

# Residential Area Socioeconomic Deprivation is Associated with Physical Dependency and Polypharmacy in Community-Dwelling Older Adults: An Analysis of Health Administrative Data in Ireland

Lauren Swan <sup>1,2</sup>, N Frances Horgan<sup>3</sup>, Chie Wei Fan<sup>4</sup>, Austin Warters <sup>5</sup>, Maria O'Sullivan<sup>1</sup>

<sup>1</sup>Department of Clinical Medicine, Trinity College Dublin (TCD), Dublin, Ireland; <sup>2</sup>North Dublin Homecare Ltd, Dublin, Ireland; <sup>3</sup>School of Physiotherapy, RCSI University of Medicine and Health Sciences, Dublin, Ireland; <sup>4</sup>Department of Geriatric Medicine, Mater Misericordiae University Hospital, Dublin, Ireland; <sup>5</sup>Older Person Services CHO9, Health Service Executive (HSE), Dublin, Ireland

Correspondence: Lauren Swan, Email swanla@tcd.ie

**Introduction:** Socioeconomic disadvantage is associated with multiple adverse health outcomes in ageing. Whether this negative impact persists in populations of more advanced age and dependency is less clear. We aimed to determine the association between residential area deprivation and pre-specified health characteristics among community-dwelling dependent older adults.

**Methods:** We conducted a cross-sectional analysis of data from 1591 community-dwelling adults aged 65 years and older of mean age  $83.9 \pm 7.1$  years and in receipt of state home support in Ireland. The HP Pobal Deprivation Index was used to categorize residential areas by socioeconomic deprivation. Health variables analysed included physical dependency (Barthel Index), polypharmacy ( $\geq 5$  medications), previous acute hospital admission, cognitive impairment, and mental health diagnoses. Associations between residential area deprivation and prespecified health outcomes were explored in multivariable logistic regression analysis.

**Results:** In socioeconomically disadvantaged areas, high physical dependency was twice that observed in affluent areas (16.2% vs 6.9%,  $p = 0.009$ ). Similarly, acute hospitalization, as the trigger for increased dependency, was more common in deprived settings (41.6% vs 29.1%,  $p < 0.001$ ). Polypharmacy was common in this population (67.6%), but significantly higher in deprived vs affluent settings (74.7% vs 64.5%,  $p = 0.030$ ). The findings persisted in multivariable analyses when adjusted for age and gender. While all participants were accessing home support, those in deprived areas were on average 6.5 years younger than in affluent areas. Associations between residential deprivation and mental health conditions or cognitive impairment, however, were not observed in this study.

**Conclusion:** Community-dwelling older adults living in socioeconomically disadvantaged areas experienced greater polypharmacy, high physical dependency, hospitalization-associated dependency, and a 6.5-year earlier need for state home support than in affluent settings. The findings suggest that health inequality persists in populations of more advanced age and dependency and highlight a need for further research as well as community-based health and social care initiatives.

**Keywords:** ageing in place, older adults, deprivation index, socioeconomic disadvantage, health inequalities

## Introduction

Consistent evidence shows that disadvantaged socioeconomic position (SEP) is associated with accelerated ageing, frailty, mobility disability and mental health conditions.<sup>1-4</sup> The association between socioeconomic disadvantage and adverse health outcomes is observed for aggregate-level indicators of SEP (neighborhood deprivation, housing conditions and environmental factors) and individual-level socioeconomic determinants (education, income, and occupation class). Populations living in socioeconomically deprived areas have been shown to have reduced life expectancies and spend

a greater proportion of life in ill health.<sup>5–7</sup> In the United Kingdom (UK), adults living in areas with high socioeconomic deprivation are reported to have a “healthy life expectancy” of 52.3 years compared to 70.7 years in the least deprived areas.<sup>6</sup> Similar differentials in life and healthy life expectancy have been reported in Ireland and elsewhere.<sup>5,8,9</sup> There is good evidence that long-term health-limiting conditions are more prevalent among the most disadvantaged older populations accounting, in part, for a greater proportion of life lived with disability.<sup>2,10</sup>

