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Aging in place and quality of life among the elderly in Europe: A moderated mediation model

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ABSTRACT

Objectives: We explored the moderated-mediation effects of perceived accessibility to the environment on quality of life in later life via two socio-spatial mediators (loneliness and connection to place) and two moderators (functional disability and marital status).

Methods: We utilized the data of the fifth wave of the Survey of Health, Aging and Retirement in Europe (SHARE) to analyze the quality of life of 13,828 Europeans aged 65 or older. Bootstrapping with resampling strategies was used to test the moderated-mediation hypotheses.

Results: Higher scores for perceived accessibility to services and sites was associated with greater quality of life. This relationship was partially mediated by lower loneliness and higher connection to place, and moderated by functional disability and marital status.

Discussion: Policymakers and planners should plan suitable, accessible and age-friendly social and spatial environments for dependent and independent older adults. They should also suggest interventions to mitigate social loneliness and modify spatial obstacles.

1. Introduction

Over the last decade, many organizations and governments have encouraged the development of age-friendly social and physical environments to promote elder health, wellbeing, quality of life and ultimately, the ability to age in place (Lehning, Smith, & Dunkle, 2015). Aging in place is defined as “remaining to live in the community, with some level of independence (e.g., receiving help from family members or caregivers, but without the need to move away from the community (Davey, de Joux, Genesh, & Arcus, 2004), rather than in residential care”. Most people prefer to age in place because it is seen as allowing older adults to maintain independence and autonomy, and as enabling them to stay connected to social support, including friends and family (Rantz et al., 2005), reducing social isolation and loneliness (Wiles et al., 2009).

One of the most important foundations in the ability of older adults to age in place is perceived accessibility to services and sites (trading areas, public services, etc.) in their living environment (where the elderly live their lives, use the public services, clinics, etc.) (Granbom, Iwarsson, Kylberg, Pettersson, & Slaug, 2016) and connection to the living environment itself (connection to place) (Roin, 2015; Burholt, 2006). For successful ageing in place, housing and neighborhood

environments need to promote accessibility and to facilitate older people's independence and activity (Burton, Mitchell, & Stride, 2011). Recent research (Liu, Everingham, Warburton, Cuthill, & Bartlett, 2009) suggests that mobility, independence and quality of life among older people is closely related to the physical environment, such as the perceived accessibility to services and sites (Gilroy, 2008).

To date, there is little research which studies the interrelationships and mechanisms in which perceived accessibility to neighborhood services, loneliness, connection to place and functional disability contribute to the quality of life of older adults.

2. Literature review

Researchers have found that oftentimes older adults are less active than they want to be because the environment does not provide sufficient accessibility and poses obstacles. For instance, when the pavements (walkways/sidewalks) are cracked and the area is not well-lit (Turel, Yigit, & Altug, 2007; Valdemarsson, Jernryd, & Iwarsson, 2005), older adults perceive their environment as inaccessible and avoid going outside and using essential services in their living areas. This, in turn, prevents them from aging with dignity in their home settlements (the places where the elderly live and use for their everyday lives).

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Actual and perceived accessibility of the outdoor environment and the ability to act outside the home are fundamental to older adults, and contribute to their well-being and quality of life (Rantakokko et al., 2010; Stoeckel & Litwin, 2015). Actual accessibility is measured in values of time or distance (Gregory, Johnston, & Smith, 1986; Hass, 2009; Pirie, 1979). However, perceived accessibility has been revealed as the most significant measure to evaluate accessibility to these neighborhood services and sites (Gregory, Johnston, Pratt, Watts, & Whatmore, 2009; Stoeckel & Litwin, 2015; Wang, Brown, & Liu, 2015). Perceived accessibility has a major influence on quality of life not only for elderly, but for the general population. The accessibility to important services and facilities in the living environment (e.g., access to public transportation, shops, gastronomy, schools, and others) was found to be a key attribute, contributing significantly to residents' satisfaction with their living environment (Sirgy & Cornwell, 2002; Talen, 2002). Although it is a complex concept, many studies have measured accessibility using either the objective distance or the perceived proximity to services and facilities. Recently, Zenker, Petersen, and Aholt (2013) have stated that access to central services and sites in the living environment was the strongest predictor of satisfaction in a sample of German agglomerations. Their approach to an index of city satisfaction was also built only on the perceived, self-reported ratings of residents (Wirth, Gret-Regamey, & Stauffacher, 2015).

2.1. Theoretical framework

Perceived environment accessibility is very important and beneficial to older adults in many aspects of life, such as enjoyment of sunlight, opportunities to obtain new information, physical exercise, and access to services, such as older adult day clubs, clinics, or the gym, meetings with friends, and recreational activities, such as shopping or coffee (Kweon, Sullivan, & Wiley, 1998; Sugiyama & Thompson, 2007). According to the environmental gerontology ecology model (Lawton & Nahemow, 1973; Wahl, Iwarsson, & Oswald, 2012), good compatibility, namely, an adequate match between older adults and their environment (starting with the home, but also the living area) results in greater psychological wellbeing and better **quality of life**. Studies have shown that perceived and actual environment accessibility are associated with subjective wellbeing and quality of life in later life (Kerr, Rosenberg, & Frank, 2012; Stoeckel & Litwin, 2015). One of the main outcomes of perceived accessibility is the opportunity to take part in social interactions, which have been shown to be important for good health, wellbeing, better quality of life and even reduced mortality among older adults (Lawton, 1991; WHO, 2007). People tend to leave their houses if they have a positive image of their environment as being walkable and accessible (Richard, Gauvin, Gosselin, & Laforest, 2008). Perceived accessibility to local services is an important indicator of a community being characterized as age friendly. In such settings, aging in place unfolds with greater ease and to a greater degree than in areas having few services at a small distance away (Scharlach, Davit, Lehning, Greenfield, & Graham, 2014).

