Title:
Access to a Car and the Self-reported Health and Mental Health of People aged 65 and older in Northern Ireland.

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Abstract

This study examines relationships between access to a car and the self-reported health and mental health of older people. The analysis is based on a sample of N=65,601 individuals aged 65 years and older from the Northern Ireland Longitudinal Study (NILS) linked to 2001- and 2011- Census-returns. The findings from hierarchical linear and binary logistic multilevel models and multilevel path analyses indicate that having no access to a car is statistically related to a considerable health- and mental health disadvantage, particularly for older people who live alone. Rural-urban health and mental health differences are mediated by access to a car. The findings support approaches that emphasize the importance of autonomy and independence for the health and mental health of older people. The results indicate that not having access to a car can be a problem for older people not only in remote and rural-, but also in intermediate and urban areas, if no sufficient alternative means of transport are provided. Implications of the findings for policy and future research are discussed.

Keywords: Aging, health, mental health, transport, car

Introduction

Mobility and independent access to transport were found to be important for the quality of life (Gilhooly 2002; Netuveli et al. 2006), well-being (Davey 2007) and health (Edwards et al. 2009) of older people, especially in remote areas, where services are not in easy reach (Heenan 2010; Walsh et al. 2012). Because the provision of public transport in rural areas is often inadequate for older people (Heenan 2010; Walsh et al. 2012; Shergold, Parkhurst, and Musselwhite 2012; Wenger 2001), having a car can be crucial to remain mobile (O'Connor et al. 2013), access services such as shops and GP practices, and to maintain social contacts (Walsh and Ward 2013; Scharf and Bartlam 2008; Bauer, Rottunda, and Adler 2003). Consequently, having no access to a car is often linked to social exclusion and isolation of older people (McDonagh 2006; Walsh and Ward 2013; Shergold, Parkhurst, and Musselwhite 2012; C. Musselwhite and Haddad 2010). Studies based on qualitative interviews report experiences of loneliness and a decreased quality of life particularly among older people who live alone and gave up driving (Musselwhite and Haddad 2010). There is qualitative (Musselwhite and Shergold 2013) and statistical evidence of a link between driving-cessation and a subsequent decrease in health and mental health (Marottoli et al. 1997, Fonda, Wallace, and Herzog 2001; Ragland, Satariano, and MacLeod 2005; Edwards et al. 2009). Depression in particular (Marottoli, Mendes, Glass, & Williams, 1997, Fonda, Wallace, and Herzog 2001; Ragland, Satariano, and MacLeod 2005; Marottoli et al. 1997; Langford and Koppel 2006) was found to be associated with driving-cessation.

This article examines relationships between access to a car and the self-reported health and mental health of older people living in Northern Ireland using a Census-linked representative sample of the population of adults aged 65 and older in 2011 (N=65,601), based on Northern Ireland Longitudinal Study (NILS) data from the 2001 and 2011-

Censuses. Northern Ireland is an excellent setting to study these relationships, as it is predominantly a rural society with two large urban centers (Belfast and Derry), and thus allows to focus on remote rural areas and compare them with urban settings. Furthermore, the exceptionally large sample size of people aged 65 and older in the NILS offers a rare opportunity to analyze statistical relationships that are indeed representative of a population of older people. This paper is the first account representative of the population aged 65 years and older of Northern Ireland.

Northern Ireland and its older Population

According to the Northern Ireland Statistics and Research Agency (NISRA), 80% of Northern Ireland's landmass consists of rural areas with settlements of less than 4,500 inhabitants (NISRA 2005). Approximately 32% of the population live in rural areas, 10% live in small towns and intermediate settlements and 58% live in urban areas (Pateman 2011, 20). In 2013, approximately 15% of the population was aged 65 years or older (NISRA 2013a). As is the case in most developed countries, Northern Ireland's population is aging, thus by 2025 the number of adults aged 65 years and older will account for 20% of its population (Ahern and Hine 2012, 28). Since driving ability decreases with age, alternative forms of real-life mobility, such as public transport and virtual mobility, such as the internet (Parkhurst et al 2014) are increasing in importance.

Access to a Car, Autonomy and Deprivation

In rural societies lacking access to a car is a measure of deprivation. Research on Northern Ireland (Ahern and Hine 2012, Heenan 2010; Walsh et al. 2011) found the provision of public transport in many rural areas to be limited and insufficient for the needs of older people, although policies to improve public transport for older people have been

implemented (Ahern and Hine 2012). Hence, the majority of rural elders in Northern Ireland largely depend on the car for their transport needs. It is particularly the income deprived who do not have a car (Gray et al. 2001; Power 2012).

Qualitative studies found that older people living in rural areas frequently mention the importance of having a car as a means to reach friends and services (Fristedt et al. 2011; Musselwhite and Haddad 2010; Shergold, Parkhurst, and Musselwhite 2012), and the importance of being independent in their choices when and where to travel (Davey 2007; Bauer, Rottunda, and Adler 2003; Musselwhite and Haddad 2010). Older people who do not have access to an independent means of transport are often forced to rely on family members, friends or neighbors for their transport needs. Being dependent on family members in order to access shops and services puts considerable constraints on older people's autonomy. They can no longer decide by themselves when and where to travel and are forced to disclose personal travel plans to others. Such restrictions of older people's autonomy could impair their quality of life and wellbeing.

