Original Article

Health and Social–Physical Environment Profiles Among Older Adults Living Alone: Associations With Depressive Symptoms

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Abstract

Objectives: We examined differences in depressive symptoms among people 65 and older who live alone, exploring whether these differences are associated with both health and environmental contexts.

Method: Data are from the 2006 wave of Health Retirement Study ($N = 2,956$, age range: 65–104). We used a two-step cluster analytical approach to identify subgroups of health-limitation profiles and environmental profiles. Logistic regression models determined associations between subgroups and depressive symptoms.

Results: Cluster analysis identified four health-profile subgroups (sensory-cognitively impaired, physically impaired, multiply impaired, and healthy) and three different physical–social environmental-profile subgroups (physically average/socially unsupported, physically unsupported/socially supported, and physically supported/socially above average). Compared to members of healthier groups, members of the multiply impaired group were the oldest and were more likely both to live in senior housing and to have depressive symptoms if they lived in a physically average/socially unsupported environment. Members of the sensory-cognitively impaired group were more likely to have depressive symptoms when they lived in a physically unsupported/socially supported environment.

Discussion: Findings regarding the range of both health and social–physical environmental profiles as well as the associations between person–environment profiles combinations (fit) and depressive symptomatology have important policy and intervention implications.

Keywords: Environment profiles—Health profiles—Health and Retirement Study—Living alone—Older adults

Despite the fact that more than 11 million people in the United States aged older than 65 years currently live alone in the community (West, Cole, Goodkind, & He, 2014), relatively little is known about the extent of subgroup heterogeneity in profiles of health and residential and social environment in this population. Subgroup variations in life contexts and support needs among older adults who live alone pose critical challenges for public policymakers

(Beard & Bloom, 2015). For example, in addition to racial/ethnic and regional differences in the U.S. population aged older than 65 years who are living alone, there are large gender disparities: 35.7% of women live alone compared with 18.8% of men (West et al., 2014).

The literature to date includes conflicting findings about the health and well-being outcomes associated with living alone. Whereas some studies report older adults who

live alone are at risk for depression, loneliness, disability, substandard ambient living conditions, and poor physical health (Cornwell, 2014; Gaymu & Springer, 2010; Russell & Taylor, 2009), others suggest those aged older than 85 years who live alone may represent a resilient subgroup in relatively good health (Ennis et al., 2014). Furthermore, although from a public health and service provision perspective, it may be advantageous for widows and other singles to live with others or move to residential care, many older adults prefer to live alone independently for as long as possible (e.g., Haslbeck, McCorkle, & Schaeffer, 2012).

Our objective in this paper was to identify subgroup variations in the profiles of health and social-physical environment revealed among participants aged older than 65 years in the Health and Retirement Study who live alone. We examined age, gender, and socioeconomic differences in profile subgroup membership and associations between profile subgroups and depressive symptoms.

The study makes two contributions to the literature on living alone. First, using a national U.S. sample, we point to the range of profiles of health, housing, and social life contexts evident in cohorts of older men and women born prior to 1941 who live alone. Previous U.S. studies compared the prevalence of separate health indicators by living arrangement (alone vs with others; e.g., Weissman & Russell, 2016). European studies develop conceptual models of variations in housing design and accessibility (e.g., Granbom, Slaug, Löfqvist, Oswald, & Iwarsson, 2016) and propose a typology of problematic person-environment (P-E) fit constellations for people with different types of functional limitations (Slaug, Schilling, Iwarsson, & Carlsson, 2015). To our knowledge, the present research is the first to identify subgroup differences in health and physical-social environment profiles among people aged older than 65 years who live alone. Second, focusing only on people who live alone, we examined the extent to which profiles of physical aspects of residential living conditions and social connections moderate the association between health-profile membership and depressive symptoms. Previous studies have examined the prediction of depressive symptoms in late life by differences in living arrangement (e.g., alone vs with others) and asked if associations were modified by specific factors such as neighborhood characteristics (e.g., Stahl, Beach, Musa, & Schulz, 2016), social integration, loneliness, or disability (e.g., Russell & Taylor, 2009). The present profile approach may reveal nuanced subgroup differentials in the vulnerability to depression among older adults who live alone.