Current evidence of health inequality in ageing is largely derived from populations aged under 80 years.<sup>11</sup> The impact of health inequality is less clear in cohorts of more advanced age and physical dependency. This remains an important evidence gap, given that adults over 80 years represent one of the fastest-growing age demographics.<sup>12</sup> Some evidence suggests that the influence of socioeconomic disadvantage may be lost as age-related dependency increases.<sup>13</sup> Consistent with this, research examining transitions in frailty in the Newcastle 85+ study showed that individual-level socioeconomic determinants did not influence the likelihood of moving from one frailty state to another.<sup>14</sup> Addressing this area is complex, due to several issues including, the underrepresentation in research of older adults with socioeconomic disadvantage, older age (80+) or functional limitations, combined with potentially higher study attrition rates.<sup>15</sup> This suggests opportunities to investigate health disparities in dependent older adults through other means, such as the use of health administrative datasets; while the latter is likely to represent age and socioeconomic diversity, specific markers of socioeconomic indicators may not be routinely recorded.<sup>16</sup>

Several markers of socioeconomic position (SEP) have been applied in examining health inequalities in ageing.<sup>17</sup> These include individual-level measures, for example, education, employment, income, wealth, health insurance status and subjective social status as well as area-level deprivation indices. Geographic area-level deprivation indices are composite measures capturing multiple inputs such as unemployment, housing tenure, material deprivation and educational attainment to estimate the socioeconomic conditions of a defined residential area. Importantly, area-level socioeconomic indicators show strong correlations with individual-level SEP markers, when constructed at small-area level.<sup>18</sup> The HP Pobal Index, applied in the present study to determine residential area deprivation, divides Ireland into uniform populations of mean 100 households classified as ‘small-areas’.<sup>19</sup> Small-area-based socioeconomic indicators appear to be robust, showing strong correlations with morbidity, mortality, and a range of adverse health outcomes.<sup>18,20,21</sup>

In the present study, we aimed to investigate the prevalence of pre-specified health variables according to area-level socioeconomic deprivation among community-dwelling dependent older adults. We analysed an administrative health and social care dataset, previously described,<sup>22</sup> with a high proportion aged 80 years and older (70%) and dependent in ADLs. We hypothesized that the specified health variables (physical dependency, acute hospitalization, polypharmacy, cognitive impairment, and mental health conditions) would be higher in participants living in socioeconomically deprived areas compared with affluent areas. The findings of this study are anticipated to have important implications for future health and social care planning in areas of high socioeconomic deprivation.

## Methods

### Study Design and Population

We conducted a cross-sectional analysis of an anonymized dataset comprised of community-dwelling adults aged 65 years and older living within a defined health administrative urban area in Ireland in 2017 (n = 1591). The dataset is described in detail elsewhere.<sup>22</sup> Briefly, participants were described as dependent as all were in receipt of formal home support services representing dependency in activities of daily living (ADLs). Currently, state-funded home support is assigned based on a clinician-led assessment of need, and at the time of this study is not income assessed in Ireland. Analysis of the data and its results were approved by the Health Policy and Management/Centre for Global Health Research Ethics Committee, Trinity College Dublin (Application: 02/2019/01).

### Health and Demographic Variables

Demographic and social characteristics included age, gender, living alone and marital status. Health variables included physical dependency, polypharmacy, acute hospitalization, cognitive impairment, and mental health conditions. Physical dependency was assessed using the Barthel Index which produces a numerical score (0–20), with higher scores indicating

greater independence. Barthel Index was classified by maximum dependency (score 0–4), high dependency (score 5–8), moderate dependency (score 9–11), mild dependency (score 12–19) and independence (score 20), as per previous studies.<sup>23</sup> Polypharmacy was defined as 5 or more prescribed medications.<sup>24,25</sup> Acute hospitalization was recorded, where this was documented as the reason and source of the referral to home support for ADL assistance. Mental health condition was recorded as present, based on a recorded diagnosis of depression, anxiety, schizophrenia, or bipolar disorder by allied healthcare professionals. Cognitive impairment was classified as previously described,<sup>22,26</sup> based on a documented diagnosis of dementia or if a validated screening tool was employed and produced a score indicative of dementia or mild cognitive impairment. Information pertinent to home care utilization and transition to long-term residential care was noted.