Especially older people who live alone and cannot rely on personal networks for transport are vulnerable. Research found single-living older people to be at an elevated risk of social isolation and loneliness (Gierveld, Dykstra, and Schenk 2012; Shimada et al. 2014), which in turn was found to be related to ill health and ill mental health (Alpass and Neville 2003; Coyle and Dugan 2012; Cacioppo et al. 2002). Access to transport is thus important particularly for those living alone in rural areas, to ensure their access to services and to maintain social contacts and prevent isolation. However, research found that older people who live alone are less likely to have a car or be drivers than those who live in a married couple or with relatives (Ahern and Hine 2012; Charlton et al. 2006; Ross et al. 2009). Having no access to a car can thus be expected to mediate the relationship between living alone and bad health.

Hypotheses

From the existing literature four hypotheses can be derived:

H1: Older people in Northern Ireland who do not have a car report worse general health and are more likely to report having a mental health condition than older people who have a car.

H2: Older people who live alone report worse health and are more likely to report having a mental health condition than older people who do not live alone.

H3: The negative effect of living alone on the self-reported health and mental health of older people is at least partly mediated by not having access to a car.

H4: Not having access to a car is more strongly positively related to a decreased self-reported health and mental health of older people, in rural and remote areas than in urban and intermediate areas.

Research Design

Data

The analysis uses data from the Northern Ireland Longitudinal Study (NILS). The NILS is a representative sample of c.28% of the population of Northern Ireland and was drawn from records from the Northern Ireland Health Card Registration system (NIHCR), based on 104 out of 365 possible birthdates. NILS members were subsequently linked to the 2001 and 2011 Census returns (Johnston, Rosato, and Catney 2010). The analysis of this article includes all NILS-members (N=65,623), who were 55 years and older in 2001 and

subsequently 65 years and older in 2011, who have a link in both the 2001 and the 2011 Censuses and who did not live in a care-home at either time-point.

Methods and Strategy

We apply hierarchical linear and binary logistic multilevel modeling and multilevel path analyses to two dependent variables, the respondents' self-reported health (five-point scale, 5 - very good, 1 - very bad) and whether they reported having a mental health condition on the 2011 Census form (1=mentioned, 0=not mentioned). The multilevel approach was chosen because a regional clustering of the respondents in rural areas is expected and the contextual effect of the remoteness of the respondents' area of residence is of substantial interest to this study.

The area level of the models consists of Northern Irelands' 582 electoral wards (NISRA 2013b). An electoral ward has on average 1,100 households (NISRA 2013b, 6). 50 scarcely populated Wards were merged with neighboring Wards into larger entities, because their numbers of observations were less than 50 and therefore too small for meaningful comparisons[1]. This leaves the analysis with 556 Wards.

In order to test for mediation (Baron and Kenny 1986) of the relationships between living alone, living in a rural area, and self-reported health and mental health by access to a car, multilevel path models (Krull and MacKinnon 2001; Zhang, Zyphur, and Preacher 2009)

[1] The following sparsely populated Wards comprised less than 50 respondents and were therefore merged with neighbouring Wards: Ballee with Ballykeel, Ballycarry with Ballyloran, Drumanaway with Farranbshane, Fountain Hill with Greystone, Killylea with Laurelvale, Knockaholet, Newhill and Route, Milebush with Northland and Sunnylands, Atlantic with Ballysally, Ardboe with Coagh, Dunnamore with Gortalowry and Killymoon, Oaklands with Oldtown and Pomeroy, Shantallow West with Springtown, Coalisland South with Coalisland West, Ballycarry with Ballyloran, Harbour with Island Magee, The Highlands with Upper Glenshane, Glenaan with Glenariff, Glentaisie with Kinbane and Knocklayd, Creggan with Crossmaglen and Daisyhill, Killyclogher with Lisanelly, Owenkillew with Sixmilecross, Dunnamanagh with East.

were carried out using the function 'gsem' in STATA 13. Path models test for the extent to which the direct statistical effect of an independent variable (living rurally, living alone) on the dependent variable is transmitted via a mediator (access to a car) (Baron and Kenny 1986, Holland 1988,). Furthermore, the path models allow to test for the effects of instrumental variables on the mediator (Angrist, Imbens, & Rubin, 1996). The path models perform stepwise regressions of the dependent variables on the independent variables, on the hypothesized mediator (access to a car) and of the mediator on the independent variables and estimate the total, direct and indirect effects that are due to the independent variables and the mediator.

Independent Variables

The following Census-questions were included as independent variables: change in access to a car between 2001 and 2011, operationalized as four binary variables (1 - the respondent had a car in the household at both time-points, 2 - had a car in the household in 2001 but not in 2011, 3 - had no car in 2001 but had a car in 2011, 4 - no car at either time-points), having had a car at both time-points was left out as the reference category. The models also include whether the respondent lives alone in the household in 2011 and controls for the marital status.

Two measures of rurality were included: Firstly, an urban-intermediate-rural classification based on settlement bands defined by the Northern Ireland Statistics and Research Agency (NISRA 2005, 3)[2]. This measure is commonly used by government departments and is comparable to the classifications used in other parts of the UK (NISRA 2005, 7). The rural-intermediate-urban classification operationalizes medium towns and cities of 10,000 or more inhabitants as urban, small towns of 10,000 and fewer inhabitants and

[2] According to NISRA's definition, settlements of a population size of 4,500 or more inhabitants are classified as urban, of 2,250 to under 4,500 inhabitants as intermediate-, and settlements of under 2,250 inhabitants as rural.

settlements of more than 2,250 inhabitants as intermediate settlements, and villages, small villages and hamlets of 2,250 and fewer inhabitants as rural (NISRA 2005, 7). Secondly, NISRA's *Proximity to Services* -index (NISRA 2010) is used as a measure of area remoteness. The *Proximity to Services* -index operationalizes remoteness as travel times by car to service providers such as GP practices, dentists, post offices and supermarkets (NISRA 2010, 17). High values indicate remote areas and low values areas that are close to services. Including both measures enables us to capture rural-urban differences in older people's health and mental health, as well as the role of access to services on a more fine-grained continuous scale. Since some rural areas are more remote than others, it is important to include both. All variables that were included in the models were tested for multicollinearity.