Conceptual Background

Conceptually, individual and subgroup variations in associations between profiles of health, housing environment, and social connections are assumed to reflect differences in P-E fit (Lawton & Nahemow, 1973). The study by Wahl, Iwarsson, & Oswald, 2012 proposes unique combinations

of person resources (e.g., health, individual competencies, and sense of agency) and environmental resources (e.g., housing, social, and connections) determine an individual's capacity to thrive and to age well. These researchers posit aging individuals—even those who have limited resources and capability—can age optimally if environmental characteristics support them in a way that compensates for their limitations or lack of resources. Whereas a good “fit” between a person and his/her environment contributes to positive well-being, a less optimal fit is associated with depression and mortality (Thomé & van Groenou, 2006). In his environmental docility hypothesis, Lawton (1982) proposed that individuals with physical disability or poor health status are more susceptible to the challenges of dealing with their immediate environment demands. Extending this conceptualization to a life-course perspective, Wahl and colleagues, 2012 noted that, in very old age, seemingly optimal P-E fit constellations are at risk for abrupt change.

Health is an important personal resource in old age. The majority of older individuals experience a constellation of correlated chronic, functional, and mental impairments (Karlman et al., 2007). For example, functional limitations have been linked with chronic diseases, sensory health (i.e., vision and hearing), and cognitive functioning (Hochberg et al., 2012). Canadian and German studies have identified a variety of health profiles in samples of married and single older adults in heterogeneous living arrangements (Lafortune, Beland, Bergman, & Ankri, 2009; Schüz, Wurm, Warner, & Tesch-Römer, 2009). In a nationwide sample aged 40–85, Schüz and colleagues, 2009 identified age-related differences in membership in the following four health profiles: subgroups with no disease, cardiovascular diseases, joint diseases, or multiple illnesses. Whereas younger adults clustered in a subgroup with no disease, people aged 60 and older primarily belonged to one of the three less healthy-profile subgroups. The study by Lafortune and colleagues, 2009 focused on community-living older adults aged older than 64 years and found four of the following profile subgroups: 23% were classified as cognitively and physically impaired, 11% as cognitively impaired, 36% as physically impaired, and 30% as relatively healthy. The study by Liu, Tian, & Yao, 2014 reported similar findings in a profile analysis of multiple health indicators including chronic conditions, sensory limitations (i.e., vision and hearing), functional limitations (i.e., activities of daily living and instrumental activities of daily living), cognitive function, and mobility limitations, obtained from a Taiwanese panel of older adults. They identified four of the following subgroups: frail, functionally impaired, highly comorbid, and relatively healthy. Thus, several researchers have identified relatively similar subgroups of older people.

Contemporary European research from a P-E perspective focuses on evaluating the available physically

supportive features (such as special railings, wheelchair accessibility, and/or bathroom fixtures) in and around the residences of older adults (Iwarsson, Horstmann, & Slaug, 2007; Oswald et al., 2007). A taxonomy of 48 problematic combinations of housing environments for older adults with impaired functional and physical health was developed by Slaug and colleagues (2015). Whereas this research has addressed the importance of the presence of physical fixtures in and around the home, other researchers (e.g., Cornwell, 2014) utilize interviewer ratings of the physical and ambient features of a person's living space (e.g., building disrepair, household messiness, noise, and cleanliness). It is also important to consider macrolevel environmental factors, such as neighborhood characteristics, community infrastructure, and urban-rural divide, which also affect the aging experience (e.g., Clarke et al., 2014; Lehning, Smith, & Dunkle, 2014; Stahl et al., 2016).

The social connections and neighborhood context in which an older person lives are also considered as environmental resources in P-E theory. Life-course theories about social relationships such as the Social Convoy Model (Antonucci, Birditt, & Arjouch, 2011) and Socioemotional Selectivity Theory (Charles & Carstensen, 2010) highlight the importance of close family and friends for meeting an individual's emotional and instrumental support needs and maintaining positive well-being. Several studies have identified subgroups of social-relational patterns with family, friends, and others and examined their associations with indices of well-being (Litwin, 2012; Park, Smith, & Dunkle, 2014). Generally, these studies report finding slight variations of four of the following main social network types: diverse, friend-focused, family-focused, and restricted. Older adults with restricted social networks typically receive less emotional and instrumental support and report more depressive symptoms.