## Residential Area Deprivation

Residential area deprivation was calculated using the HP Pobal Deprivation Index, a tool measuring the relative affluence or disadvantage of a residential small-area.<sup>19</sup> The HP Pobal Deprivation Index uses data from the Irish 2016 Census to determine an area's relative socioeconomic deprivation including, the age-dependency ratio, educational attainment, occupational class, gender-specific unemployment rates and mean number of persons per room per household. Based on these indicators, each small area was categorized as one of the following: affluent, marginally above average, marginally below average or disadvantaged.

## Statistical Analysis

Descriptive statistics were used to compare health and social factors across each of the defined residential deprivation categories: affluent, marginally above average, marginally below average and disadvantaged. Normality was assessed visually using histogram plots in addition to normal probability plots and Shapiro–Wilks test. Continuous variables were examined using ANOVA analysis or Kruskal–Wallis tests to examine differences between groups. Mantel–Haenszel test for trend was used to examine trends between categorical variables and residential deprivation. All analyses were performed using IBM SPSS Statistics V27 software.

## Results

### Study Population

Characteristics of the study population ( $n = 1591$ ) are presented in [Table 1](#). Overall, the study group were of mean age  $83.9 \pm 7.1$  years, the majority (73%) were aged 80 years and older, female (64%) and over half lived alone (54.3%). Based on residential area deprivation, 31.7% of older adults lived in areas described as affluent, while 11.2% lived in the most socioeconomic disadvantaged areas. The prevalence of polypharmacy (67.6%), acute hospitalization (33.4%) and documented cognitive impairment (43.0%), was high in the study population.

### Health Variables According to Residential Area Deprivation

High physical dependency was significantly more common among older adults in disadvantaged compared with affluent areas (16.2% vs 6.9%,  $p < 0.009$ ) ([Table 1](#), [Figure 1](#)). In line with this, mild dependency was lowest in disadvantaged areas. Acute hospitalization-associated dependency was highest (41.6%) in the most socioeconomically disadvantaged areas, while significantly lower in affluent settings (29.1%,  $p < 0.001$ ).

Polypharmacy ( $\geq 5$  medications) was significantly higher among older adults living in the most (74.7%) compared with the least deprived areas (64.5%,  $p = 0.030$ ). Similarly, excessive polypharmacy ( $\geq 10$  medications) and the median number of medications (IQR) prescribed were higher in disadvantaged compared to affluent settings (8 (8) vs 7 (10),  $p = 0.034$ ). No significant differences, however, were observed for recorded cognitive impairment or for mental health conditions according to residential deprivation ([Table 1](#), [Figure 1](#)).

While all older adults were accessing state home support for assistance with ADLs, those residing in disadvantaged areas were on average 6.5 years younger compared to affluent areas ( $79.1 \pm 7.3$  vs  $85.6 \pm 6.7$ ,  $p < 0.001$ , respectively) ([Table 1](#)). The proportion of the population who had died during the study period of 2017 overall was 9.3%, ranging from 6.9% to 12.1% in affluent areas relative to areas marginally below average for socioeconomic disadvantage ( $p = 0.033$ ).