Controls

The models control for marital status (married is the reference category), sex (male is the reference category), age, educational deprivation and tenure. Because the NILS does not contain a direct measure of income, tenure is used as a proxy for wealth; social housing (the respondent lives in rented social housing)[3] and private renting (rented from a private landlord) are included in the models and being a house-owner (owning outright or with a mortgage) is the reference category. In addition, educational deprivation[4] can to an extent be interpreted as an indicator of low social status, as people with low educational qualifications tend to cluster in the lower income groups. The full model also includes NISRA's aggregate-level variable *Income Deprivation Affecting older People* per Ward. This variable captures

[3] Social housing in the UK caters for the housing needs of those who cannot afford privately rented accommodation and is allocated by the government (local councils).

[4] The educational deprivation measure is a household-level variable from the 2001-Census provided by NISRA and coded as follows: the household is educationally deprived if no person aged over 18 has high-school-level (level-2-) education and no person aged 16-18 is in full-time education or has high-school-level education.

the percentage of people aged 60 years and older living in households in receipt of income support, state pension credit, jobseeker's allowance, or housing benefit per electoral Ward. The reasoning behind this is that the income-deprived tend to cluster in income deprived areas. Thus, including all three tenure, educational deprivation and aggregate-level *Income Deprivation affecting older people* ensures that the models adjust for socio-economic deprivation. Adjusting for socio-economic deprivation is important, since a car is, apart from being a means of transport also a financial asset. This analysis is primarily interested in the car as a means of transport.

A general problem when modeling health outcomes is selection bias. In order to adjust for the fact that the causality between access to a car and health can point in both directions (some respondents may have given up the car because ill health or disability impairs their ability to drive), the models adjust for the three chronic conditions asked in the 2011-Census[5] which likely lead to driving cessation: having a chronic long-term illness limiting the respondents' day-to-day activities, a chronic visual impairment, and cognitive impairment, such as frequent memory-loss. The three items were coded into a combined measure "driving-disability" (1= the respondent has one or any combination of the three conditions – 0= the respondent has none of these conditions) and included in the multilevel path analysis as an instrumental variable with a causal path to the mediator (access to a car). This strategy allows to estimate what part of the total statistical effect of access to a car (its indirect effect) is really caused by having a health-related driving-disability. By allowing a causal path of driving disability and allowing its effect on the error terms, the model adjusts for possible selection bias. This strategy follows the approach described by Holland, (1988), Angrist,

[5] The question wording in the Census is: "Do you have any of the following conditions which have lasted, or are expected to last, at least 12 months?" "- a chronic illness, such as cancer, heart disease, epilepsy, HIV, Diabetes" "- a chronic eye-condition, such as blindness or partial sight-loss", "- frequent periods of confucion or memory loss". Other conditions asked are "deafness or partial hearing loss", "communicating difficulty", "a mobility or dexterity difficulty limiting activities such as walking, climbing stairs heavy lifting", "a learning difficulty", "mental health condition", "long-term pain or discomfort", "shortness of breath/asthma", "other condition".

Imbens and Rubin (1996) and MacKinnon, Fairchild and Fritz (2007). Table 1 contains the summary statistics of the variables of the analysis.

[Table 1 about here]

Results

The analysis starts with a look at frequency distributions. On the Census day 2011, 55% of the sample were 65 to 74 years old, 33.3% were aged 75 to 84, 11% were aged 85 to 94, and 546 respondents (0.8%) were 94 years or older. Regarding our main explanatory variable, 25.4% of the respondents do not have a car in the household in 2011. 16% of those living in rural areas, 24% of those living in intermediate settlements and 32% of those living in urban areas do not have access to a car. Of those who live alone, 53.5% do not have access to a car in 2011 and of those who do not live alone, 13% do not have access to a car.

Table 2 contains the percentages for self-reported health and mental health in 2011 by change in access to a car between 2001 and 2011.

[Table 2 about here]

The percentages show that those who had access to a car at both time-points are considerably more likely to report good or very good health in 2011 and less likely to report bad or very bad health than the other groups. Those who did not have access to a car at both time-points are the least likely to report good or very good health, followed by those who gave up the car between 2001 and 2011.

As regards self-reported mental health, those who gained a car between 2001 and 2011 are the most likely to report having a mental health condition, followed by those without access to a car at both time-points. Those who had a car in the household at both time

points are the least likely to report having a mental health condition. The between-group differences are small, but statistically significant (the p-value of the Chi-square test is <0.01).

Access to a Car and Self-Reported Health

Table 3 summarizes the stepwise multilevel model for self-reported health as the dependent variable. M1 includes a dummy variable for living alone while controlling for marital status and dummies for living in a rural area and living in an intermediate settlement (urban is left out as the reference category). M2 adds three dummy variables measuring change in access to a car: having given up the car between 2001 and 2011, having had no access to a car at both time-points, and having acquired a car in the household between 2001 and 2011. Having had access to car at both time-points is left out as the reference category. M3, the full model includes all controls and *Proximity to Services*, our measure of area-remoteness.

