of their study on housing as a social determinant of health in relation to those with disabilities.

The intersection of housing and disablement is a complex and critical area of study, particularly as individuals with disabilities seek to meet their needs while living in the community. Specifically, housing aspects that potentially offer unique challenges to those with disabilities include indicators such as housing hazards, amenities, retrofitting, and assistive devices, as well as neighborhood conditions and urban–rural differences. The need to meet additional health and housing needs, including accessibility and safety, combined with often greater employment instability, makes persons with disabilities more susceptible to housing crises and directly impacts health outcomes [26,27].

1.2. Housing Type

Housing planning and policy fails to account for housing that is available to persons with disabilities, causing social exclusion for disabled individuals [28]. The need for accessible housing increases when measuring the expected lifetime of a housing unit as opposed to measuring at a single point in time for an individual household. The probability of a housing unit being occupied by a disabled resident was estimated as substantial in the United States, pointing to a greater need for accessible single-family detached units [29].

Higher odds of disability were found amongst those who lived in mobile homes or large apartment buildings compared to those living in single-family homes [29]. Furthermore, previous findings noted that disabled persons were more likely to experience compounding housing issues, and they were more likely to live in apartments and mobile homes [9,13]. Additionally, they may face housing that is not properly upkept and has had little maintenance [13].

1.3. Housing Issues

In the United States, many disabled individuals actively participate in the rental market. However, this creates unique challenges for individuals with disabilities: first, rental prices have increased dramatically, and second, it is often much harder to introduce the improvements and accessibility changes often needed for persons with disabilities [30,31]. On average, individuals with disabilities spend 131% of their monthly income on rent for a one-bedroom apartment [1]. For individuals who may rent or own a house, other challenges exist. For instance, attributes of the house can generate other costs that add to and increase the disabled person's cost burden beyond the rent itself, such as deficiencies in plumbing and kitchen facilities. Not only do these deficiencies compound cost burdens for individuals with disabilities, but this cost burden is exacerbated by the fact that individuals with disabilities are more likely to live alone, although this reduces the prevalence of overcrowded housing in comparison to adults without disabilities [31]. Due to cost, many adults with disabilities opt to live in older housing, which presents its own challenges. Older buildings and an overall lack of quality housing for disabled individuals is an ongoing concern. A lack of space, standardization in design, cause an overall failure to allow an individual to live comfortably and humanely [11]. Specifically, a lack of quality space including standardization in design for individuals with disabilities leads to further disparities for a group that deserves to live comfortably and humanely. Disabled individuals may face inappropriate housing that is unsuitable and overall ableist in its design processes.

For this study, compounding housing issues is defined as having incomplete plumbing, an incomplete kitchen, and old housing. This type of compounding housing issues leads to further burdens for individuals with disabilities, such as additional health risks to an otherwise at-risk population for worse health [32]. Compounding housing issues make community living burdensome as residents become more susceptible to added health risks [1]. Moreover, successful rehabilitation requires a safe, stable and affordable home to return to the community in. In this context, housing improvements can lead to improved health and successful rehabilitation and a return to the community and home.

Although it is well known that compounding poor housing issues is associated with poorer health for individuals with disabilities, no studies have examined the relationship between compounding housing issues and how compounding housing issues further adds to other housing issues as well as housing cost burden.

To that end, the purpose of this research was to examine housing precarity with multifaceted housing issues that aggregate across time. To accomplish this, we examine how singular housing issues, compounding housing issues, and housing type are different for disabled adults compared to non-disabled adults. Then, we examine the effect of singular housing issues, compounding housing issues, and housing type on housing cost burden both as a concurrent effect as well as a lagged effect for disabled adults.

2. Materials and Methods

2.1. Materials

We utilized national state-level data from 2019 to 2022 within the American Community Survey (ACS), a nationally representative online study conducted by the US census annually, examining a wide breath of topics including housing and disability. Data for the years 2019 to 2022 provide comprehensive coverage of the existing housing crisis utilizing the most recent data at the time of this analysis. This four-year snapshot provides the ability to examine concurrent and carryover effects: concurrent effect 2022, one-year immediate past effect 2021, two-year lagged effect 2020, and three-year lagged effect 2019. ACS data are provided for state-level measures of all 50 states. States with low response rates which do not pass the census's ethical standards for small N data are omitted from reporting and thus also omitted from this analysis.

The ACS measures housing issues across six housing metrics: lacks complete kitchen, lacks complete plumbing, overcrowded home environment, housing cost burden, old housing, and compounded housing issues. The ACS also measures types of housing such as house, apartment, or mobile home, which encompasses all other housing types. In addition to housing metrics, the ACS also requests information on individual self-reported disability states. This housing and disability data were combined to generate state-level metrics of prevalence for housing issues and housing types by disability status.

Data for this study are supplemented with state-level aggregated measures from the Annual Disability Statistics Compendium. Data from the Annual Disability Compendium utilizes the U.S. Census Bureau American Community Survey, Public Use Microdata Sample (PUMS) with Experimental Weights for its calculations.

2.1.1. Housing Cost Burden Measures

Households are classified as having a 'housing cost burden' if the household residents spent more than 30% of their household income on housing costs. Housing cost includes rent or mortgage payments; however, housing cost does not include other housing costs such as household maintenance, repairs, and utilities [33]. The Census Bureau released a report on Multidimensional Deprivation in the spring of 2019. The Multidimensional Deprivation Index (MDI) consists of six dimensions: standard of living, health, education, economic security, housing quality, and neighborhood quality. One criticism of the MDI is that the neighborhood quality dimension was based on county level data. To be considered a deprived county, the county had to be in the bottom 10 percent of counties, as measured by crime, pollution, and access to food, for at least two out of the three metrics. Six alternative neighborhood quality measures, available at the census tract or block group level, are discussed in this paper. To evaluate these different neighborhood quality measures, three criteria are examined: the geographic level at which the measure is available; the relationship of the neighborhood quality measures to several county level social and economic characteristics; and the relationship of the neighborhood quality measures to tract level social and economic characteristics. Using these criteria, the original measure from the 2019 MDI report performs the worst, and the national Area Deprivation Index (ADI) measure performs the best. When the national ADI is used to measure neighborhood quality, the MDI rate is not statistically different than the original MDI for the United States. However, the MDI rate is higher than the original MDI in 21 states, lower than the original MDI in 10 states and the District of Columbia, and not statistically different than the original MDI in 19 states [33].

2.1.2. Housing Issues Measures

The metric 'lacks complete kitchen' applies to housing units missing one or more of the following essential kitchen components: a refrigerator, a stove or range, or a sink with faucet [33]. 'Incomplete plumbing' refers to the percentage of state residents who lack access to both hot and cold running water and/or a shower or bathtub [33]. 'Overcrowded home environment' is defined as having more than twice the number of occupants compared to

the number of bedrooms in a home [33]. 'Housing cost burden' describes situations where residents spent more than 30% of their household income on housing costs [33]. Housing is considered 'old housing' if it was constructed in or prior to 1990, making it at least 30 years old at the time the data were collected [33].

'Compounded housing issues' is derived from the poor housing measure which identifies all households that experience at least two of the described housing measures: lacks complete kitchen, lacks complete plumbing, and overcrowded home environment. The metric is a comprehensive measure to include residents who may not be income poor but experience accumulating deprivation of quality and livability within their homes [33,34].

2.1.3. Housing Type Measures

Housing types are measured by state-level percentages of adults (ages 18–64) living in communities in the United States, who reside in houses [33], apartments [33], or mobile homes [33].

2.1.4. Community-Living Adults by Disability Measures

Community-living adults are all individuals aged 18 and older in the United States who at the time of data collection resided outside of institutional settings. Institutional settings include correctional facilities, nursing facilities, group homes, dorms, hospitals or residential healthcare facilities.