**Table 1** Health and Demographic Characteristics of Community-Dwelling Older Adults According to Residential Area Deprivation (N = 1591)

Residential Deprivation	Overall (n= 1591)	Affluent (n= 505)	Marginally Above Average (n= 568)	Marginally Below Average (n= 340)	Disadvantaged (n= 178)	p-value
Demographics						
Age, mean $\pm$ SD <sup>a</sup>	83.9 $\pm$ 7.1	85.6 $\pm$ 6.7	84.6 $\pm$ 7.0	82.8 $\pm$ 6.6	79.1 $\pm$ 7.3	<0.001*
Gender, n (%)						
Female	1013 (63.7)	341 (67.5)	373 (65.7)	203 (59.7)	96 (53.9)	<0.001*
Male	578 (36.3)	164 (32.5)	195 (34.3)	137 (40.3)	82 (46.1)	<0.001*
Marital Status, n (%)						
Married	471 (29.6)	152 (30.1)	138 (24.3)	125 (36.8)	56 (31.5)	0.112
Divorced/ Separated	67 (4.2)	11 (2.2)	18 (3.2)	17 (0.1)	21 (11.8)	<0.001*
Single	313 (19.7)	137 (27.1)	139 (24.5)	57 (16.8)	40 (22.5)	0.007*
Widowed	680 (42.7)	205 (40.6)	273 (48.1)	141 (41.5)	61 (34.3)	0.223
Lives Alone, n (%)	864 (54.3)	283 (56.0)	328 (57.7)	162 (47.7)	91 (51.1)	0.029*
Health and Dependency						
Barthel Index Score <sup>b</sup> , mean $\pm$ SD <sup>a</sup>	13.1 $\pm$ 3.9	13.2 $\pm$ 3.9	13.0 $\pm$ 3.9	13.2 $\pm$ 4.1	12.9 $\pm$ 3.9	0.688
Barthel Category, n (%)						
Maximum dependency	45 (3.0)	17 (3.5)	13 (2.4)	11 (3.4)	4 (2.4)	0.610
High dependency	138 (9.2)	33 (6.9)	54 (10.2)	24 (7.5)	27 (16.2)	0.009*
Moderate dependency	298 (19.9)	83 (17.3)	110 (20.7)	70 (21.7)	35 (21.0)	0.151
Mild dependency	959 (64.0)	329 (68.7)	332 (62.5)	202 (62.7)	96 (57.5)	0.008*
Independent	59 (3.9)	17 (3.5)	22 (4.1)	15 (4.7)	5 (3.0)	0.889
Polypharmacy, n (%)						
Prescribed $\geq$ 5 medications	1076 (67.6)	325 (64.5)	390 (68.7)	228 (67.1)	133 (74.7)	0.030*
Prescribed $\geq$ 10 medications	519 (32.6)	139 (27.5)	198 (34.9)	111 (32.6)	71 (39.9)	0.005*
Median number of medications <sup>c</sup>	7 (9)	7 (10)	7 (8)	7 (9)	8 (8)	0.034*
Documented Cognitive Impairment	686 (43.1)	205 (40.6)	248 (43.7)	152 (44.7)	81 (45.5)	0.170
Documented Mental Health Condition ( $\geq$ 1)	313 (19.7)	97 (19.2)	106 (18.7)	65 (19.1)	45 (25.3)	0.190
Acute hospitalization, n (%)	531 (33.4)	147 (29.1)	182 (32.0)	128 (37.6)	74 (41.6)	<0.001*
Died, n (%)	148 (9.3)	35 (6.9)	54 (9.5)	41 (12.1)	18 (10.1)	0.033*