Quality of life is related to many life aspects; the most frequent are social relationships, social activity, services in the living environment, perceived self-health, and physical characteristics (Felce & Perry, 1995; Lawton, 1991; Litwin, 2005). Since these variables are the most common in explaining quality of life, the aim was to understand how perceived accessibility relates to quality of life via mediators and moderators. The mediators and moderators represent a combination of social, personal and environmental variables, as has been found in many studies relating to quality of life and ageing in place (Amit & Litwin, 2010; Grant & Bowling, 2011; Iecovich, 2014; Li et al., 2014; Perez, Fernandez-Mayoralas, Rivera, & Abuin, 2001; Vitman Schorr, Iecovich, & Alfasi, 2013).

2.2. Loneliness

Perceived easier access to services and sites has also been found to be associated with lower social isolation and feelings of loneliness (Burton et al., 2011; WHO, 2007), and perceived inaccessibility to services and sites can be associated with greater social isolation and loneliness (Hall, Havens, & Sylvestre, 2003). Loneliness is defined as a subjective distressing feeling that might result from social isolation (Ashida & Heaney, 2008; Cloutier-Fisher, Kobayashi, & Smith, 2011). This feeling might be connected to the physical character of the neighborhood since the physical attributes of the neighborhood have a significant impact on mobility, independence and quality of life of community-dwelling older adults (Burton et al., 2011). As such, in the U.K. and other places, neighborhood planning takes into account the ability of older adults to get to services and amenities on foot, to be able to attend social activities and to have the opportunity of engaging in social interactions (Godfrey, Townsend, & Denby, 2004). Given the above relationships between perceived accessibility, loneliness, and quality of life, one may assume that loneliness can mediate the relationship between perceived accessibility and quality of life.

2.3. Marital status and functional disability

The literature has also revealed two factors that may influence the associations between perceived accessibility, loneliness and quality of life in later years: **marital status** (Syed et al., 2017), and **functional disability** (Hall et al., 2003; Perissinotto, Stijacic Cenzer, & Covinsky, 2012). For example, ill and disabled elderly people perceive of access to services and places as more difficult than independent seniors (Valdemarsson et al., 2005). In this case, disabled older adults might find themselves socially isolated (Hall et al., 2003; Lawton, 1990), which might also decrease their quality of life (Hao et al., 2017). However, other studies have shown that easier and more suitable access to services and sites for disabled persons, particularly among older adults, would encourage them to leave their homes, and this might increase their social interactions and reduce their loneliness and isolation (Cho, McLachlan, Clarke, & Mannan, 2016). Therefore, it is important to explore whether perceived accessibility levels influence quality of life differently among older adults with functional disability and among those with no limitations.

Some studies also indicate that older adults living alone or who are unmarried reported higher loneliness levels (Jakobsson & Hallberg, 2005; Lee & Bulanda, 2005) and a lower level of quality of life than those who are married or who are living with a partner (Lee & Bulanda, 2005). In this case, one can assume that the effect of perceived accessibility on quality of life via loneliness depends on whether the older adults have a partner or not. Perceived accessibility can also contribute to a greater connection to place (Shamai, 1991).

Connection to place (or attachment to the living area or the close living environment) is expressed by close acquaintance with the physical environment together with strong feelings of belonging to a place and being part of its social and cultural fabric for many years. These feelings develop in most cases after many years of residence (Shamai, 1991). Previous studies have found that the connection to place is considered a strong predictor of social well-being and high quality of life, especially in a population of older adults (Rollero & De Piccoli, 2010; Taylor, 2001). These relationships between perceived accessibility, connection to place and quality of life may indicate that connection to place mediates the relationship between perceived accessibility and quality of life.

Quality of life is also influenced by a variety of socio-economic variables. For example, greater quality of life has been found to be related to females (Campos, Ferreira, Vargas, & Albala, 2014); to younger older adults (Layte, Sexton, & Saava, 2013); to those with higher education levels (Lasheras, Patterson, Lasheras, Casado, & Fernandez, 2001); and continuous employment (Chandola, Brunner, &

Marmot, 2006; Wahrendorf, Dragano, & Siegrist, 2013). Health related factors can also be associated with quality of life. For instance, greater quality of life has been found to be related to good perceived health (Ishizaki, Kai, & Imanaka, 2006; Lin, Yen, & Fetzer, 2008) and a lower number of chronic diseases (Chen & Chen, 2017).