Disabled adults are defined as persons 18 years and older who have at least one of the six types of disabilities defined in the United States of America by the American Community Survey: hearing difficulty, vision difficulty, cognitive difficulty, ambulatory difficulty, self-care difficulty, and independent living difficulty [35]. Non-disabled adults are all individuals 18 years of older who do not experience any of the listed disabilities.

2.2. Methods

In the first stage of analysis, we compared state-level housing issues between community-living disabled persons and non-disabled persons for the years 2019 to 2022 using paired sample *t*-tests. For each state, we have the prevalence as percent of disabled and non-disabled persons for these measures, making these variables well suited for paired sample *t*-tests. These results and descriptive statistics are presented in Table 1. After establishing a clear distinction between disabled persons and non-disabled persons, we then examined the averaged cumulative trends of the 4-year metrics of housing burdens, housing issues, and housing types to consider potential state and regional trends in housing. Finally, in our third stage of analysis, we utilized lagged time-series regression analysis to examine both the lagged individual year and compounding year lagged effects of housing cost burden of disabled households in 2022 issues as predicted by the percent of housing type, singular housing issue metrics, and compounding housing issue metrics from 2019 to 2022.

Single Year Lagged Time-Series Regression Equations:

- $Y_{costburden2022} = \beta_0 + \beta_1 X_{HousingType2022} + \beta_2 X_{HousingIssue2022} + \beta_3 X_{CompoundingHousingIssues2022} + \varepsilon t$
- $Y_{costburden2022} = \beta_0 + \beta_1 X_{HousingType2021} + \beta_2 X_{HousingIssue2021} + \beta_3 X_{CompoundingHousingIssues2021} + \varepsilon t$
- $Y_{costburden2022} = \beta_0 + \beta_1 X_{HousingType2020} + \beta_2 X_{HousingIssue2020} + \beta_3 X_{CompoundingHousingIssues2020} + \varepsilon t$
- $Y_{costburden2022} = \beta_0 + \beta_1 X_{HousingType2019} + \beta_2 X_{HousingIssue2019} + \beta_3 X_{CompoundingHousingIssues2019} + \varepsilon t$

Compounding Lagged Time-Series Regression Equation:

- $Y_{costburden2022} = \beta_0 + \beta_1 X_{HousingType2022} + \beta_1 X_{HousingType2021} + \beta_1 X_{HousingType2020} + \beta_1 X_{HousingType2019} + \beta_1 X_{SingleHousingIssues2022} + \beta_1 X_{SingleHousingIssues2021} + \beta_1 X_{SingleHousingIssues2020} + \beta_1 X_{SingleHousingIssues2019} + \beta_1 X_{CompoundingHousingIssues2022} + \beta_1 X_{CompoundingHousingIssues2021} + \beta_1 X_{CompoundingHousingIssues2020} + \beta_1 X_{CompoundingHousingIssues2019} + \varepsilon t$

Table 1. Prevalence of Housing Issues.

	Adults with Disabilities		Adults Without Disabilities		Analysis: Paired Sample *t*-Tests	
	M	**SD**	**M**	**SD**	**t**	***p***
2019 State Level Prevalence						
Housing Type						
House	64.78	8.09	74.14	7.15	13.580	***
Apartment	25.34	10.65	20.03	8.97	−8.246	***
Mobile Home	10.47	5.90	5.94	4.37	−12.532	***
Singular Housing Issue						
Lacks Kitchen	1.13	0.66	0.49	0.30	−8.755	***
Lacks Plumbing	0.81	0.64	0.39	0.39	−8.345	***
Overcrowded	3.73	1.77	3.81	2.16	0.743	
Housing Cost Burden	33.03	4.99	20.1	3.85	−26.169	***
Old Housing	30.81	9.76	38.11	10.81	16.699	***
Compounding Housing Issues						
2 or More Housing Issues	14.21	3.04	6.94	1.89	−26.556	***
2020 State Level Prevalence						
Housing Type						
House	65.53	8.33	75.52	7.33	18.234	***
Apartment	24.68	11.34	18.82	9.01	−10.253	***
Mobile Home	10.38	6.31	5.76	4.19	−10.726	***
Single Housing Issue						
Lacks Kitchen	1.09	0.54	0.46	0.26	−10.114	***
Lacks Plumbing	0.78	0.82	0.35	0.35	−5.134	***
Overcrowded	3.70	1.89	3.78	2.25	1.248	
Housing Cost Burden	32.75	4.96	19.78	4.02	−30.156	***
Old Housing	30.18	9.31	37.59	10.00	16.511	***
Compounding Housing Issues						
2 or More Housing Issues	13.94	3.04	6.97	2.01	−26.614	***
2021 State Level Prevalence						
Housing Type						
House	65.15	8.36	75.13	7.35	17.348	***
Apartment	25.66	11.18	19.35	9.01	−9.893	***
Mobile Home	9.73	5.67	5.64	4.16	−13.301	***
Singular Housing Issue						
Lacks Kitchen	1.12	0.61	0.50	0.26	−8.424	***
Lacks Plumbing	0.88	0.89	0.40	0.39	−5.569	***
Overcrowded	4.01	1.87	3.86	2.06	−0.418	
Housing Cost Burden	33.81	5.12	21.4	4.23	−2.455	***
Old Housing	32.81	10.02	40.68	11.17	17.969	***
Compounding Housing Issues						
2 or More Housing Issues	15.25	3.27	7.88	2.16	−23.452	***
2022 State Level Prevalence						
Housing Type						
House	64.19	7.95	74.62	7.67	19.077	***
Apartment	26.6	11.03	19.88	9.40	−11.069	***
Mobile Home	9.20	5.95	5.50	4.13	−11.810	***
Singular Housing Issue						
Lacks Kitchen	1.13	1.06	0.53	0.30	−5.325	***
Lacks Plumbing	0.84	1.08	0.40	0.46	−4.782	***
Overcrowded	3.87	1.92	3.80	2.01	−0.495	***
Housing Cost Burden	28.24	4.09	16.81	3.46	−30.272	***
Old Housing	34.75	10.14	42.01	11.48	17.572	***
Compounding Housing Issues						
2 or More Housing Issues	1.79	1.33	1.24	0.77	−4.197	***

*** $p < 0.001$.

A lagged time-series regression analysis allows researchers to consider the time delay between the current value and its past values or associated values. In this context, we consider housing cost burden in 2022 by components of housing type and housing issues in previous years to capture the potential temporal patterns in housing precarity for disabled persons. These results are displayed in Table 2. Our combined, compounding lagged time-series regression analysis considers the combined effects of multiple years, housing issues, and housing types, on the housing cost burden in 2022. These results are displayed in Table 3.

Utilizing a lagged dependent variable in situations where the dependent variable (t) is a function of $t - 1$, modified by new information, captures the dynamic specification of the process being modeled. This both creates an improved specification of the underlying model and reduces or eliminates the effects of autocorrelation by downward biasing of the coefficients of the explanatory variables [36]. In this way, we correctly specify both our theoretical model, where previous housing conditions are generally continuations of previous housing conditions, and mathematically, by controlling for the autocorrelation of explanatory variables in our analysis.

Data in this study were curated through SPSS (version 29.0.2.0), analyzed via SPSS and STATA (version 18.5), and visualizations were generated through Excel (version 16.91.1).

Figure 1 is a research flow diagram outlining the data curation and analytical process used for this study.