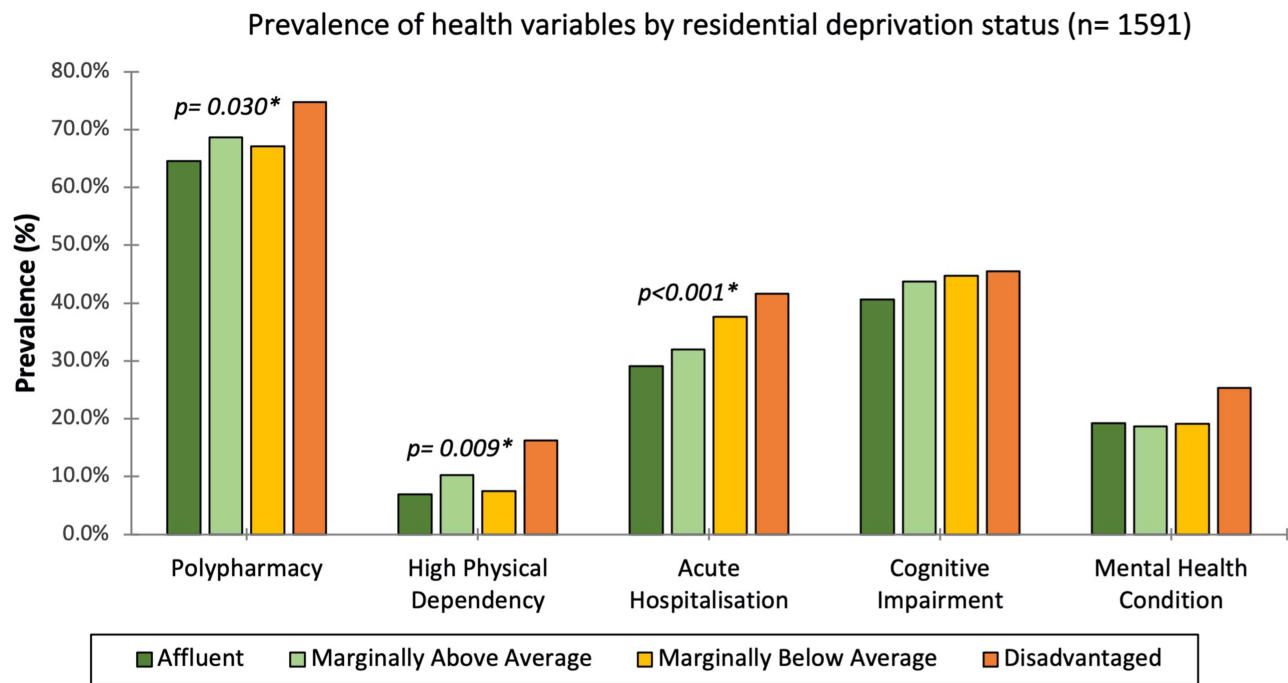
Notes: <sup>a</sup>Mean  $\pm$  standard deviation; one-way ANOVA test. <sup>b</sup>Missing values n= 92 (5.8%); Barthel Index Score ranges from 1 to 20 with lower scores indicating dependence. <sup>c</sup>Median (IQR); Kruskal–Wallis H-Test. \*Denotes p<0.05.

## Multivariable Regression Analyses of Residential Area Deprivation and Health Outcomes

In multivariable logistic regression analyses, adjusted for age and gender (Table 2), disadvantaged residential area deprivation status was associated with an increased likelihood of polypharmacy [OR, CI 1.75 (1.18, 2.61), p = 0.006] When compared to those living in affluent areas, older adults in areas of disadvantaged residential deprivation status observed a greater likelihood of high physical dependency [OR, CI 2.60 (1.47, 4.58), p = 0.013] and previous acute hospitalisation [OR, CI 1.59 (1.10, 2.30), p < 0.001]. Consistent with bivariate analysis no significant associations were observed between residential area deprivation status with cognitive impairment or mental health conditions.

## Discussion

We examined health characteristics in a large population (n = 1591) of ADL-dependent older adults of mean age 83.9  $\pm$  7.1 years according to residential area deprivation. Severe physical dependency, polypharmacy and acute hospitalization were significantly more common in older adults with high residential socioeconomic disadvantage. Differences in cognitive impairment and mental health conditions were not observed in this study, contrary to our expectations. The



**Figure 1** Prevalence (%) of health variables in community-dwelling dependent older adults based on residential area deprivation (n= 1591). \*Denotes Mantel-Haenszel test for trend  $p < 0.05$ .

findings indicate evidence of health inequalities, specifically in markers of physical health, in populations of more advanced age and dependency.