[Table 3 about here]

We see from M2 and M3 that those who gave up the car, those who had no access to a car at both time-points and those whose household gained a car report significantly worse health on average than those who had access to a car at both time-points. M3 also tells us that the relationship between access to a car and self-reported health is robust when controlling for tenure, educational deprivation, living alone, living rurally, marital status, age, sex, and area-level *Income Deprivation Affecting Older People*. The finding supports H1.

A main research interest of this paper is whether older people living alone and older people living in rural areas are at a particular health disadvantage and whether this disadvantage is at least partly explained by having no access to a car. We already saw from the frequency distributions that older people who live alone are far more likely not to have a

car than those living with a partner or with other relatives. We also saw that those living in rural areas depend more on the car than those living in urban areas.

Because this analysis is interested in the net effect of living alone, the statistical effect of having lost one's partner needs to be held constant, as bereavement could in itself affect the respondents' health and mental health. We hypothesize that controlling for marital status, living alone is related to a worse health and mental health of older people. We hypothesize further that the relationship is at least partly mediated by having no access to a car.

The coefficients of M1 indicate that older people living alone are indeed less likely than those living with others to report good health. The findings support H2. Moreover, M2 shows that when access to a car is included the effect of living alone changes its sign. When holding access to a car constant, living alone at older ages is positively related to self-reported good health. The finding indicates mediation of living alone by access to a car, as hypothesized in H3. This will be tested further using a multilevel path analysis in M4 (Figure 1).

A similar mediation effect by access to a car is observed with regards to living rurally. When included on their own, living in a rural area and living in an intermediate settlement are both positively related to self-reported good health. However, as soon as access to a car is included, the coefficient of living in a rural area ceases to be statistically significant. Thus, the statistically observed health-advantage of living rurally is mediated by access to a car.

M3 in Table 3demonstrates that *Proximity to Services* is statistically unrelated to self-reported ill-health of older people. Those living in remote areas do not differ significantly in their subjective health from those living in areas that are closer to services. *Proximity to Services* was also included on its own in a separate model, which, too, gave a non-significant result.

The coefficients of the controls are as expected: area-level *Income Deprivation of older people* is strongly negatively related to self-reported good health, renters of social housing and private renters report worse health than house-owners, educational deprivation and age are negatively related to good health, and women tend to report worse health than men.

Figures 1 and 2 present path models of the statistical effects of living alone (M4) and living rurally (M5) on self-reported health mediated by having no access to a car.

[Figure 1 and Figure 2 about here]

Figure 1 shows the path model for self-reported health as the dependent variable, living alone as the independent variable and having no access to a car as the mediator (M7). In addition, driving-disability was included as an instrumental variable with a causal path to having no access to a car, to adjust the model for selection bias.

The path-coefficients show clearly that the negative effect of living alone on self-reported health is due to mediation by access to a car. While the total effect of living alone is statistically significantly positive (0.092), the mediated, indirect effect is negative (-0.035) leading to a direct effect of living alone of -0.055. This means that older people who live alone and have a car report better health than those who live with others, but those who live alone and do not have a car tend to feel significantly less healthy. Because single-living older people are less likely to have a car than those who live with relatives, the relationship between living alone and self-reported health is seemingly negative when not controlling for access to a car. As can be seen from the path diagram, adjusting for driving disability reduces the effect size of access to a car somewhat, but does not change the overall relationships or their statistical significance.

Figure 2 (M5) shows a path model of the statistical effect of living in a rural area on self-reported health, mediated by access to a car. The path-diagram demonstrates that the

positive effect of living in a rural area on self-reported health is fully mediated by having no access to a car. The finding makes sense. We already know that those who live in rural areas are more dependent on the car, thus the majority of households have a car. Models M2 and M3 showed that access to a car has a strong positive main effect on self-reported health and the path model (M5) demonstrates that it also mediates any rural-urban differences in the self-reported health of older people. In other words, those who have access to a car do not differ significantly in their subjective health whether they live in rural, intermediate or urban areas. This finding does not support H4. However, urban-rural classifications only tell part of the story, as some rural areas are closer to services than others. Thus, as a last step, we investigate whether older people who do not have access to a car face a more severe health-disadvantage the further they live away from service providers. To this end, a cross-level interaction is fitted between access to a car and the *Proximity to Services* -index, our measure of area-remoteness.

The last column in Table 3 contains the cross-level interaction (M3) with self-reported health as the dependent variable. The coefficient of the interaction is not statistically significant, *Proximity to Services* does not moderate the effect of having access to a car. Older people who do not have access to a car are considerably worse off no matter whether they live in remote, rural or urban areas. Thus, H4 is not supported by the data with regards to self-reported general health.

Access to a Car and Mental Health

With self-reported mental ill-health as the dependent variable, the same analytical strategy was applied as with general health. Table 4 contains the binary logistic multilevel model. The relationships resemble those found for general health. Having given up the car between 2001 and 2011, having had no access to car at both time-points, but also having

gained a car to the household between 2001 and 2011 are strongly positively related to having a mental health condition. The findings again support hypothesis H1.

When included on its own and alongside living rurally (M1), living alone is statistically significantly positively related to having a mental health condition, but when controlling for having no access to a car, the coefficient of living alone loses its statistical significance.