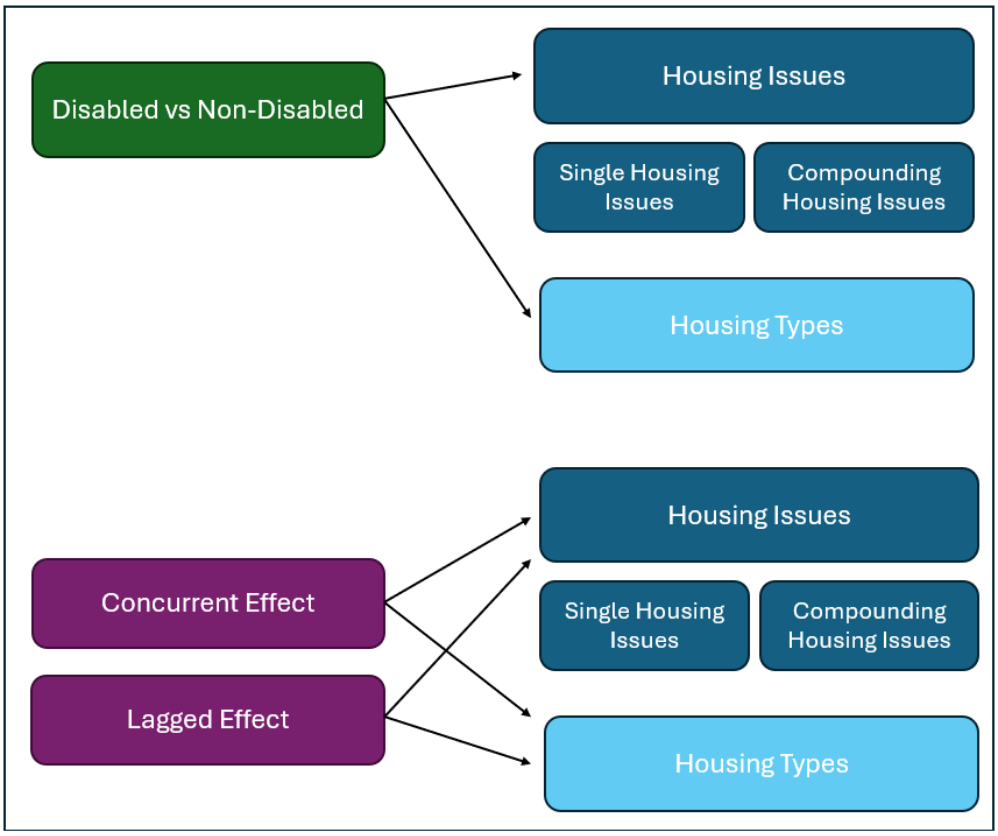

Figure 1. Research flow diagram.

Table 2. Concurrent and lagged year time-series regression analysis, predicting housing cost burden by housing type and housing issues.

	Housing Type								**Housing Type, Single Housing Issue, and Compounding Housing Issues**								**Housing Type and Compounding Housing Issues**							
	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**		**Model 6**		**Model 7**		**Model 8**		**Model 9**		**Model 10**		**Model 11**		**Model 12**	
	2019		**2020**		**2021**		**2022**		**2019**		**2020**		**2021**		**2022**		**2019**		**2020**		**2021**		**2022**	
	β	**sig**	**β**	**sig**	**β**	**sig**	**β**	**sig**	**β**	**sig**	**β**	**sig**	**β**	**sig**	**β**	**sig**	**β**	**sig**	**β**	**sig**	**β**	**sig**	**β**	**sig**
Housing type [1]																								
Apartment	0.30	***	0.34	***	0.30	***	0.27	***	0.26	**	0.12		0.21	**	0.21	***	0.19	**	0.20	**	0.17	**	0.27	***
Mobile home	−0.03		−0.01		−0.04	***	−0.04		0.09		0.01		0.09		0.03		−0.02		−0.04		−0.04		−0.04	
Singular housing issue																								
Incomplete kitchen									0.35		0.85		1.33		1.48									
Incomplete plumbing									−1.73		−0.99		−2.02	*	−1.47									
Old housing									−0.01		−0.03		−0.04		−0.04									
Overcrowded home									0.41		0.54	*	0.58	*	0.87	*								
Compounding housing issues																								
2 or more housing issues									0.37		0.47	*	0.42	*	−0.64		0.54	**	0.53	**	0.59	**	−0.04	
Intercept	20.91	***	20.13	***	21.08	***	21.46	***	15.78	***	17.45	***	15.44	***	21.20	***	15.98	***	16.42	***	15.39	***	21.55	***
Model fit	0.5360		0.6276		0.5230		0.5651		0.7028		0.8175		0.7409		0.6337		0.6128		0.7088		0.6278		0.5560	

[1] reference group- living in house. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Note: Models examining housing type and singular housing issues reported in Appendix A.

Table 3. Compounding year lagged time series regression analysis; housing cost burden in 2022, predicted by housing issues and housing type.

	Model 1		Model 2		Model 3		Model 4	
	2022		2022–2021		2022–2020		2022–2019	
Housing Type								
House								
2019							−0.05	
2020					−0.18		−0.17	
2021			−0.11		−0.10		−0.09	
2022	−3.32	***	−0.21		−0.05		−0.03	
Intercept	49.00		49.07		49.67		49.89	
Model Fit (r^2)	0.3831		0.3752		0.3819		0.3701	
Apartment								
2019							0.12	
2020					0.43	**	0.41	**
2021			0.18		0.03		−0.03	
2022	0.28	***	0.10		−0.17		−0.20	
Intercept	20.72		20.86		21.51		21.37	
Model Fit (r^2)	0.5724		0.573		0.6542		0.6515	
Mobile Home								
2019							0.37	
2020					−0.43	†	−0.49	†
2021			−0.19		−0.17		−0.21	
2022	−0.39	***	−0.16		0.26		−0.01	
Intercept	31.8		31.26		31.31		31.05	
Model Fit (r^2)	0.3131		0.2398		0.2699		0.2764	
Single Housing Issues								
Incomplete Kitchen								
2019							−1.66	
2020					0.21		0.55	
2021			1.57		2.89		3.51	
2022	−0.06		−0.66		−1.22		−0.89	
Intercept	28.31		27.47		26.52		27.06	
Model Fit (r^2)	−0.0201		−0.0232		−0.0507		−0.0674	
Incomplete Plumbing								
2019							−0.39	
2020					−5.63	*	−5.38	†
2021			0.01		5.67	†	5.58	†
2022	−0.38		−0.27		−0.95		−0.85	
Intercept	28.55		28.60		28.65		28.76	
Model Fit (r^2)	−0.0104		−0.0494		0.1047		0.0696	
Overcrowded								
2019							−0.11	
2020					0.91	†	0.76	
2021			0.35		−0.35		0.29	
2022	1.17	***	0.92	*	0.58		0.30	
Intercept	23.71		23.25		23.81		23.50	
Model Fit (r^2)	0.2881		0.2847		0.2804		0.2794	

Table 3. *Cont.*

	Model 1		Model 2		Model 3		Model 4	
	2022		2022–2021		2022–2020		2022–2019	
Old Housing								
2019							−0.29	
2020					−0.33	†	−0.21	
2021			0.09		0.31		0.36	
2022	−0.18	**	−0.27		−0.19		0.08	
Intercept	34.515		34.556		34.779		34.33	
Model Fit (r^2)	0.1844		0.1705		0.2108		0.213	
Compounding Housing Issues								
2 or More Housing Issues								
2019							0.11	
2020					0.57	**	0.53	**
2021			1.09	***	0.67	***	0.61	**
2022	0.51		−0.61	*	−0.50	†	−0.52	†
Intercept	27.33		12.71		10.93		10.87	
Model Fit (r^2)	0.007		0.6411		0.715		0.7099	

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

3. Results

3.1. Housing Issues and Housing Types by Disability

Our first stage of analysis, Table 1, presents a comparison of state-level housing issues between community-living disabled persons and non-disabled persons for the years 2019 to 2022 using paired sample *t*-tests.