In socioeconomically disadvantaged areas, high physical dependency was twice that observed in affluent areas (16% vs 7%,  $p = 0.009$ ), while mild dependency was the lowest. This association persisted when adjusted for age and gender, with those residing in areas of high socioeconomic deprivation observing a 2.6 times increased likelihood of high physical dependency when compared to individuals with affluent residential deprivation status. The association between area-level socioeconomic disadvantage and poor physical function is well evidenced.<sup>27–29</sup> In the English Longitudinal Study on Ageing (ELSA), lower socioeconomic status was independently associated with an accelerated decline in markers of physical function, including grip strength, gait speed and physical activity.<sup>1</sup> Similarly, other population studies report an increased burden of sarcopenia, frailty, and ADL-impairment among older adults with socioeconomic

**Table 2** Multivariable Logistic Regression Analyses for Residential Area Deprivation with Prespecified Health Variables, Adjusted for Age and Gender

	Polypharmacy (n= 1591)		Physical Dependency (n= 1499)		Acute Hospitalization (n= 1591)		Mental Health Condition (n= 1591)		Cognitive Impairment (n= 1591)	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95%	OR	95% CI
Residential Area Deprivation										
Affluent	Reference									
Marginally Above Average	1.23	0.95–1.58	1.53	0.97–2.41	1.14	0.87–1.47	0.92	0.68–1.26	1.15	0.90–1.47
Marginally Below Average	1.16	0.86–1.50	1.09	0.63–1.88	1.41*	1.05–1.90	0.89	0.63–1.28	1.24	0.94–1.65
Disadvantaged	1.75*	1.18–2.61	2.60*	1.47–4.58	1.59*	1.10–2.30	1.10	0.72–1.68	1.35	0.94–1.93

**Notes:** Binary logistic regression analysis was used to determine the odds ratio (OR) and 95% confidence intervals (CI) for associations between residential area deprivation status and health outcomes of interest, when adjusted for age and gender. \*Denotes  $p < 0.05$ .

disadvantage.<sup>3,4,30</sup> It is argued, however, that chronological “age is a leveler” and that differences in physical function between socioeconomic groups plateau as age-related decline outweighs the influence of social factors.<sup>31</sup> Our findings provide evidence of health inequality for physical dependency amongst an older population with an average age of 84 years.

Polypharmacy, an indicator of multiple long-term conditions in older adults,<sup>25</sup> was observed more frequently in deprived (75%) compared with affluent areas (65%), with a similar pattern noted for excessive polypharmacy and the mean number of medications prescribed. When adjusted for age and gender, older adults living in areas with socioeconomic deprivation had a 75% increased likelihood of polypharmacy when compared to the least deprived areas. This is consistent with findings in younger ageing cohorts. In the Irish Longitudinal Study on Ageing (TILDA), polypharmacy was significantly associated with lower educational attainment and wealth in adults over 50 years.<sup>32</sup> Other authors, in an analysis of routine administrative data, report higher rates of polypharmacy among adults aged 45–64 years with socioeconomic deprivation.<sup>33</sup> These associations are often attributed to a higher prevalence, and earlier onset, of chronic conditions and multimorbidity.<sup>33,34</sup> Polypharmacy, however, is also independently associated with multiple adverse outcomes including the risk of hospitalization, mortality, adverse drug events, and potentially inappropriate prescribing.<sup>24,33,35,36</sup> While our findings may reflect multimorbidity, further investigation is needed to confirm and explore medication management and deprescribing approaches in deprived settings.

In the present study, acute hospitalization, as the trigger for increased dependency, was more common in older adults with residential deprivation. Associations between socioeconomic disadvantage and risk of hospitalization and greater emergency department utilization have previously been reported.<sup>37</sup> Analysis of the EPIC-Norfolk cohort showed that residential area deprivation was a predictor of future hospitalization, length of stay and the number of admissions.<sup>17</sup> We found that 42% of older adults residing in socioeconomically disadvantaged areas had a documented acute hospitalization necessitating the initiation of formal home support for ADLs on discharge, compared to 29% in affluent settings. It is plausible that acute hospitalization represented a tipping point for older adults in deprived settings, which may be amplified by lower access to and engagement with community health and social care supports and services.<sup>38,39</sup>