As with general health as the dependent variable, when included on its own, and alongside living alone (M1), living rurally appears to be beneficial for older people's mental health. But when controlling for having no access to a car, the coefficient loses its statistical significance. In order to test for the mediation, path models of the effects of living alone (M4) and living rurally (M5) on self-reported mental health, mediated by having no access to a car were fitted (Table 5). The models are as shown in Figures 1 and 2. The models again include driving-disability with causal paths to access to a car and self-reported mental health and also include the other controls. The path-analyses show a full mediation of both living alone and living rurally by access to a car. The direct effects of both living alone and living rurally on having a mental health condition are statistically non-significant, their effects are almost entirely due to the indirect effect, hence mediated through access to a car. H3 is thus strongly supported by the data.

The full model including all covariates (Table 4, M6) shows that most of the relationships are as expected: social and private renters are more likely than house-owners, and women are more likely than men to report a mental health condition. Educational deprivation is positively related to mental ill-health and so is living in an income-deprived area.

Again, *Proximity to Services* is not statistically related to reporting a mental health condition: people living in remote areas are no more likely than those living in urban centers

to report suffering from mental ill-health. As with self-reported health as the dependent variable we fitted a cross-level interaction between *Proximity to Services* and access to a car, to test if its statistical effect is moderated by area-remoteness. Looking at the third column of Table 4 (M3), we see that the statistical effect of access to a car is not moderated by area-remoteness. Thus, H4 is not supported with regards to mental health. Both older people who gave up the car and those who had no access to car at both time-points are considerably more likely to suffer from ill mental health than those who had a car at both time-points, regardless whether they live in rural or urban areas. Strikingly, however, the interaction between having gained a car between 2001 and 2011 and area-remoteness is statistically significant and positive. Older people who acquired a car are more likely to report having a mental health condition the more remote their area of residence is. This finding is puzzling; it neither accords with the literature, nor does it make intuitive sense.

In summary, the analyses of this paper confirm hypotheses H1, H2 and H3, while H4 is not supported by the data.

Discussion

The analysis of the NILS-data could show that having access to a car is strongly related to a better self-reported health and mental health of older people in Northern Ireland. Those who gave up their car between 2001 and 2011, and those who did not have a car at both time-points are considerably more likely than those who had a car at both time-points to report ill-health and ill mental health.

The negative relationships found between having gained a car to the household (from 2001 to 2011) and good health and mental health are puzzling. It makes no sense that having a new car in the household should in itself be related to ill health. If anything, one would expect the opposite. The finding is likely spurious: The number of NILS-members aged 65 or

older who gained a car between 2001 and 2011 is very small: 2,079 out of 65,623 individuals, 3% of the sample. Looking at the age distributions we see that 48% of older NILS-members who acquired a car between 2001 and 2011 were older than 75 years and 29% were older than 80 years in 2011. The majority are unlikely to be drivers.

This points us towards several limitations of this study: Access to a car is a household-level variable. Thus, at least for multi-person households we cannot know whether the older person living in the household is the driver, nor does the measure indicate the actual car-usage. A significant minority of older people who used to live on their own move in with younger relatives when their health declines. Of those who gained a car between 2001 and 2011, 18% had lived on their own in 2001, but lived with other adults in the same household in 2011. Given that Northern Ireland is largely a rural society, these relatives are likely drivers. It is known that older people sometimes buy a car for a younger relative and register it in their own household, which could have caused some positive bias to our findings. Secondly, the NILS does not provide information on the respondents' usage of alternative means of transport, such as buses. Thus using access to a car as a proxy for transport is not unproblematic. Nevertheless, because the provision of alternative means of public transport that suit the needs of older people was found by other research to be very limited in Northern Ireland (Ahern and Hine 2012, Heenan 2010, Walsh et al. 2011), one can reasonably assume that for many older people in Northern Ireland having no access to a car is indeed strongly linked to not having sufficient independent access to transport. A third, related limitation is that although the path modeling approach was historically designed to test causal assumptions, our findings cannot claim causality. Not all variables of the analysis were measured at both time-points, e.g. mental health was asked only in the Census 2011. Hence, the relationships could not be tested longitudinally.

Nonetheless, the findings are strong, consistent across both response variables, and are robust when controlling for having a chronic eye-condition, having a limiting long-term illness, having a cognitive impairment, age, tenure, educational deprivation and area-level *Income Deprivation affecting older people*. It is noteworthy that after controlling for area- and individual-level deprivation, the coefficients of access to a car remain strongly significant for both dependent variables. Notwithstanding the fact that respondents living in deprived areas are less likely to have a car, the results of our multilevel models show a strong, statistically significant effect of having no access to a car on self-reported health and mental health over and above the effect of deprivation.

Interestingly, living alone as such does not pose a health-and mental health disadvantage to older people. When having no access to a car is held constant, older people who live alone are even slightly more likely to report good health than those living with relatives in the household. Those who live alone without access to a car tend to report worse health and mental health. The path analyses showed that the positive relationships between living alone and ill health and mental health are fully mediated by access to a car. The findings demonstrate the importance of having independent access to a car particularly for single-living older people. The result reminds us that the car is more than just a means of transport, but also a means of maintaining autonomy and independence (Bauer and Rottunda 2003, Shergold, Pankhurst and Musselwhite 20012), both of which have been linked to wellbeing and good health. Those without access to a car, on the other hand, could face a double disadvantage: many have difficulty reaching services on their own and might not have someone who could run errands for them or offer a lift. Furthermore, social contacts beyond the immediate neighborhood are often difficult to maintain without a car, resulting in an increased risk of isolation and loneliness. Both are known to pose a risk to older people's health and mental health (Alpass and Neville 2003; Coyle and Dugan 2012).