3. Hypotheses

3.1. The mediation hypotheses

The effect of perceived accessibility on quality of life occurs directly and/or indirectly via mediators (loneliness and connection to place), while controlling for covariates.

- 1 Higher perceived accessibility is associated with greater quality of life among elderly adults aged 65 and older.
- 2 Higher perceived accessibility is associated with lower loneliness, which is associated to greater quality of life among elderly adults aged 65 and older.
- 3 Higher perceived accessibility is associated with higher connection to place, which is associated to greater quality of life among elderly adults aged 65 and older.

3.2. The moderated – mediation hypotheses

- 1 The indirect effect of perceived accessibility on loneliness depends on the limitation levels in Instrumental Activities of Daily Living (IADLs).
- 2 The indirect effect of loneliness on quality of life depends on whether the respondent is married or not.

4. Methods

4.1. Data and sampling

The present study is based on data from the Survey of Health, Aging, and Retirement in Europe (SHARE), which includes 15 countries: Austria, Belgium, Switzerland, Czech Republic, Germany, Denmark, Estonia, Spain, France, Israel, Italy, Luxembourg, Netherlands, Sweden, and Slovenia. SHARE data collection is based on computer-assisted personal interviewing (CAPI). For more details on SHARE data collection, see the methodology of Börsch-Supan (2017), Börsch-Supan et al. (2013). SHARE includes respondents aged 50 years and older as well as their partners of any age. The current analysis used data from the fifth wave of SHARE which were collected in 2012–2013. The current analytic sample comprises 13,828 individuals aged 65 and older who participated in wave five and for whom there was no missing data on the dependent variable – quality of life.

5. Measures

5.1. Dependent variable

Quality of life—measured by six items drawn from the CASP-12 scale developed by Von dem Knesebeck et al. (2005) Von dem Knesebeck, Hyde, Higgs, Kupfer, & Siegriest, (2005). CASP-12 scale assesses quality of life, divided into four domains: control, autonomy, self-realization, and pleasure (Wiggins, Netuveli, Hyde, Higgs, & Blane, 2008). The six items used in the current study reflect two domains: self-realization and pleasure, and included: "Look forward to each day, Life has meaning, Look back on life with happiness, Feel full of energy, Full of opportunities, looks good". Each statement is measured on a 4-point Likert scale, showing how often it is relevant in the respondent's life: 1 (often), 2 (sometimes), 3 (rarely), or 4 (never). The overall score was based on reverse-coding of the six items. Total score ranged from 6 to 24, with higher scores indicating higher quality of life (Cronbach $\alpha = 0.82$).

5.2. Independent variable

5.2.1. Perceived accessibility

Operationalized as the ease of access to four services and sites that pertain to daily life: bank, grocery store, general practitioner and pharmacy. Respondents were asked to rate how easy it was to get to each of these services and sites. Answer categories were on 4-point scale, ranging from (1) very easily to (4) very difficult. *The sum score of the perceived accessibility scale is based on reverse-coding of the four items, in which higher scores represented easier access to the services (Cronbach's alpha in the current analysis = 0.93.)*

6. Mediators

6.1. Loneliness

The measure was developed by Hughes and colleagues in 2004 to assess loneliness in large scale surveys (Hughes, Waite, Hawkley, & Cacioppo, 2004). The variable "loneliness" contains a sum score based on reverse-coding of three items: *Feels lack of companionship; Feels left out; Feels isolated from others*. Likert-type scores for each item ranged between 1 (Often), 2 (Some of the time) and 3 (Hardly ever or never). The total score range between 3 and 9, with higher scores indicating greater loneliness ($\alpha = 0.75$).

Connection to place- was evaluated by four items: "Feeling part of this area", "Vandalism/Crime is a big problem in this area", "Area is kept very clean", "If I were in trouble, there are people in this area who would help me." Likert-type scores ranged between 1 (strongly disagree) and 4 (strongly agree) with higher scores indicating greater connection to place. Scores ranged between 4 and 16. Internal consistency for the whole measure in the current analysis (Cronbach's alpha) was $\alpha = 0.70$.

6.2. Covariates and moderators

The study controlled for six background socioeconomic variables and three health related factors. Background variables included gender, age, marital status, years of education and employment status. Age and years of education were both defined as continuous measures. Sex was a dichotomous (0 = male, 1 = female). Employment status was dichotomized as "employed = 1" or "unemployed/retired = 0". Marital status was coded as with partner = 1 or without partner (single, widowed or divorced) = 0. Marital status was proposed as a **moderator** in the current study.

Health-related factors included three measures: self-rated health (SRH), physical health (by measuring the number of chronic diseases), and functional disability (by measuring the IADL limitation scores). **Self-perceived health** in wave five was determined by the respondents' descriptions of their general health on a scale ranging from "excellent" to "poor" (dichotomized here as (1) "less than very good (good, fair, poor)" and (0) "very good/excellent"). Thus, the variable reflects poor self-perceived health.

In terms of **physical health**, respondents were also asked to specify whether they were ever diagnosed with a chronic illness from a list of 14 diseases (e.g., heart failure, hypertension, cerebral vascular disease, diabetes, hyperlipidemia, chronic lung disease etc.). The chronic disease variable was calculated as the number of cited diseases and its score ranged from 0 to 14, with a higher score indicating more of these diseases.