While all participants were accessing state-funded home care to support ADLs, the present study observed that those in socioeconomically deprived areas were on average 6.5 years younger than in affluent areas. This finding fits with published evidence that health inequality is associated with more years living with disability or limiting chronic conditions,<sup>10</sup> along with the premature onset of multimorbidity by up to 10–15 years compared with the least deprived areas.<sup>34</sup> This adds to the growing evidence of reduced healthy life expectancy in areas of high socioeconomic deprivation.<sup>6</sup>

Several potential pathways between area-level socioeconomic deprivation and adverse health outcomes have been hypothesized including a greater frequency of environment hazards and pollution, poor housing conditions, access to healthcare, availability of healthy foods, and open space for physical activity.<sup>40,41</sup> McCann et al, in analyses of area-level socioeconomic deprivation and cognitive function in older adults in Ireland, found a significantly higher prevalence of high blood pressure, diabetes risk, obesity, alcohol consumption and smoking in areas of high socioeconomic deprivation.<sup>42</sup> The findings add to previous research on the impact of area-level socioeconomic deprivation in older adult populations in Ireland, suggesting a greater burden of adverse health outcomes in areas of socioeconomic disadvantage.

Based on limited administrative data the results collectively begin to build a consistent picture of health inequality in physical health (ie, greater physical dependency, polypharmacy, and hospital-associated dependency) among dependent community-dwelling older adults. Contrary to our hypothesis, associations between residential area deprivation and mental health conditions or cognitive impairment were not observed in this study, in contrast to younger ageing cohorts.<sup>43,44</sup> While it is possible that differences in these conditions across socioeconomic groups plateau with chronological age, however, there are notable challenges in the use of routine data relating to cognition and mental health,<sup>45</sup> including under-reporting, underutilization of validated screening tools and difficulties performing data linkage due to the absence of dementia registries.<sup>46,47</sup> Furthermore, the present study applied an aggregate-level socioeconomic indicator meaning that the anticipated associations between area-level socioeconomic disadvantage with cognition and mental health may be less clear. Embedding the collection of more robust data on cognitive and mental health, along with



physical health variables and individual-level socioeconomic indicators would strengthen the usability of administrative datasets.

This study has several strengths, including access to a large administrative data set (n = 1591) of community-dwelling older dependent adults predominantly aged over 80 years, representing a rapidly growing age demographic often underrepresented in traditional health research.<sup>48,49</sup> We applied the HP Pobal area-level deprivation Index, which could be a practical addition to other routine health data and is increasingly utilized in government and population reports. Equally, administrative datasets have known limitations, including a lack of comprehensive and detailed health variables and covariates which impeded the full specification of multivariable models controlling for known risk factors of the prespecified health variables. Additionally, this was a cross-sectional descriptive study and therefore, does not show cause and effect. Given the absence of electronic health records and limited primary care data in Ireland, the present study reflects the real-world data for dependent older adults of advanced age in Ireland relevant to health and social care planning and resourcing. Ideally, administrative health datasets would capture simple, practical valid measures of physical and mental health, that serve health care needs, research and complement longitudinal studies.<sup>1</sup>

## Conclusion

In conclusion, community-dwelling dependent older adults living in socioeconomically disadvantaged areas experienced greater polypharmacy, high physical dependency, hospitalization-associated increased dependency and a 6.5 year earlier need for state home support than in affluent areas. The findings suggest that health inequality persists despite older age and dependency. The study highlights the need for community-based health and social care initiatives that address this inequality gap in community-dwelling older adults in Ireland.

## Data Sharing Statement

The data that support the findings of this study are available from Health Service Executive (HSE) but restrictions apply to the availability of these data. Data may be available from the corresponding author upon reasonable request with the permission of HSE.

## Ethical Approval and Consent to Participate

This study was approved by the Health Policy and Management/Centre for Global Health Research Ethics Committee, Trinity College Dublin (Application: 02/2019/01).

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## Disclosure

The authors declare that they have no competing interests.

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