The analyses found that access to a car matters to older people, regardless whether they live in remote, rural or urban areas. Older people living in rural areas have a statistical health- and mental health advantage over those living in urban and intermediate areas only when having no access to a car is not controlled for. As soon as our models include having no access to a car, their health-advantage vanishes. Considering that the health-disadvantage of not having a car is linked to a loss of mobility the finding makes sense (Musselwhite and Haddad 2010; Ahern and Hine 2012). People whose physical mobility is impaired will have difficulty accessing even services that are located relatively nearby without a car. To a person who has difficulty walking longer distances or carrying heavy bags it makes little difference if a shop is half a mile away and located on top of a hill, in the city centre of a nearby small-town, or 50 miles away. Without access to an easy door-to-door mode of transport, the shop will be equally inaccessible to them in all three scenarios.

Conclusion

The findings of this article demonstrate that having no access to a car is related to a worse subjective health and mental health of older people in Northern Ireland. Particularly those who live alone and in areas, where public transport is not sufficiently tailored to the needs of older people face considerable health- and mental health disadvantages, if they have no access to a car. The results hold across rural, intermediate and urban areas and indicate to future research and policy makers that assessments of older people's transport needs should not just focus on rural areas, but also pay attention to older people living in intermediate settlements and urban areas, without access to a car. Because these areas are closer to services they are at risk of being overlooked. Older people with disabilities impeding their ability to drive may be deprived of services even in intermediate and urban areas if alternative means of transport that are accessible to them are not provided. Secondly, the car

is more than just a means of transport. It allows individuals to maintain their autonomy and independence, which benefits their mental health. Thus, policies addressing older people's public participation and access to services should not just focus on the provision of transport alone, but also recognize their need for autonomy and independence and support alternative forms of mobility that give older people sufficient options.

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Tables and Figures

Table 1: Summary Statistics of the Dependent and Independent Variables of the Analysis

Binary Variables:	Obs.	Percent		Min	Max
Mental Health Condition (yes –no)	65605	4.7		0	1
Driving-disability	65605	37.0		0	1
Gave up the car, 2001-2011	65623	9.4		0	1
No car in the household in 2001 and 2011	65623	15.9		0	1
Gained a car, 2001-2011	65623	3.2		0	1
No car in 2001	65508	19.1		0	1
No car in 2011	65623	25.4		0	1
Sex: female	65605	5.61		0	1
Rural	65623	32.2		0	1
Intermediate Settlement	65623	16.0		0	1
Urban	65623	51.7		0	1
Social renter	65623	13.4		0	1
Private renter	65623	4.1		0	1
House owner	65623	77.4		0	1
Lives alone in 2011	65606	31.1		0	1
Married 2011	65623	57.2		0	1
Widowed, 2001-2011	65623	13.3		0	1
Divorced, 2001-2011	65623	1.3		0	1
Continuous Variables:	Obs.	Mean	Std. Dev.	Min	Max
Self-reported Health 2011 (five-point scale)	65605	3.433	0.945	1	5
Self-reported Health 2001 (three-point-scale)	65603	1.268	0.763	1	3
Age	65605	74.21	7.317	65	100+
Income-deprivation of older people/ Ward	556	0.003922	1.001502	-1.947	3.260
Proximity to Services/Ward	556	0.000342	1.000264	-1.169	4.185

Note: Due to a non-disclosure policy of the data provider in order to eliminate the risk of identifying individual respondents, the exact maximum value for age cannot be reported.

Table 2: Self-reported health and mental health by having a car in the household, Column Percentages

	Car in the household (2001 and 2011)	Car in the household in 2001, but not in 2011	No car in the household in 2001, but car in 2011	No car in the household (2001 and 2011)
	%	%	%	%
Health 2011: very good	14.5	6.4	7.3	5.8
Health 2011: good	35.7	25.2	24.8	23.0
Health 2011: fair	37.6	48.6	44.9	49.6
Health 2011: not good	9.8	15.6	17.5	17.3
Health in 2011: bad	2.5	4.0	5.5	4.3
Mental health condition, 2011	4.89	6.06	7.98	6.57
Total	100.0	100.0	100.0	100.0

Table 3: Access to a Car and Self-reported Health in 2011- Hierarchical Linear Model

DV: Self-reported Health in 2011:	M1		M2		M3	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Driving-disability			-1.058***	0.006	-1.058***	0.006
Gave up the car (2001-11)			-0.098***	0.011	-0.093***	0.010
No car in 2001 and 2011			-0.112***	0.001	-0.112***	0.010
Gained a car (2001-11)			-0.151***	0.017	-0.151***	0.017
Lives alone in 2011	-0.076***	0.009	0.094***	0.008	0.094***	0.008
Widowed	-0.048***	0.011	-0.039***	0.009	-0.034***	0.009
Divorced	-0.078*	0.031	-0.088***	0.026	-0.088***	0.026
Rural Area	0.089***	0.018	0.002	0.012	0.017	0.014
Intermediate Settlem.	0.094***	0.022	0.039***	0.00	0.038**	0.015
Social Housing			-0.138***	0.001	-0.138***	0.001
Private Renter			-0.074***	0.015	-0.074***	0.015
Educational Deprivation			-0.129***	0.006	-0.129***	0.007
Age			-0.005***	0.000	-0.005***	0.000
Sex: female			-0.001***	0.006	-0.001***	0.006
Proximity to Services/Ward			-0.006	0.007	-0.008	0.017
Income deprivation / Ward			-0.078***	0.004	-0.078***	0.004
Gave up the car*Proximity to Services					-0.008	0.017
No car in '01 and '11*Proximity to Services					-0.008	0.005
Gained a car*Proximity to Services					-0.019	0.022
Constant	3.410***	0.013	4.026***	0.033	4.023***	0.034
Level-2-Variance	0.197***	0.036	0.0.040***	0.003	0.040***	0.003
Residual-variance	0.919***	0.003	0.751***	0.003	0.751***	0.003
N	65605		65605		65605	
BIC	176214		149007		149026	

Note: *** $P<0.001$, ** $P<0.01$, * $P<0.05$; Standard errors in parentheses.