For housing type from 2019 to 2022, adults with disabilities are more likely to live in apartments and mobile homes, while non-disabled adults are more likely to live in houses. For singular housing issues from 2019 to 2022, adults with disabilities are more likely to have an incomplete kitchen, incomplete plumbing, and have high housing cost burden while adults without disabilities are more likely to live in old housing. For compounding housing issues from 2019 to 2022, adults with disabilities are more likely to have multiple housing issues. To that end, there are significant and substantive differences between disabled and non-disabled adults on types of housing, singular housing issues, and compounding housing issues where disabled adults consistently have poorer housing. Notably, the only housing measure for which disabled and non-disabled adults do not significantly differ is for living in a home that is overcrowded.

Adults with disabilities also were found to have higher rates in four out of six housing issues: incomplete kitchen ($M_{disabled} = 1.13$, $M_{non\text{-}disabled} = 0.49$, $t = -8.755$, $p < 0.001$), incomplete plumbing ($M_{disabled} = 0.81$, $M_{non\text{-}disabled} = 0.39$, $t = -8.3455$, $p < 0.001$), housing cost burden ($M_{disabled} = 33.03$, $M_{non\text{-}disabled} = 20.10$, $t = -26.169$, $p < 0.001$), and poor housing ($M_{disabled} = 14.21$, $M_{non\text{-}disabled} = 6.94$, $t = -8.3455$, $p < 0.001$).

Additionally, in 2020, adults with disabilities were less likely to live in old housing ($M_{disabled} = 30.18$, $M_{non\text{-}disabled} = 37.59$, $t = -165.11$, $p < 0.001$) but more likely to experience all other housing issues: incomplete kitchen ($M_{disabled} = 1.09$, $M_{non\text{-}disabled} = 0.46$, $t = -10.114$, $p < 0.001$), incomplete plumbing ($M_{disabled} = 0.78$, $M_{non\text{-}disabled} = 0.35$, $t = -4.782$, $p < 0.001$), housing cost burden ($M_{disabled} = 32.75$, $M_{non\text{-}disabled} = 19.79$, $t = -30.156$, $p < 0.001$), and poor housing ($M_{disabled} = 13.94$, $M_{non\text{-}disabled} = 6.97$, $t = -26.614$, $p < 0.001$).

Furthermore, in 2021, the prevalence of having an incomplete kitchen ($M_{disabled} = 1.12$ $M_{non\text{-}disabled} = 0.50$, $t = -8.424$, $p < 0.001$), incomplete plumbing ($M_{disabled} = 0.88$, $M_{non\text{-}disabled} = 0.40$, $t = -5.569$, $p < 0.001$), housing cost burden ($M_{disabled} = 33.81$, $M_{non\text{-}disabled} = 21.40$, $t = -2.455$, $p < 0.001$), and poor housing ($M_{disabled} = 15.25$, $M_{non\text{-}disabled} = 7.88$, $t = -23.452$, $p < 0.001$) was higher for adults with disabilities than for adults without disabilities but lower for living in old housing ($M_{disabled} = 32.81$, $M_{non\text{-}disabled} = 40.68$, $t = 17.969$, $p < 0.001$).

In 2022, adults with disabilities were less likely to live in old housing ($M_{disabled}$ = 34.75, $M_{non\text{-}disabled}$ = 42.01, t = 17.572, $p < 0.001$), but they more likely to experience all other housing issues: lacking complete kitchen ($M_{disabled}$ = 1.13, $M_{non\text{-}disabled}$ = 0.53, t = −5.325, $p < 0.001$), lacking complete plumbing ($M_{disabled}$ = 0.84, $M_{non\text{-}disabled}$ = 0.40, t = −5.569, $p < 0.001$), housing cost burden ($M_{disabled}$ = 33.81, $M_{non\text{-}disabled}$ = 21.40, t = −2.455, $p < 0.001$) and poor housing ($M_{disabled}$ = 1.79, $M_{non\text{-}disabled}$ = 1.24, t = −4.197, $p < 0.001$).

The results from Table 1 clearly demonstrate that overall, adults with disabilities overwhelmingly experience more housing issues than adults without disabilities, both across housing issues and over the course of years. This clear distinction validates our second stage of analysis where we consider the effects on just households with disabled individuals. In Figure 2, we examine the average cumulative trends of the 4-year metrics of housing burdens, housing issues, and housing types by state to consider potential state and regional trends in housing.

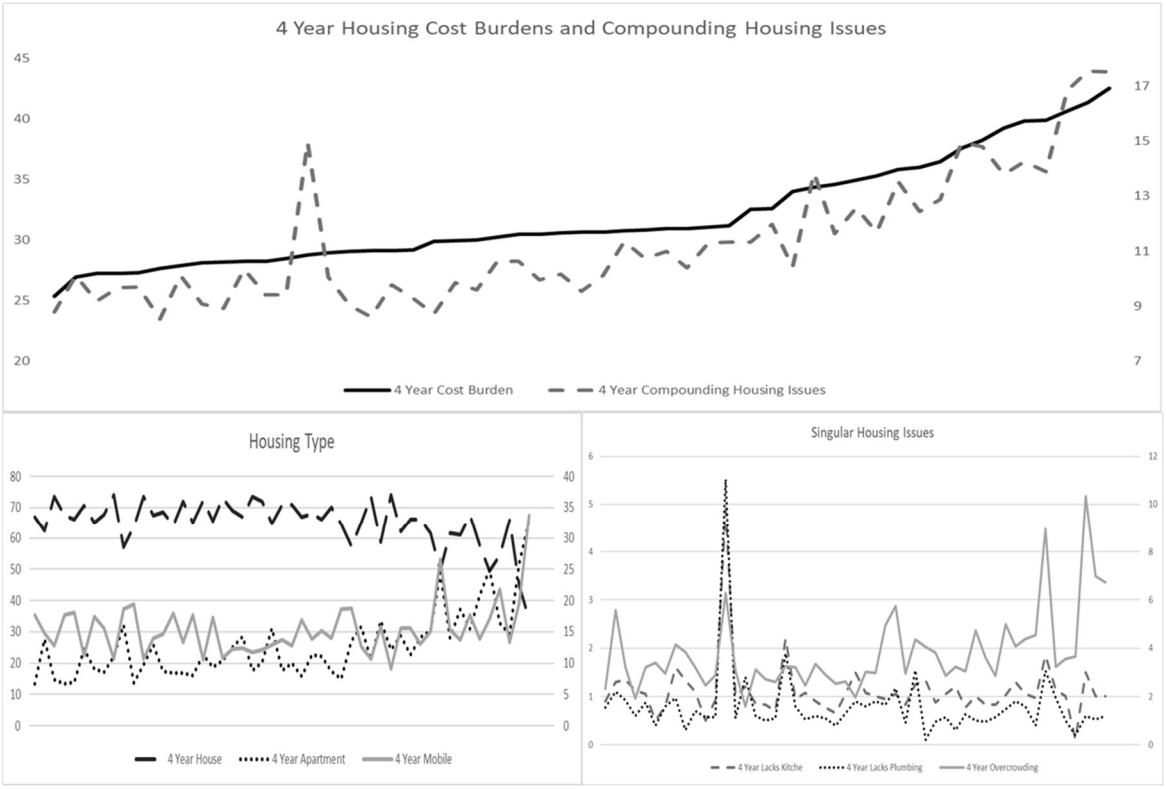

Figure 2. Four-year average percentage for persons with disability.