Well-documented poor health, housing, neighborhood, and limited social connections are the risk factors for depression in old age. Older adults dealing with the burden of multiple chronic illnesses, reduced physical mobility, and disability have a higher probability of depression (Fiske, Wetherell, & Gatz, 2009). Aspects of the physical environment such as exposure in old age to disadvantaged neighborhoods (e.g., high crime rates and low access to services) and housing that imposes constraints on activities of everyday life (e.g., Clarke et al., 2014; Granbom et al., 2016) are also increasingly recognized as sources of stress that contribute to depressive symptomatology. After age 65, generally people who are married, live with others, and have frequent connections with children and friends that are perceived to provide emotional and practical support to live longer and maintain positive well-being (e.g., Antonucci et al., 2011). In contrast, widowhood and living alone as an older person are associated with subclinical and clinical depression (Fiske et al., 2009; Russell & Taylor, 2009).

Research Questions

This study addresses two primary questions. First, we ask if a range of subgroup differences in profiles of health and social-physical environment can be identified in a sample of individuals aged older than 65 years living alone. From a P-E perspective, we conceptualized the P as health and E as the social and physical environment in which a person lives. Based on earlier profile research with samples of older adults in heterogeneous living arrangements (e.g., Lafortune et al., 2009; Litwin, 2012), we expected to find clearly differentiated health and social-physical environment-profile groups.

Second, we ask whether reported depressive symptomatology is related to the health and social-physical environment profiles. We conceptualized depressive symptoms as an indicator of varying degrees of P-E fit. Based on the environmental docility hypothesis, we expected that compared with the subgroup with a healthy profile, reports of depressive symptoms would be attenuated in less healthy subgroups especially when members of these subgroups lived in relatively unsupportive social-physical environments.

Method

Data and Sample

Data are from the 2006 Health and Retirement Study (HRS). The HRS is a national longitudinal study that surveys more than 22,000 older adults aged 50 and older and their spouses every 2 years. Details of the multistage sample design, selection criteria, implementation, and response rates are available elsewhere (Sonnegg et al., 2014) and data are publically available at <http://hrsonline.isr.umich.edu/>. We selected older adults aged 65 years and older who lived alone; respondents living in an institution or unable to answer the survey questions independently (i.e., without a proxy) were excluded. The sample was also restricted to respondents who provided housing-related information.

Participants' average age was 77 ($SD = 8.03$; range: 65–104 years); 75% were women. Age-cohort comparisons were made among the young-old group, aged 65–74 years (46%; $n = 1,362$); the old-old, aged 75–84 (34%; $n = 997$); and the oldest-old, aged 85 and more (20%; $n = 597$). Of the sample, 69% were widowed, 34% had more than 12 years of education, 82% were White, 17% currently resided in senior housing, and 18% reported depressive symptoms (Supplementary Table 1).

Measures

Health

To facilitate a comparison with previous health-profile research (e.g., Lafortune et al., 2009; Liu et al., 2014), we selected seven individually measured indicators of health-related status available in HRS. Physical health was

measured as an index of eight of the following diagnosed chronic conditions (Fisher, Faul, Weir & Wallace, 2005): high blood pressure, diabetes, cancer, lung disease, heart disease, stroke, hip fracture, and arthritis. Three standard measures of self-reported limitations in physical mobility and activities of daily living (Fonda & Herzog, 2004) were also included. A sum score (Max = 5) of mobility limitations was formed from respondent's reported difficulties walking several blocks, one block, across the room, climbing several flights, or climbing one flight of stairs. Instrumental activities of daily living limitations (Max = 5) were the sum of reported difficulties using a telephone, taking medication, handling money, shopping, and preparing meals. Activities of daily living limitations (Max = 5) were measured by items that asked if participants had difficulty bathing, eating, dressing, walking across rooms, and entering or leaving bed. Cognitive function was measured using a global composite of cognitive functioning (Max = 35; Rodgers, Ofstedal, & Herzog, 2003). It is a summary score of performance on an immediate and delayed word recall task and a backwards serial 7-s task together with a measure of cognitive status (e.g., object identification, date naming, and president and vice president naming). Higher scores indicate higher cognitive function. To measure sensory impairment, participants rated their corrected hearing and vision acuity from 1 (*poor*) to 5 (*excellent*).