Functional disability was obtained by reported difficulties in instrumental activities of daily living (IADL) (Lawton & Brody, 1969). IADL difficulties included using the telephone, shopping, housekeeping, laundry, transportation, managing medications, and managing finances, with a possible score of 0–7. The score was dichotomized to: (0) "no IADL difficulty" and (1) "one IADL difficulty or more". This variable is proposed as a **moderator** in the current study.

6.3. Data analyses

Descriptive statistics were employed to calculate the means and standard deviations of the continuous variables and the percentage and frequency of the categorical variables. In the second stage, bivariate analyses were performed to examine the association between perceived accessibility, mediators, covariates and the dependent variable using an independent *t*-test, Pearson or Spearman correlation tests.

Next, to test the mediation hypotheses and moderated mediation hypotheses, we followed the guidelines of and employed the analytic methods outlined in Preacher and Hayes (2008). Hayes (2012) suggests using PROCESS model 21, which simultaneously tests mediation and moderated mediation effects. This model allows the indirect effects of the independent variable (*X*) on a dependent variable (*Y*) through two mediators (*M1* and *M2*) to be moderated by two moderators (*W* and *V*). The moderator (*W*) moderates the association between (*X*) and (*M1*), and the moderator (*V*) moderates the association between (*M1*) and (*Y*).

In the current study this method calculates the mediating effect between (*X*; perceived accessibility) and (*Y*; quality of life) through two mediators (*M1*: loneliness, and *M2*: connection to place) at several values of the two moderators (*W*: IADL; and *V*: marital status).

The first stage was to assess the direct effect (weight *C*) of the independent variable (*perceived accessibility*) on the dependent variable (*quality of life*) with the mediators; and the total effect without the mediators (weight *C*) while controlling for covariates and moderators, using the PROCESS mediation model 4 (Hayes, 2012; Preacher & Hayes, 2008).

The second stage refers to the moderated mediation effects, using PROCESS model 21 (see Fig. 1, moderated mediation model) (Hayes, 2012). The first analysis in this model shows the indirect effects of [*X* (path *a1*), *W* (path *a2*), *XW* (path *a3*)] on *M1*. The second analysis shows the indirect effect of *X* on *M2* (path *a4*). The final analysis of the coefficients for the *C'1*-path reflects unstandardized regression weights of the direct effect of *X* on the dependent variable (*y*) after taking into account mediators and moderators, and controlling for covariates. In this analysis, paths *b* reflect the effects of the mediators [*M1(b1)*, *M2(b2)*], the effects of the moderator [*V(b3)*], and the effect of interaction [*M1*V(b4)*] on the dependent variable (*y*).

The total effect, conditional indirect and direct effects were calculated through bootstrapping set at 5000 samples. Confidence intervals

were calculated using this method by sorting the lowest to the highest of these 5000 samples of the original dataset, yielding a 95 percentile confidence interval. All analyses were run using SPSS 20.0 with the PROCESS statistical program (Hayes, 2012). All estimated effects reported by PROCESS are *unstandardized regression coefficients*.

7. Results

Table 1 shows that the sample consists of a majority of women, of respondents who are unemployed or retired, and who are married or have a partner. The age range was 65–108 years (Mean = 75.9, *SD* = 7.9). The average years of education were about 10.9. The respondents report, on average, two chronic diseases; about 21 percent have a limitation in at least one instrumental activity of daily life, and the majority rate their health as less than very good.

Their average score on quality of life (self-realization/pleasure subscales) is 19.6, indicating high appraisal of quality of life. Average scores of perceived accessibility to services and connection to place were fairly high in this sample. The loneliness level was in low with an average of 3.84, and ranged between 3 and 9 (see **Table 1**).

Table 2 presents the bivariate tests between the study variables with quality of life as the dependent variable. Results revealed that all socioeconomic variables were significantly related to quality of life. The table shows that Israeli respondents have a lower quality of life than their European counterparts. It was also found that women, those with no partner, and unemployed respondents have lower quality of life than their counterparts. In addition, greater quality of life was associated with younger age, and higher education level. Lower quality of life was correlated with poor perceived health, physical limitations, and chronic diseases. Furthermore, perceived accessibility and connection to place were positively associated with quality of life, while loneliness was negatively correlated with quality of life.

7.1. The mediation analyses

Using PROCESS model 4, we first tested whether loneliness and connection to place mediated the relationship between perceived accessibility and quality of life, controlling for covariates. The results indicated a significant total direct effect (path *c*; without mediator) of perceived accessibility on quality of life (*B* = 0.26, *t*(13,828) = 23.76,