Table 4: Access to a Car and Mental Health in 2011 – Binary Logistic Multilevel Model

DV: Self-reported Mental Health Condition	M1		M2		M3	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Driving-disability			1.642***	0.044	1.642***	0.044
Gave up the car (2001-11)			0.278***	0.064	0.277***	0.064
No car in 2001 and 2011			0.283***	0.057	0.283***	0.057
Gained a car (2001-11)			0.378***	0.089	0.377***	0.089
Lives alone in 2011	0.164***	0.042	0.085	0.048	0.087	0.049
Widowed	0.081	0.056	0.085	0.058	0.086	0.058
Divorced	0.932***	0.111	0.647***	0.116	0.647***	0.115
Rural	-0.143*	0.056	0.032	0.076	0.032	0.076
Intermediate	-0.064	0.060	0.034	0.06	0.034	0.06
Social Housing			0.218 ***	0.051	0.218 ***	0.051
Private Renter			0.379***	0.079	0.378***	0.079
Age			-0.061***	0.003	-0.061***	0.003
Sex: female			0.147***	0.004	0.157***	0.040
Educational Deprivation			0.050	0.042	0.050	0.042
Proximity to Services/Ward			-0.026	0.036	-0.026	0.036
Income deprivation / Ward			0.146***	0.023	0.146***	0.023
Gave up the car*Proximity to Services					-0.043	0.063
No car in '01 and '11*Proximity to Services					0.029	0.055
Gained a car*Proximity to Services					0.222**	0.081
Constant	-3.102***	0.043	0.062***	0.007	-0.064	0.003
Level-2-Variance	0.381***	0.072	0.163***	0.19	0.163***	0.19
N	65,605		65,605		65,605	
BIC	24908.28		22732.67		22743.57	

Note: *** $P<0.001$, ** $P<0.01$, * $P<0.05$; Standard errors in parentheses.

Table 5: The Effects of Living Alone and Living Rurally on Self-reported Mental Health – Tests for Mediation by Access to a Car

Mediator: Having no Access to a Car (2011)	M4: IV: Living Alone		M5: IV: Living in a Rural Area	
	Coef.	S.E.	Coef.	S.E.
A-Path	0.371***	0.003	-0.163***	0.004
B-Path	0.248***	0.049	0.460***	0.039
AB-Path: Indirect Effect	**0.033*** **	0.017	**-0.015** **	0.006
C' -Path: Direct Effect	0.089	0.048	-0.021	0.040
C -Path: Total Effect	0.097**	0.039	-0.095**	0.038
IV2: Driving-Disability:				
A-Path 2: No Access to a Car on Driving-disability	0.130***	0.003	-0.049***	0.004
AB-Path 2: Indirect Effect	0.032***	0.006	-0.003*	0.001
C-Path 2: Mental Health on Driving-Disability	1.555***	0.041	0.049***	0.040
Error-variance (ε) DV	0.136***	0.001	0.213***	0.001

Note: *** $P<0.001$, ** $P<0.01$, * $P<0.05$; Standard errors in parentheses. Binary logistic multilevel path analyses with bootstrapped standard errors.

Figure 1: Path-Model – The Statistical Effect of Living Alone on Self-Reported Health, Mediated by Access to a Car