In Figure 2, the top chart demonstrates a high association when comparing the 4-year averaged housing cost burdens and compounding housing issues by state. The bottom left chart illustrates the relative differences in housing type by states, indicating that although disabled households were significantly more likely to live in an apartment or mobile home than non-disabled persons (displayed in Table 1), most disabled persons also live in single family homes throughout the United States. Finally, the bottom right chart demonstrates singular housing issues across states, demonstrating some key differences in state-level metrics. Specifically, states with overcrowding as the key housing issue are generally distinct from states where plumbing and kitchen issues were the predominant housing issues. Only Alaska (AK) ranked as one of the top five states across all three housing issues.

3.2. Housing Cost Burden by Prevalence of Housing Issues and Types: Individual Year Lagged Effects

Table 2 includes the third stage of analysis and contains 12 models utilizing a lagged-time-series regression analysis to examine the lagged year effects of housing cost burden of

disabled households in 2022 issues as predicted by the percent of housing type, singular housing issue metrics, and compounding housing issue metrics for each of the previous 3 years (2019–2021) and 2022.

Models 1–4 analyze the association between the housing cost burden percent in 2022 as predicted by the percent of disabled households type of housing for 2019–2022. Disabled adults living in apartments in 2019 had a strong association with having a housing cost burden in 2022 ($\beta = 0.30$, $p < 0.001$). Similarly, in 2020, disabled adults living in apartments had a strong positively associated outcome of experiencing a housing cost burden in 2022 ($\beta = 0.34$, $p < 0.001$). Disabled adults living in apartments in 2021 were more likely to experience a housing cost burden in 2022 ($\beta = 0.30$, $p < 0.001$). Alternatively, disabled adults living in mobile homes in 2021 were less likely to report having a housing cost burden in 2022 ($\beta = -0.04$, $p < 0.001$). Disabled adults residing in apartments in the year 2022 had a positive association with having a housing cost burden within the same year ($\beta = 0.27$, $p < 0.001$).

Models 5–8 presents the association between the housing cost burden percent in 2022 as predicted by the percent of disabled households experiencing their housing type, singular housing issue, and their compounding housing issues for 2019–2022. Disabled adults living in apartments for 2019 ($\beta = 0.26$, $p < 0.01$), 2021 ($\beta = 0.21$, $p < 0.01$), and 2022 ($\beta = 0.21$, $p < 0.001$) were more likely to experience a housing cost burden in 2022. Overcrowded homes occupied by disabled individuals in 2020 ($\beta = 0.54$, $p < 0.05$), 2021 ($\beta = 0.58$, $p < 0.05$), and 2022 ($\beta = 0.87$, $p < 0.05$) were more likely to face high housing cost burdens in 2022.

Alternatively, disabled adults in 2021 who encountered incomplete plumbing were less likely to have housing cost burdens in 2022 ($\beta = -2.02$, $p < 0.05$). Disabled individuals who encountered compounding housing issues in 2020 ($\beta = 0.47$, $p < 0.05$) and 2021 ($\beta = 0.42$, $p < 0.05$) also experienced high housing cost burdens in 2022.

Models 9–12 focus on the relationship between the housing cost burden percent in 2022 as predicted by the percent of disabled households experiencing their housing type and compounding housing issues for 2019–2022. Disabled individuals living in apartments in 2019 ($\beta = 0.19$, $p < 0.01$), 2020 ($\beta = 0.20$, $p < 0.01$), 2021 ($\beta = 0.17$, $p < 0.01$), and 2022 ($\beta = 0.27$, $p < 0.001$) were more likely to experience a housing cost burden in 2022 compared to disabled adults residing in mobile homes or houses. Disabled adults living in apartments for each year of 2019, 2020, 2021, and 2022 experienced a housing cost burden in 2022. Similarly, disabled households with compounding housing issues in 2019 ($\beta = 0.54$, $p < 0.01$), 2020 ($\beta = 0.53$, $p < 0.01$), and 2021 ($\beta = 0.59$, $p < 0.01$) experienced a higher housing cost burden in 2022. This demonstrates an inter-year effect in which housing issues are manifesting and persisting—creating cost barriers for basic needs like housing amongst disabled individuals and disabled households.

3.3. Annual Analysis of Individual Housing Issues and Housing Type on Housing Cost Burden

Table 3 contains our compounding lagged time-series regression analysis, predicting housing cost burden in 2022 at a state level by individual housing issues and individual types of housing. Models are built in a reverse chronological order with housing issues and housing types to predict housing cost burden in 2022. Model 1 uses only data from 2022, Model 2 uses data from 2022 and 2021, Model 3 uses data from 2022, 2021, and 2020, and finally Model 4 uses data from 2022, 2021, 2020, and 2019. This allows for improved model accuracy to consider changing and lagged temporal patterns and illustrates carryover effects of individual housing issues onto a current cost burden at a state level. Further, the use of compounding lagged effects improves the interpretability of the models and identifies causal relationships with overcoming the effects of autocorrelation among explanatory variables by the downward biasing of the coefficients of the explanatory variables [36]. Thus, the coefficients presented in Table 3 can be considered conservative estimates of the housing issues and housing type on cost burden in 2022.

Overall findings indicate that the prevalence of incomplete plumbing, overcrowded homes, and poor housing are significantly associated with housing cost burden. In 2022, disabled adults with incomplete plumbing had a negative association, while overcrowding and poor housing both have positive associations. Additionally, disabled households with multiple compounding issues have significant overall effects on future cost burdens with an r^2 above 0.7 for both Models 3 and 4 where multiple previous years are considered.

3.3.1. Housing Type

Housing type is analyzed across three distinct dwellings: houses, apartments, and mobile homes. The overall findings indicate that a higher prevalence of disabled adults living in houses in 2022 is associated with a lower housing cost burden in 2022, while a higher prevalence of disabled adults living in apartments in 2020 and 2022 is associated with a higher housing cost burden for disabled adults in 2022.

Houses. Model 1 indicates that the percent of disabled adults in 2022 that lived in houses is inversely related to the housing cost burden in 2022, accounting for 38.31% of the variability in housing cost burden ($\beta = -3.32$, $p < 0.001$, $r^2 = 0.3831$). Models 2 through 4 indicate that the multiyear prevalence of disabled adults living in houses is not a significant predictor of housing cost burden in 2022 for disabled adults.

Apartments. Model 1 indicates that the percent of disabled adults living in an apartment is positively associated with the prevalence of housing cost burden for disabled adults in 2022 ($\beta = 0.283$, $p < 0.001$), accounting for 57.24% of the variability of housing cost burden ($r^2 = 0.5724$). When combining 2021 and 2022 apartment prevalence, neither are significant predictors of housing cost burden in 2022 ($\beta_{2021} = 0.180$, $p > 0.10$; $\beta_{2022} = 0.104$, $p > 0.10$). Model 3 uses data from 2020 through 2022 for apartment prevalence to project the housing cost burden prevalence in 2022, where the prevalence of disabled adults living in apartments in 2020 is positively associated with the prevalence of holding cost burden in 2022 ($\beta = 0.432$, $p < 0.01$), accounting for 65.42% of the variability of housing cost burden in 2022 ($r^2 = 0.6542$). Similarly, in Model 4, when accounting for apartment prevalence from 2019 through 2022, the 2020 prevalence of apartment dwelling is positively associated with housing cost burden in 2022 ($\beta = 0.413$, $p < 0.01$), accounting for 65.15% of the variability of housing cost burden in 2022 ($r^2 = 0.6515$).