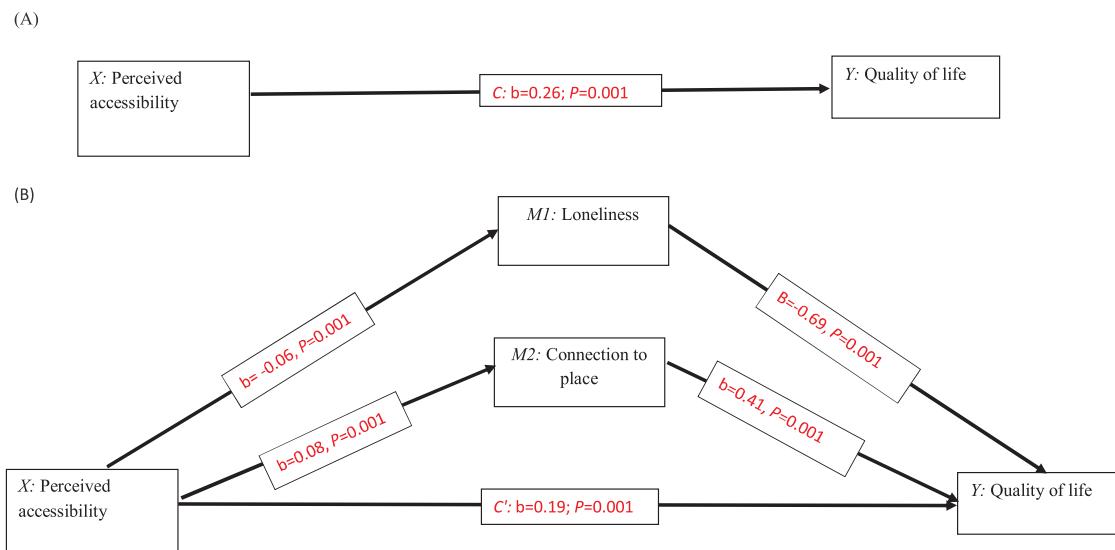


Fig. 1. The multiple mediating model depicting direct and indirect effects of Perceived accessibility (*X*) on Quality of life (*Y*) tested in the current study, controlling for covariates. Notes: Graphic A depicts the total effect (*C*) of Perceived accessibility (*X*) on Quality of life (*Y*). Graphic B depicts the direct effect (*C'*) of Perceived accessibility (*X*) on Quality of life (*Y*) after including two mediators (*M1*: loneliness and *M2*: connection to place). Values represent unstandardized regression coefficients.

Table 1

Descriptive statistics of the study variables (N = 13,828).

Covariates		N (valid%)	Mean (S.D)	Range
Gender	Female	49,808 (54.6)		
	Male	41,472 (45.4)		
Age			75.9 (7.9)	65–108
Education			10.9 (4.3)	0–25
Marital status	No partner	9560 (30.9)		
	Has partner	21,426 (69.1)		
Employment status	Unemployed	79,952 (90.2)		
	Employed	8672 (9.8)		
Self-rated health	Very good/excellent	19,348 (21.3)		
	Less than very good	71,644 (78.7)		
IADL	No limitations	71,516 (78.6)		
	1 + limitations	19,500 (21.4)		
Number of chronic diseases			2.0 (1.6)	0–14
Independent variable				
Perceived accessibility			12.5 (3.1)	4–16
Mediators				
Loneliness			3.84 (1.4)	3–9
Connection to place			13.17 (2.0)	4–16
Dependent variable				
Quality of life			19.6 (3.7)	6–24

Table 2

Bivariate tests of covariates and mediator with quality of life (N = 13,828).

Variables	Quality of life			
		Mean (S.D)	Test	p.value
Gender	Female	19.4 (3.7)	t = -14.9	0.001
	Male	19.8 (3.6)		
Age			r = -0.23	0.001
Education			r = 0.26	0.001
Marital status	No partner	18.7 (4.0)	t = -30.10	0.001
	Has partner	20.2 (3.3)		
Employment status	Unemployed	19.5 (3.7)	t = -46.13	0.001
	Employed	21.1 (2.9)		
Self-rated health	Very good/excellent	21.7 (2.6)	t = 112.92	0.001
	Less than very good	19.0 (3.6)		
IADL	No limitations	20.2 (3.3)	t = 108.5	0.001
	1 + limitations	16.9 (4.1)		
Chronic diseases			r = -0.31	0.001
Perceived accessibility			r = 0.27	0.001
Loneliness			r = -0.39	0.001
Connection to place			r = 0.26	0.001

p = 0.001, 95%CI = 0.23, 0.27; R^2 = 0.15), a significant direct effect (*path c'*; with mediators) (B = 0.19, $t(13,828)$ = 18.59, *p* = 0.001, 95%CI = 0.16, 0.20; R^2 = 0.28), and a significant indirect effect through loneliness (B = 0.04, 95% CI = 0.03, 0.05), and through connection to place (B = 0.03, 95% CI = 0.02, 0.04) (see Fig. 1).

7.2. The moderated mediation analyses

Table 3 shows the conditional indirect effect of perceived accessibility on quality of life through loneliness and connection to place, moderated by IADL and marital status, using PROCESS model 21. The first model in Table 3 shows the effect of perceived accessibility on the first mediator (loneliness). The results showed that easier access to services and sites was found to be associated with lower feelings of loneliness (path a1). It was also found that the number of IADL limitations was positively associated with loneliness scores (path a2). The effect of the perceived accessibility – IADL interaction on loneliness (path a3) was also significant [B = -0.04, *p* = 0.002].