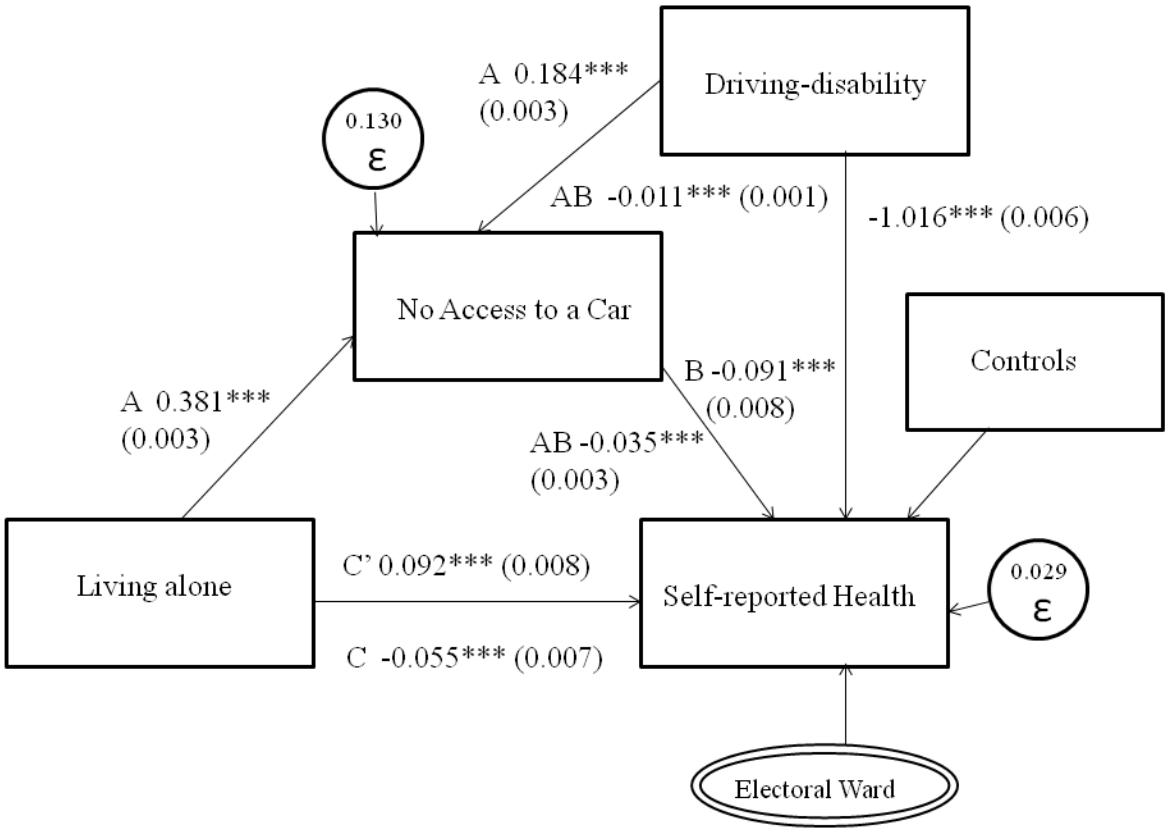

Figure 1: Note: *** *P*<0.001, ** *P*<0.01, * *P*<0.05, standard errors in parentheses. A-Path= path from the independent variable (IV) to the mediator, B-Path= path from the mediator to the dependent variable, AB-Path= indirect effect C'-Path= direct effect, C= total effect, ε=error-term of the random part. Hierarchical linear multilevel path analyses with bootstrapped standard errors were performed.

Figure 2: Path-Model – The Statistical Effect of Living Alone on Self-Reported Health, Mediated by Access to a Car

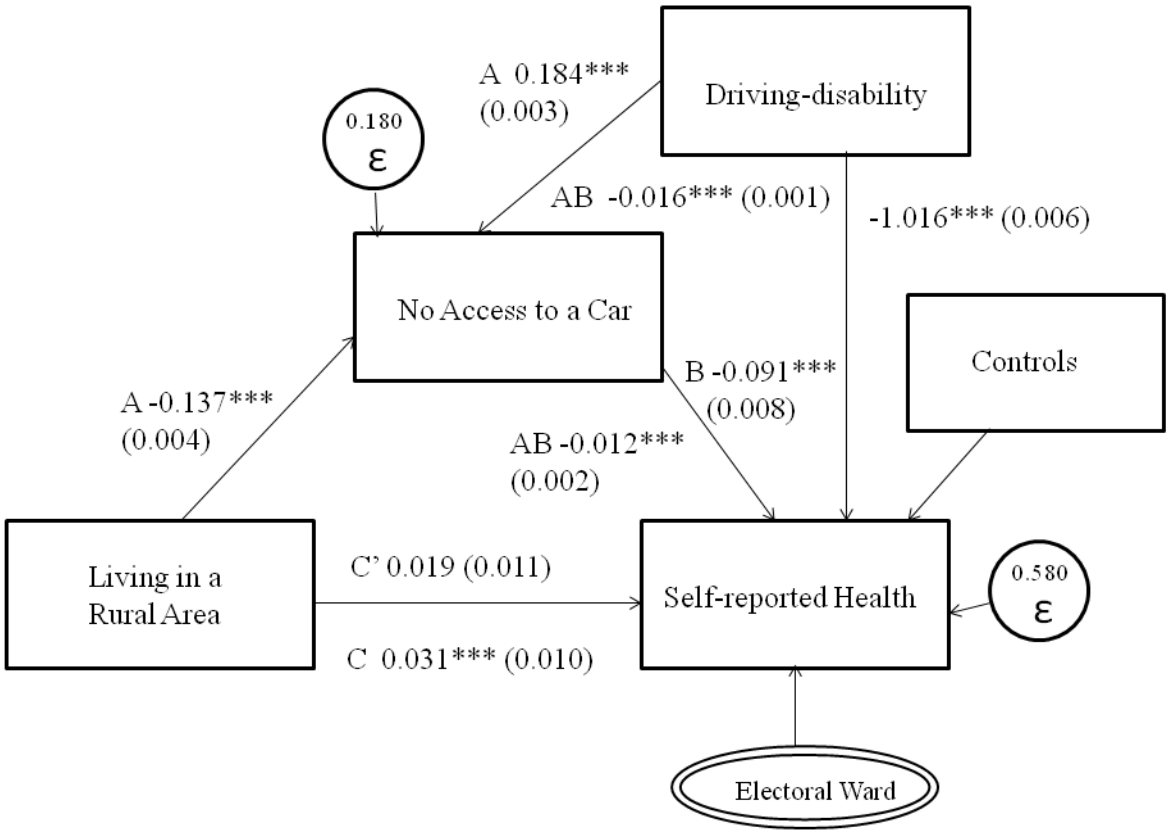

Figure 2: Note: *** *P*<0.001, ** *P*<0.01, * *P*<0.05, standard errors in parentheses. A-Path= path from the independent variable (IV) to the mediator, B-Path= path from the mediator to the dependent variable, AB-Path= indirect effect C'-Path= direct effect, C= total effect, ε=error-term of the random part. Hierarchical linear multilevel path analyses with bootstrapped standard errors were performed.