Mobile Homes. Model 1 indicates that the percent of disabled adults living in a mobile homes is positively associated with the prevalence of housing cost burden for disabled adults in 2022 ($\beta = -0.39$, $p < 0.001$), accounting for 31.31% of the variability of housing cost burden ($r^2 = 0.3131$). When combining 2021 and 2022 mobile home prevalence, neither are significant predictors of housing cost burden in 2022 ($\beta_{2021} = -0.19$, $p > 0.10$; $\beta_{2022} = -0.16$, $p > 0.10$). Model 3 indicates that there is a marginally negative association with the prevalence of disabled adults living in mobile homes and housing cost burden in 2022 ($\beta = -0.425$, $p < 0.10$), accounting for 26.99% of the variability of housing cost burden in 2022 ($r^2 = 0.2699$). Similarly, Model 4 indicates that there is a marginally negative association between the prevalence of disabled adults living in mobile homes in 2020 and housing cost burden in 2022 for disabled adults ($\beta = -0.490$, $p < 0.01$), which accounts for 27.64% of the variability in housing cost burden ($r^2 = 0.2764$).

3.3.2. Single Housing Issues

Single housing issues are examined across four areas: incomplete kitchen, incomplete plumbing, overcrowded homes, and old housing.

Incomplete Kitchen. Incomplete kitchens are not a significant predictor of housing cost burden in 2022, which was indicated in Models 1 through 4.

Incomplete Plumbing. For incomplete plumbing, the Model 1 analysis indicates that there is not a significant association between incomplete plumbing in 2022 and housing cost burden in 2022 ($\beta = -0.38$, $p > 0.10$). Similarly, there is not an association between incomplete plumbing in 2021 and 2022 and housing cost burden in 2022 (Model 2 $\beta_{2021} = 0.01$, $p < 0.10$; $\beta_{2022} = -0.27$, $p < 0.10$). In Model 3, plumbing issues in 2020 have a negative

association with housing cost burden ($\beta = -5.63$, $p < 0.05$), while plumbing issues in 2021 have a marginally positive association with housing cost burden in 2022 ($\beta = 5.67$, $p < 0.10$). State-level incomplete plumbing in 2020 through 2022 accounts for 10.47% of the variability of housing cost burden in 2022 ($r^2 = 0.1047$). Similar to Model 3, the Model 4 findings indicate that incomplete plumbing in 2020 has a marginally negative association ($\beta = -5.38$, $p < 0.10$) with housing cost burden in 2022, while incomplete plumbing in 2021 has a marginally positive association ($\beta = 5.58$, $p < 0.10$) accounting for 6.96% of the variability in housing cost burden.

Overcrowded Homes. The percent of state-level overcrowded homes for disabled adults in 2022 is positively associated with the amount of housing cost burden for disabled adults in 2022 ($\beta = 1.17$, $p < 0.001$), accounting for 28.81% of the variability in housing cost burden ($r^2 = 0.2881$). When overcrowded home data from 2022 and 2021 are used (Model 2), 2022 is still a significant positive predictor of housing cost burden in 2022 ($\beta = 0.917$, $p < 0.05$); however, the percent of overcrowded homes for disabled adults in 2021 is not a significant predictor ($\beta = 0.350$, $p < 0.10$) with similar model fit to the 2022 model ($r^2 = 0.2804$). The Model 3 findings using overcrowded home data from 2020 through 2022 indicate that 2020 has a marginally positive relationship with housing cost burden in 2022 ($\beta = 0.906$, $p < 0.10$), accounting for 28.04% of the variability of housing cost burden in 2022 ($r^2 = 0.2804$). Model 4 utilizes data from 2019 through 2022 of overcrowded homes to protect housing cost burden in 2022, yielding no significant results.

Old Housing. As indicated in Model 1, the prevalence of old housing in 2022 is negatively associated with the prevalence of housing cost burden in that same year ($\beta = -0.18$, $p < 0.01$), accounting for 18.44% of the variability of the housing cost burden in 2022 ($r^2 = 0.1844$). Old housing in 2021 in 2022 when combined are not significant predictors of housing cost burden in 2022 (2021 $\beta = 0.09$, $p > 0.10$; 2022 $\beta = -0.27$, $p > 0.10$). Model 3 reports an analysis of old housing prevalence from 2020 through 2022, where old housing in 2020 has a marginally negative association with housing cost burden in 2022 ($\beta = -0.33$, $p < 0.10$), accounting for 21.08% of the variability of housing cost burden in 2022 ($r^2 = 0.2108$). When combining prevalence data for old housing from 2019 through 2022, none are significant predictors of housing cost burden in 2022.

3.3.3. Compounding Housing Issues

Compounding housing issues were measured by a single metric, poor housing, where households with two or more housing issues identified were then aggregated to a state level.

Compounding housing issues. The percent of poor housing of disabled adults in 2022 is not a significant predictor of housing cost burden in 2022 (Model 1, $\beta = 0.51$, $p < 0.10$). In Model 2, however, when the percentages of poor housing in 2021 and 2022 are used, poor housing in 2021 has a positive association with housing cost burden in 2022 ($\beta = 1.09$, $p < 0.001$), yet poor housing in 2022 has a negative association ($\beta = -0.50$, $p < 0.05$). The percentage of poor housing in 2021 and 2022 accounts for 64.11% of the variability of housing cost burden in 2022 for disabled adults ($r^2 = 0.6411$). Model 3 contains poor housing data from 2020 through 2022. Poor housing in both 2020 and 2022 has a positive association with housing cost burden in 2022 ($\beta_{2020} = 0.57$, $p < 0.01$; $\beta_{2021} = 0.67$, $p < 0.001$), and poor housing in 2022 has a marginally negative association with housing cost burden in 2022 ($\beta = -0.50$, $p < 0.10$). The percentage of poor housing experienced by disabled adults in 2020 through 2022 accounts for a staggering 71.50% of the variability of housing cost burden in 2022 ($r^2 = 0.7150$). Model 4 includes poor housing from 2019 through 2022 where poor housing in 2020 and 2021 both have positive associations with housing cost burden in 2022, while poor housing in 2022 has a marginally negative association, where poor housing across these years accounts for 70.99% of the variability and housing cost burden for disabled adults ($r^2 = 0.7099$).

4. Discussion

This analysis directly examines the carryover relationship between housing types and cost burden for disabled adults across three dwelling types—houses, apartments, and mobile homes, along with the impact of single and compounding housing issues, from 2019 to 2022. Our analysis highlights both individual and compounding effects for disabled persons with housing types and associated deficiencies in the livability of their home. We consider housing cost burden in 2022 by components of housing (type and housing issues) in previous years to capture the potential temporal patterns and cumulative conditionalities that account for causal effects in housing precarity by state for disabled persons in the United States.

When comparing disabled and non-disabled adults' housing issues, disabled adults are more likely to have housing cost burden, compounding housing issues, incomplete kitchens, and incomplete plumbing, while non-disabled adults are more likely to live in old housing. There are not significant differences in the prevalence of living in an overcrowded home by disability status.

When predicting housing cost burden for disabled adults, there is a concurrent, or same-year, effect, where disabled persons face a higher housing cost burden when more disabled people are living in apartments and overcrowded homes. While there is a concurrent effect, the lagged effect is much stronger. Overall, 63% of the variability in housing cost burden is accounted for in the concurrent year's status on housing type and housing issues compared to 70–82% for previous years. Thus, housing issues in prior years generate greater housing burdens over time. When more disabled adults are living in apartments, have incomplete plumbing, live in an overcrowded home and have compounding housing issues, there are more disabled people with housing cost burden.

Overall, our findings highlight the key deficits that disabled persons face, in comparison to non-disabled persons, when seeking affordable, accessible, and well-maintained housing within their communities. We find that apartments contribute to higher cost burdens, while mobile homes and houses were linked to lower burdens in some instances. Using lagged time series regression analysis, we find that housing cost burdens in the present are significantly associated with housing issues in previous years. Specifically, home livability deficiencies demonstrate a two-year lagged effect on housing cost burdens, demonstrating that poor quality housing is neither supportive of individuals needs for community and livable housing, nor is it alleviating the precarious situation of persons with disability due to lower cost burdens. The premise that older and lower quality housing, while not adequate for disabled persons livability needs, would be somehow affordable, is erroneous.