The second model in Table 3 shows the effect of perceived accessibility on the second mediator (connection to place). The results

Table 3

Direct and indirect effect of subjective accessibility to services on quality of life through two mediators (loneliness and connection to place) conditionally in the level of two moderators (IADL and marital status) (N = 13,828).

Path: Predictor	B	SE	t	p	Adj R2 (p.value)
Mediator 1 variable model (M1; Loneliness)					
Constant	3.85	0.15	24.53	0.001	0.09 (0.001)
a1: Perceived accessibility	-0.02	0.01	-5.70	0.001	
a2: IADL	1.07	0.15	7.30	0.001	
a3: Perceived accessibility*IADL	-0.04	0.01	-3.62	0.002	
Mediator 2 variable model (M2; Connection to place)					
Constant	11.12	0.22	50.05	0.001	0.04 (0.001)
a4: Perceived accessibility	0.07	0.01	10.15	0.001	
Dependent variable model (Y = Quality of life)					
Constant	18.82	0.52	36.16	0.001	0.31
C1: Perceived accessibility	0.15	0.01	14.97	0.001	(0.001)
b1: loneliness	-0.69	0.03	-21.66	0.001	
b2: Connection to place	0.37	0.02	15.52	0.001	
b3: marital status	-0.52	0.46	-1.10	0.31	
b4: loneliness *marital status	0.16	0.05	3.60	0.001	
Covariates					
Gender	-0.17	0.05	-3.28	0.001	
Education years	0.09	0.01	16.02	0.001	
Age	-0.01	0.07	-1.68	0.091	
Employment status	0.08	0.07	16.02	0.001	
Chronic diseases	-0.18	0.02	-10.26	0.001	
SRH	-1.12	0.05	-23.40	0.001	

Notes: Value labels of categorical variables: gender (0 = female, 1 = male); Marital status (0 = no partner, 1 = has partner); employment status (0 = Unemployed, 1 = Employed); SRH (0 = Very good/excellent, 1 = less than very good); IADL (0 = no limitations, 1 = 1+ limitations).

indicated that ease of access to services and sites was positively correlated to connection to place among elderly aged 65 and older (path a4).

The final model in Table 3 showed the effect of perceived accessibility perception on quality of life, after taking into account all covariates, mediators and moderated mediation effects. The results indicated a significant direct effect of perceived accessibility on quality of life (path $c'1$) even after including covariates, mediators, and moderators ($B = 0.15$, $t(13,828) = 14.97$, $p = 0.001$, 95%CI = 0.13, 0.17; $R^2 = 0.31$). The results also revealed that higher quality of life scores are related to lower loneliness levels (path $b1$; $B = -0.69$, $p = 0.001$), and to higher connection to place scores (path $b2$; $B = 0.37$, $p = 0.001$). No association was found between marital status and quality of life (path $b3$; $B = -0.52$, $p = 0.31$). Although, an interaction effect of loneliness and marital status on quality of life was found to be statistically significant (path $b4$; $B = 0.16$, $p = 0.001$). The results also showed that men, employed, having more years of education and living in Europe (as compared with living in Israel) were all associated with higher quality of life. However, having more chronic diseases, and perceived health as less than very good were associated with lower quality of life scores. Finally, no association was found between age and quality of life.

A simple moderation analysis was next conducted to explore the effect of perceived accessibility – IADL interaction on loneliness. The results show that the slope of the negative relationship between perceived accessibility and loneliness is stronger among respondents with IADL limitations ($B = -0.06$, $p = 0.001$) than among those with no IADL limitations ($B = -0.03$, $p = 0.001$). In other words, while, on the average, loneliness scores are higher among respondents with IADL limitations as compared with respondents without IADL limitations, this difference is reduced under conditions of high perceived accessibility to services and sites (see Fig. 2).

Further simple moderation analysis was next conducted to examine the effect of the perceived accessibility – marital status interaction on quality of life. The results showed that among both married and unmarried respondents, higher loneliness scores were significantly associated with lower quality of life scores. Interestingly, the association is significantly stronger among unmarried respondents. While in the case

of married persons the estimated coefficient was ($B = -0.93$, $p = 0.001$), the value of the coefficient for unmarried respondents was ($B = -0.86$, $p = 0.001$) (see Fig. 3).

8. Discussion

The current study assumed that the connection between perceived accessibility and quality of life can occur directly and/or indirectly via mediators (loneliness and connection to place). It was also hypothesized that functional disability (IADL limitation scores) and marital status moderate the indirect paths between perceived accessibility and quality of life through feeling of loneliness.

First, as expected, the study findings revealed a significant positive association between adults' perceived accessibility and quality of life even after we take the covariates and mediators into account. Put differently, the easier the accessibility to services and sites in the living area, the greater the quality of life in old age. This finding is consistent with numerous studies (Burton et al., 2011; Gilroy, 2008; Liu et al., 2009; WHO, 2007) which have explored such relationships.

Furthermore, we found an indirect explanation consistent with the hypotheses for the relationship between neighborhood perceived accessibility, in terms of services and sites, and quality of life, through two mediators: connection to place and loneliness. These results suggest that the research findings confirm the hypothesis that feelings of loneliness and connection to place were key variables, partially explaining the pathway between perceived accessibility and quality of life.