Social-physical environment

Five of the following aspects of physical environment were examined: in-home supportive features, housing accessibility or barriers, self-rated satisfaction with housing condition, neighborhood safety, and urbanicity. These variables overlapped conceptually with previous studies (e.g., Clarke et al., 2014; Cornwell, 2014; Slaug et al., 2015). HRS generally collects details about housing at study entry but updates this information in subsequent waves if respondents move or report making a home modification. Data on housing characteristics for the present study were aggregations of information obtained across five waves (1993, 1995, 1996, 2000, and 2004). In-home supportive features were coded as a binary indicator: 1 = the reported presence of any of six supportive features (ramps, railings, wheelchair access, grab bars, emergency-call button, and others), 0 = no supportive features. Accessibility was also coded as a binary variable: 1 = if all living space was on one floor or respondent lived in one story or multistory building with elevator, otherwise, 0. For residential region, urban areas were coded 1 and nonurban areas, 0. Participants rated on a 5-point scale ranging from 1 (*poor*) to 5 (*excellent*) both the physical condition of their residence and the safety of their neighborhood.

Three global aspects of the social environment were examined: a binary indicator measured whether a child lived nearby (no = 0, yes = 1), and/or a close friend lived nearby (no = 0, yes = 1). Frequency of social engagement in the community was measured on a 6-point scale ranging

from 1 (*less than once a year or never*) to 6 (*three or more times a week*). Additional granular measures of perceived instrumental and emotional social support typically used in the literature were collected in the 2006 HRS wave from less than 50% of the sample.

Depressive symptoms

Depressive symptoms were measured with eight items from the Center for Epidemiologic Studies Depression scale (CES-D). Six items asked whether, over the preceding week, respondents had felt depressed, alone, or sad, that everything was an effort, they could not get going, and if their sleep was restless; two items measured experience of happiness and enjoyment of life and were reverse coded. The validity and reliability of this measure have been extensively evaluated by the HRS group (Steffick, 2000). We used the HRS recommended cutoff point of 4 or higher that approximates the traditional cutoff point of 16 or higher for the original 20-item CES-D scale that indicates a high likelihood of clinical depression.

Covariates

Age was coded 1 = age 65–74, 2 = 75–84, or 3 = 85 years and more. Current marital status was coded 0 = never married, 1 = widowed, or 2 = divorced/separated. Gender was coded 0 = *men*, 1 = *women*. We used RAND HRS-imputed composite variables for total household wealth and income. Composite dollar values of both variables were coded as quartiles (1 = *lowest* to 4 = *highest*). Education was centered at 12 years (i.e., high-school graduation, range = 0 to 17+ years). Race was coded 0 = White, 1 = non-White. Additionally, we included senior housing residency as a control because relocation to this type of housing is associated typically with very poor health and depression (Bekhet, Zauszniewski, & Nakhla, 2009). For age-segregated senior housing residency, as in the case of housing characteristic variables, values for the senior housing (1 = *yes*, 0 = *no*) were obtained during the wave of study entry or corresponding to the residential move.

Analysis

Two clustering techniques (hierarchical and *K* means) were applied to examine the first research question regarding the identification of separate health and environmental profiles. This traditional two-step combination has been shown to reveal subgroups consistent with other model-based approaches (e.g., Latent Class Analysis) especially when true cluster structure is unknown (e.g., Eshghi, Haughton, Legrand, Skaletsky, & Woolford, 2011; Steinley & Brusco, 2011). In the absence of consensus about a universal best-performing method (Wiwie, Baumbach, & Röttger, 2015), we adopted the traditional exploratory similarity partitioning approach instead of a latent model-based probability of subgroup membership approach and decided to identify

H and E profile subgroups separately. The traditional two-step *K*-means approach provided parsimonious descriptions of H and E subgroups of older adults living alone that could be compared with previous research and facilitated interpretation of follow-up analyses for our second research question regarding P–E fit.

From the initial sample of 2,956 individuals aged older than 65 years who lived alone in 2006, 45 cases (2%) and 82 cases (3%) had missing values on health and environmental characteristics, respectively. These cases were not included in the cluster analyses. All variables included in the cluster analyses were standardized to *T* scores in order to eliminate effects stemming from scale differences (Steinley & Brusco, 2011). The hierarchical minimum-variance method by Ward (1963) was applied initially to obtain information about the ideal number of clusters in the sample and determine starting seeds for *K* means. The number of clusters was determined using the following multiple criteria (Milligan & Cooper, 1987): (a) an atypical decrease in overall between-clusters variance (R^2) and increase in within-clusters variance (Ward, 1963), with no reverse trend in subsequent steps, (b) simultaneous elevation of the pseudo-*F* statistic over the pseudo-*T*² statistic, and (c) a peak in Searle's cubic clustering criterion. Subsequently, the *K*-means procedure was used to determine case classification in the separate subgroups. The cluster profiles of standardized scores obtained were separately interpreted in terms of their overall level (mean), scatter (score variation), and shape (pattern of high and low scores on the variables entered). Follow-up bivariate analyses were conducted with potential correlates external to the cluster types (e.g., sociodemographic variables and senior-housing residency) to assist in the interpretation of the health and environment profiles.