Instead, cost burdens and low-quality housing are synonymous, indicating that housing precarity, through cost burdens and poor housing conditions, represents a long-term structural challenge to the ability of persons to remain housed within communities throughout the United States. We argue this research demonstrates that there is no current model of state-level policies or housing conditions that successfully addresses these issues as inter-related and compounding factors. We find the analogy, "when it rains, it pours", to be particularly applicable, as these results underscore the compounding nature of housing issues on cost burdens, demonstrating that housing precarity is strongly associated with multi-faceted housing issues and aggregates across time.

5. Conclusions

The ongoing housing crisis and corresponding housing precarity throughout the United States remain critical aspects of both the ability of individuals to remain housed within the community and a critical health concern. Secure housing is not only vital for meaningful community engagement but also serves as a significant social determinant of health [32], where disabled persons are more likely to encounter poor housing conditions with deficiencies in plumbing and kitchen facilities, compounding their cost burdens. Cost burdens have carryover effects on disabled persons through increased social and

geographic exclusion from both community and health care accessibility as well as poorer housing quality [9,12,13].

Our analysis highlights and expands on previous international research on housing burdens, housing precarity, and health outcomes [6,7]. In the United States, this manifests itself most dramatically where housing burdens disproportionately affect individuals with disabilities and further social exclusion and health risks for disabled individuals [9,12,13]. Thus, secure housing is not only vital for meaningful community engagement for disabled individuals but also serves as a significant social determinant of health.

Given that housing is a key social determinant of health, its impact on current and future health outcomes is key for the quality of life for those with disabilities. The existing literature has long shown that social determinants of health deficits are associated with a significant increase in disability [16–18]. However, those with disabilities are still less visible than other social groups despite the major impact social determinants of health have on this population [19–21]. Sociology, especially urban sociology, has largely understudied and failed to consider people with disabilities as a significant underserved population. Existing studies have associated housing and housing precarity with health outcomes but without the context of disability and the importance of living in community for persons with disability [35]. As the field evolves, future research should delve into the specific challenges faced by subgroups within the disabled population, incorporating innovative housing solutions and leveraging technology to enhance accessibility and inclusivity. Through nuanced insights, this analysis paves the way for a more informed, empathetic, and inclusive approach to housing for individuals with disabilities.

This compounding and multi-faceted crisis further demonstrates that housing conditions and affordability need to be considered primary factors in the study and support of disabled persons. Our analysis highlights the urgent need for inclusive housing policies that address the challenges faced by disabled persons to promote equitable access to sustainable, quality housing as a fundamental component of public health for disability. Future housing policy and planning must consider disabled populations, focusing on both affordability and accessibility as mutually reinforcing contingencies, to ensure equitable and sustainable living environments. Qualitative research is needed to further understand the additional costs and unmet needs of disabled individuals in housing.

Future studies around housing policy must focus on housing and affordability as social determinants of health [9] and intentionally acknowledge and include disabled people in order to increase equitable access to fair and sustainable housing. Additionally, qualitative and participatory research is necessary to understand the consequences extra costs and to investigate any unmet needs amongst disabled individuals [36]. Rehabilitation focus should be on reconnecting to community and building a permanent home that is accessible. Rehabilitation requires a commitment to maintaining a home and connection to community, which is a vital social determinant of health. Complimenting the other work in the rehabilitation research sphere on housing by Corrigan et al., Kumar et al. and Semanision et al. [21–23], we call to action housing policy makers and advocates to address housing issues with a keen focus on disability.

Housing policy needs to include disabled adults as a key disadvantaged group as disabled adults consistently experience nearly all housing issues at a higher rate when compared to adults without disabilities. The effects of these housing issues compound and are inter-related over time, as having both singular and compounding housing issues is an overwhelming driver of housing cost burden as well as other housing issues [9].

Specific to housing cost burden, social policy work seeking to reduce housing cost burden for disabled adults should prioritize programs and funding that address singular housing issue (e.g., incomplete kitchens, incomplete plumbing, overcrowding) as well as compounding housing issues. Our findings indicate that when disabled adults experience one or more housing issues, they are much more likely to have housing cost burden both concurrently as well as in the future.

Author Contributions: Conceptualization, C.M.S., L.B.L., M.L.T., R.K.A. and D.S.P.; methodology, R.K.A. and D.S.P.; validation, C.M.S., R.K.A., D.S.P., L.B.L. and M.L.T.; formal analysis, R.K.A., D.S.P. and C.M.S.; investigation, C.M.S., R.K.A., D.S.P., L.B.L. and M.L.T.; resources, D.S.P. and R.K.A.; data curation, C.M.S. and R.K.A.; writing—original draft preparation, C.M.S., R.K.A., D.S.P., L.B.L. and M.L.T.; writing—review and editing, C.M.S., R.K.A., D.S.P., L.B.L. and M.L.T.; visualization, D.S.P.; supervision, R.K.A. and D.S.P.; project administration, R.K.A. and D.S.P. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: Data are available vis the Disability Statistics Compendium annual reports.

Acknowledgments: Thank you to the Disability Statistics Compendium Research Group for their work in curating high-quality data focusing on disabled adults. Also, thank you to the Shepherd Center and Georgia State University's Department of Sociology for your support of the formal partnership between the two institutions. Thank you to Patricia R. Lawrence, Melissa A. Treanor, Keith R. Kowalchuk, and Natasha H. Anno for your ongoing support.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Models 1–4 report the association between the housing cost burden percent in 2022 as predicted by the percent of disabled households experiencing a singular housing issue as well as housing type from the years 2019–2022. Disabled adults living in apartments in 2019 ($\beta = 0.32$, $p < 0.001$), 2020 ($\beta = 0.23$, $p < 0.01$), 2021 ($\beta = 0.27$, $p < 0.001$), and 2022 ($\beta = 0.22$, $p < 0.001$) were more likely to experience a housing cost burden in 2022. Similarly, disabled individuals exposed to incomplete plumbing in their home environments in 2021 ($\beta = 0.10$, $p < 0.10$) also were more likely to experience an increase in their housing cost burden in 2022. On the other hand, disabled individuals residing in overcrowded homes in 2019 ($\beta = -1.57$, $p < 0.05$), 2020 ($\beta = -0.84$, $p < 0.001$), 2021 ($\beta = -1.88$, $p < 0.01$), and 2022 ($\beta = -1.47$, $p < 0.01$) were significantly less likely to face a housing cost burden in 2022.