Referring to the first mediator, connection to place, the result revealed that higher perceived accessibility is associated with stronger connection to place, and the latter is correlated with greater quality of life. These findings are consistent with previous research (Burton et al., 2011; Taylor, 2001), and reinforce the relationship between perceived accessibility and "sense of place" or "place attachment", which encapsulates both spatial and social entities (Burholt, 2006). According to these theoretical terms, connection to place develops after a long period

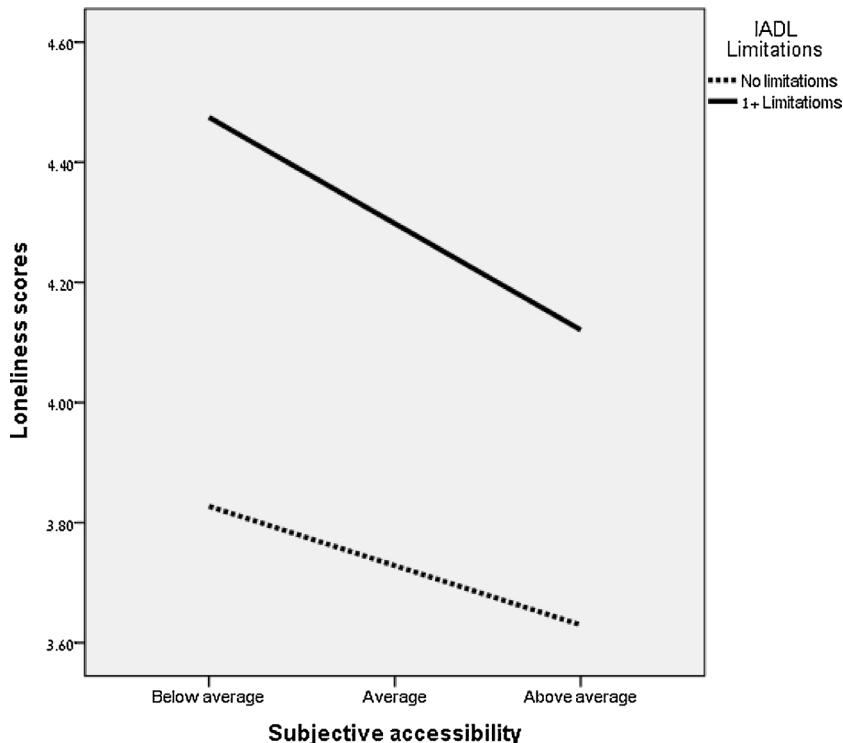


Fig. 2. Relationship between perceived accessibility and loneliness at different level of the moderator (W; IADL limitations: (no limitations, 1+ limitations), controlling for covariates).

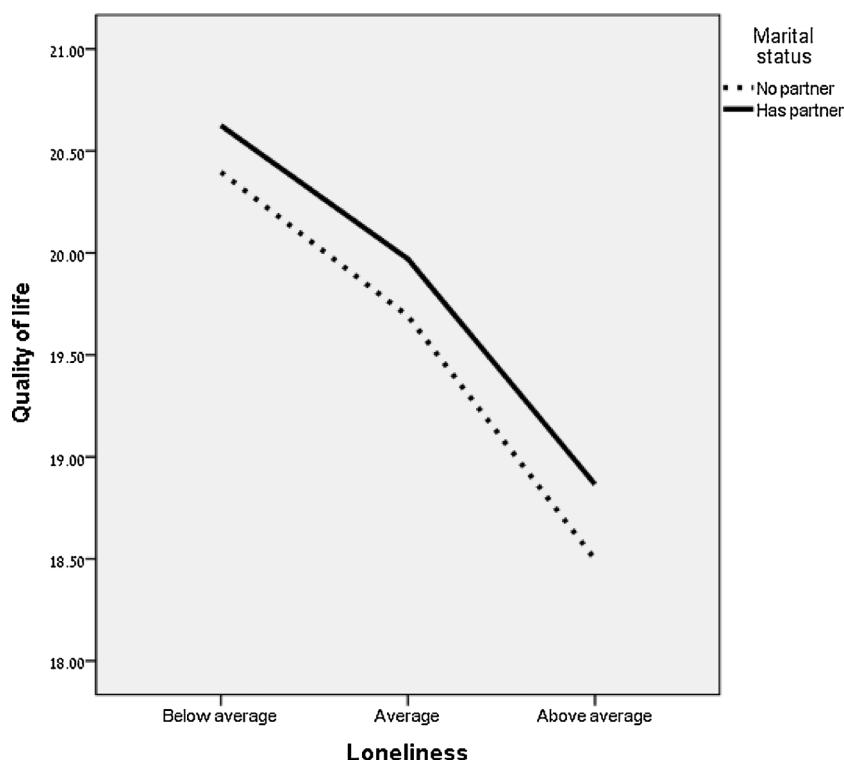


Fig. 3. Relationship between loneliness and quality of life at different values of the moderator (Z; marital status: no partner, has partner), controlling for covariates.

of living in the same place with safety and easier access to services and sites, which increases familiarity with the physical environment and enhances feelings of belonging to the place (Iwarsson, Stahl, & Lefqvist, 2013; Rowles & Bernard, 2013). Therefore, elderly people with a high sense of place tend to appreciate their living area and environment, which encourages them to go outside, to be socially integrated, to be familiar with their physical living surroundings, to be connected to the physical surroundings and to be part of the social fabric. These multi-faceted relations create a high connection to place and that develops high quality of life.

As expected, the results further showed that the second mediator, loneliness, mediates the relationship between perceived accessibility and quality of life. In other words, easier access to services and sites is associated with less loneliness, which in turn, is associated with greater quality of life. These findings are consistent with other studies that have shown a negative association between perceived accessibility and loneliness (Burton et al., 2011; Hall et al., 2003; Jakobsson & Hallberg, 2005; Liu et al., 2009; Perissinotto et al., 2012; WHO, 2007), and negative correlations between loneliness and quality of life (Lawton, 1991; Lowenstein & Daatland, 2006). Whereas the previous studies examined these associations separately, particularly unique for this study is the examination of all these associations with the mediator simultaneously using a bias-corrected and accelerated bootstrapping method (Preacher & Hayes, 2008). These results suggest that developing age-friendly and suitable access to vital services and places for elderly adults can reduce their feelings of loneliness and enhance better quality of life.

Beyond the mediating effect of loneliness just discussed, the results also revealed significant moderated-mediating effects on the pathways between perceived accessibility, loneliness and quality of life, by two moderators: IADL limitations and marital status. First, the negative relationship between perceived accessibility to services and loneliness was found to be moderated by the respondents' IADL limitation scores. This association is stronger among elderly with high IADL limitation scores than among independent elderly. What is particularly interesting is that the gap in loneliness scores between disabled elderly and independent

elderly almost disappeared when the perceived accessibility scores were high. These results reinforce previous results that showed that functional disabilities in old age increase feelings of loneliness (Shankar, McMunn, Demakakos, Hamer, & Steptoe, 2017), and support the connection between perceived accessibility and low mobility or functional disability (Vitman Schorr, Iecovich, Alfasi, & Shamai, 2015).

An explanation for this unique result is that the reduction in the perceived accessibility scores makes elderly adults feel insecure about going outside and as a result, they are less socially active, since most of the social activity in old age is outside the home, at informal meetings while going to the shop or park (Sugiyama & Thompson, 2007). Immobility outside the home due to inaccessible environments keeps the adults homebound and increases the probability that they will become even more disabled (Cho et al., 2016), and lonely (Perissinotto et al., 2012; Richard et al., 2008; Valdemarsson et al., 2005). These results emphasize the importance of ease of access to home environment in later life, particularly when health and physical impairment can impede abilities to handle distances (Wahl et al., 2012). These results are compatible with the pioneer ecological model (Lawton & Nahemow, 1973) which explains the deep connection between environmental characteristics and older adult capabilities; when physical abilities in old age are reduced, the environment must be made more suitable and accessible.

A further moderated mediation effect was also revealed in the pathway between loneliness and quality of life, by the moderator marital status. The results showed that the negative relationship between loneliness and quality of life is stronger among elderly who live without partners than among elderly who live with partners. This confirms the second moderation hypothesis, and is consistent with previous research (Chalise, Kai, & Saito, 2010). It suggests that elderly who are living with no partner may be at greater risk of poor quality of life, and this risk may increase if the elderly also have lower perceived accessibility to services, greater functional disability, and/or higher feelings of loneliness. This result suggests that interventions to reduce loneliness and enhance quality of life among elderly persons should take into account marital status and functional disability of the elderly.

9. Conclusion

The present study indicates the vital role of environmental characteristics (e.g. perceived accessibility, connection to place) in determining the quality of life in later life in Europe. Perceived accessibility to services and sites is an important factor for better quality of life. It also determines other aging in place aspects (feelings of loneliness and connection to place), which in turn, are associated with quality of life in later life. In other words, the possibility of elderly adults leaving their homes or alternatively, their participation in social activities, have great influence on their quality of life, health, happiness, and levels of loneliness, opportunity to age in place, feelings of belonging to the place, and being active in their home environment.

In addition, the results show that functional disability among the elderly and their marital status can moderate these associations, and services providers and policymakers should be aware of these risk groups (disabled and unmarried elderly), and plan suitable, accessible and age-friendly services for dependent and independent elderly adults in their living environment. Therefore, the results of the study suggest establishing multidisciplinary collaborations between geographers, city planners, gerontologists and sociologists in order to understand the complex mechanisms which are connected to perceived accessibility and quality of life in later life.

10. Limitations

We should point out two limitations of the current study. One is the cross-sectional study design, which doesn't allow prediction of a causal relationship between the variables. A future study should use longitudinal data to examine the relationship between perceived accessibility to services and sites, and quality of life in later life. A further limitation might be the use of only subjective measures of accessibility, and the fact that objective measures were not used. However, previous studies have revealed that subjective measures of accessibility are a robust measure for accessibility to services, in the absence of objective measures (Stoeckel & Litwin, 2015). Despite these limitations, however, the present study provides initial insights into the mechanisms of the correlation between perceived accessibility, loneliness, connection to place, and quality of life among elderly people in Europe, which have not been widely studied in this context thus far.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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