References

1. Burns, S.P.; Mendonca, R.; Pickens, N.D.; Smith, R.O. America's housing affordability crisis: Perpetuating disparities among people with disability. *Disabil. Soc.* **2021**, *36*, 1719–1724. [CrossRef] [PubMed]
2. Sho, K.; Kidokoro, T. Housing Inequality and Community-Based Counteracting in a Deprived Community in Taipei, Taiwan. In *Neoliberal Policies and Inequality*; Routledge: Delhi, India, 2024.
3. Wetzstein, S. The global urban housing affordability crisis. *Urban Stud.* **2017**, *54*, 3159–3177. [CrossRef]
4. Hsiao, H. Transformation and issues of public housing policies facing aging society: Case review of Osaka City, Japan. *Jpn. Archit. Rev.* **2021**, *4*, 5–13. [CrossRef]
5. Schuelke, L.; Munford, L.; Morciano, M. Estimating the additional costs of living with a disability in the United Kingdom between 2013 and 2016. *Eur. J. Health Econ.* **2021**, *23*, 313–327. [CrossRef]
6. Kim, S.B.; Kim, J.S. The Effect of Housing Cost Burden on the Mental Health of Middle-aged and Older People with Disabilities: Focused on the Moderating Effect of Social Capital. *J. Korea Soc. Comput. Inf.* **2024**, *29*, 147–155.
7. Clair, A.; Reeves, A.; Loopstra, R.; McKee, M.; Dorling, D.; Stuckler, D. The impact of the housing crisis on self-reported health in Europe: Multilevel longitudinal modelling of 27 EU countries. *Eur. J. Public Health* **2016**, *26*, 788–793. [CrossRef]
8. Gregoir, S.; Maury, T.-P. The impact of social housing on the labour market status of the disabled. *Health Econ.* **2013**, *22*, 1124–1138. [CrossRef] [PubMed]
9. Anderson, R.K.; Pasciuti, D.S.; Sellers, C.M. Livability vs. Affordability; Disability and Housing in the United States. *Soc. Sci.* **2024**, *13*, 291. [CrossRef]
10. Hoffman, D.W.; Livermore, G.A. The House Next Door: A Comparison of Residences by Disability Status Using New Measures in the American Housing Survey. *Cityscape* **2012**, *14*, 1.
11. Oldman, C.; Beresford, B. Home, Sick Home: Using the Housing Experiences of Disabled Children to Suggest a New Theoretical Framework. *Hous. Stud.* **2000**, *15*, 429–442. [CrossRef]
12. World Health Organization. Social Determinants of Health. Available online: https://www.who.int/health-topics/social-determinants-of-health (accessed on 9 November 2023).
13. Lawrence, P.R.; Anderson, R.K. Poverty and Disability: A State-Level Geospatial Analysis. *Clin. Nurs. Res.* **2024**, *33*, 344–354. [CrossRef] [PubMed]

14. Friedman, C. Disparities in Social Determinants of Health Amongst People with Disabilities. *Int. J. Disabil. Dev. Educ.* **2021**, *71*, 101–117. [CrossRef]
15. Wolbring, G. People With Disabilities and Social Determinants of Health Discourses. *Can. J. Public Health* **2011**, *102*, 317–319. [CrossRef] [PubMed]
16. Frier, A.; Barnett, F.; Devine, S.; Barker, R. Understanding disability and the 'social determinants of health': How does disability affect peoples' social determinants of health? *Disabil. Rehabil.* **2016**, *40*, 538–547. [CrossRef] [PubMed]
17. Iezzoni, L.I. Eliminating Health and Health Care Disparities Among the Growing Population of People with Disabilities. *Health Aff.* **2011**, *30*, 1947–1954. [CrossRef]
18. Krahn, G.L.; Walker, D.K.; Correa-De-Araujo, R. Persons with Disabilities as an Unrecognized Health Disparity Population. *Am. J. Public Health* **2015**, *105*, S198–S206. [CrossRef] [PubMed]
19. Altman, B.M.; Bernstein, A. Disability and Health in the United States, 2001–2005. 2008. Available online: https://stacks.cdc.gov/view/cdc/6983 (accessed on 6 December 2024).
20. Burns, M.E. Medicaid Managed Care and Health Care Access for Adult Beneficiaries with Disabilities. *Health Serv. Res.* **2009**, *44*, 1521–1541. [CrossRef]
21. Corrigan, J.D.; Hammond, F.M.; Sander, A.M.; Kroenke, K. Model of Care for Chronic Brain Injury. *Arch. Phys. Med. Rehabil.* **2024**, 1–5, *in press*. [CrossRef]
22. Kumar, R.G.; Delgado, A.; Corrigan, J.D.; Eagye, C.; Whiteneck, G.G.; Juengst, S.B.; Callender, L.; Bogner, J.A.; Pinto, S.M.; Rabinowitz, A.R.; et al. The TBI Model Systems Neighborhood Socioeconomic Disadvantage Index (TBIMS-NSDI): Development and Comparison to Individual Socioeconomic Characteristics. *J. Head Trauma Rehabil.* **2024**, 10–97. [CrossRef]
23. Semanision, K.; Williams, R.; Moran, E.; Rabinowitz, A. Psychosocial Determinants Conferring Resilience after TBI: Current Understanding. *Curr. Phys. Med. Rehabil. Rep.* **2024**, *12*, 359–367. [CrossRef]
24. Semeah, L.M.; Ahrentzen, S.; Cowper-Ripley, D.C.; Santos-Roman, L.M.; Beamish, J.O.; Farley, K. Rental Housing Needs and Barriers from the Perspective of Veterans with Disabilities. *Hous. Policy Debate* **2019**, *29*, 542–558. [CrossRef]
25. Harrison, M. Defining housing quality and environment: Disability, standards and social factors. *Hous. Stud.* **2004**, *19*, 691–708. [CrossRef]
26. Somerville, P. Explanations of Social Exclusion: Where Does Housing Fit in? *Hous. Stud.* **1998**, *13*, 761–780. [CrossRef]
27. Smith, S.K.; Rayer, S.; Smith, E.; Wang, Z.; Zeng, Y. Population Aging, Disability and Housing Accessibility: Implications for Sub-national Areas in the United States. *Hous. Stud.* **2012**, *27*, 252–266. [CrossRef]
28. Chisholm, E.; Howden-Chapman, P.; Fougere, G. Tenants' Responses to Substandard Housing: Hidden and Invisible Power and the Failure of Rental Housing Regulation. *Hous. Theory Soc.* **2018**, *37*, 139–161. [CrossRef]
29. Plouin, M.; Adema, W.; Fron, P.; Roth, P.-M. *A Crisis on the Horizon: Ensuring Affordable, Accessible Housing for People with Disabilities*; OECD: Paris, France, 2021. [CrossRef]
30. Gibson, M.; Petticrew, M.; Bambra, C.; Sowden, A.J.; Wright, K.E.; Whitehead, M. Housing and health inequalities: A synthesis of systematic reviews of interventions aimed at different pathways linking housing and health. *Health Place* **2010**, *17*, 175–184. [CrossRef]
31. Paul, S.; Rogers, S.; Bach, S.; Houtenville, A.J. 2023 Annual Disability Statistics Compendium. Institute on Disability, University of New Hampshire, 2023. Available online: https://eric.ed.gov/?id=ED628628 (accessed on 6 December 2024).
32. Glassman, B. The Multidimensional Deprivation Index Using Different Neighborhood Quality Definitions. Poverty Statistics Branch Social, Economic, and Housing Statistics Division, U.S. Census Bureau, Denver, CO, SEHSD Working Paper Number 2020-08, June 2017. Available online: https://www.census.gov/content/dam/Census/library/working-papers/2020/demo/SEHSD-WP2020-08.pdf (accessed on 3 December 2024).
33. Erickson, W. A Guide to Disability Statistics from the American Community Survey (2008 Forward). December 2012. Available online: https://hdl.handle.net/1813/90090 (accessed on 6 December 2024).
34. Keele, L.; Kelly, N.J. Dynamic Models for Dynamic Theories: The Ins and Outs of Lagged Dependent Variables. *Polit. Anal.* **2006**, *14*, 186–205. [CrossRef]
35. Gilderbloom, J.I.; Rosentraub, M.S. Creating the Accessible City. *Am. J. Econ. Sociol.* **1990**, *49*, 271–282. [CrossRef]
36. Mitra, S.; Palmer, M.; Kim, H.; Mont, D.; Groce, N. Extra costs of living with a disability: A review and agenda for research. *Disabil. Health J.* **2017**, *10*, 475–484. [CrossRef] [PubMed]