We used nested hierarchical regression models to examine subgroup profile associations with depressive symptoms. Missing values on covariates in this analysis (in particular

for residence in senior housing) reduced the analytic sample by 10.1% (299 cases) to 2,657 cases. We ran the same models with multiple imputed data without testing nested models and the results were similar. Presence of depressive symptoms was regressed on health and social–physical environmental subgroups to examine main and interaction effects after the effects of covariates were controlled. All analyses were conducted in STATA Version 13.

Results

Health Profiles

Four health profiles with qualitatively different sets of health conditions were identified (Table 1): sensory-cognitively impaired (SCI), physically impaired (PI), multiply impaired (MI), and healthy (H). The distinguishing features of the SCI profile (28% of sample) were high levels of vision and hearing impairment and low cognitive function. Individuals in this group showed lower levels of physical and functional impairment. The physically impaired profile (23%) was characterized by high levels of chronic conditions and mobility-limitation impairments, while showing average health across other criteria. Members of the multiply impaired profile (9%) were impaired across all health indicators and were clearly set apart from other profiles with values of at least one-half standard deviation below sample mean on all health variables. In contrast, members of the healthy profile (38%) had low levels of mobility, vision and hearing impairment, higher cognitive function, and fewer chronic conditions compared to members of other groups.

Social–Physical Environmental Profiles

We found three of the following different environments: physically average/socially unsupported (PA-SU),

Table 1. Health and Environment Profiles Derived by Cluster Analysis

Health profiles					Social–physical environment profiles			
	SCI	PI	MI	H		PA-SU	PU-SS	PS-SAA
N (%)	827 (28)	688 (23)	277 (9)	1,119 (38)		736 (25)	1,403 (47)	735 (25)
Chronic conditions	47.29	58.43	55.36	45.38	In-home supports	47.66	43.26	64.85
Mobility limitations	45.96	59.20	64.71	44.27	Accessibility	48.45	46.88	55.46
IADL limitations	47.90	48.76	73.08	46.39	Housing condition	49.02	49.12	52.80
ADL limitations	46.50	50.91	72.47	46.33	Neighborhood safety	48.55	50.18	51.28
Cognition function	45.21	49.83	41.37	55.78	Urban	50.94	49.72	49.46
Vision impairment	53.91	51.63	58.15	43.91	Children	50.80	49.31	50.62
Hearing impairment	55.48	51.49	55.60	43.59	Friend	34.17	56.31	53.90
					Social engagement	41.65	52.58	53.40

Notes: ADL = activities of daily living; IADL = instrumental activities of daily living; H = healthy; MI = multiply impaired; PA-SU = physically average/socially unsupported; PI = physically impaired; PS-SAA = physically supported/socially above average; PU-SS = physically unsupported/socially supported; SCI = sensory-cognitively impaired. The variables means are standardized *T* scores ($M = 50$, $SD = 10$). Means approximately half a standard deviation above or below the mean (representing peaks of the clusters) are shown in bold. Values close to peak values are italicized.

physically unsupported/socially supported (PU-SS), and physically supported/socially above average (PS-SAA; see also Table 1). For the PA-SU, physical characteristics of the environment hovered around average support levels but social environments were unsupportive. Members of this group tended not to have close friends living nearby and were not actively engaged in community social functions. Those in PU-SS environment reported a lack of supportive in-home physical features but average housing accessibility. The PS-SAA group lived in an environment that was both physically and socially supportive characterized by high levels of in-home support features and accessibility and higher-than-average levels of social support (e.g., close friends, active social engagement).

External Correlates of Health and Environmental Profiles

Participants in different health profiles varied on all correlates examined (Table 2). The MI group was significantly older ($M = 82$ years) and H group was younger ($M = 74$ years) than those in other groups. Characteristics of the MI and H groups contrast in several additional respects. The MI group had the highest proportion of widows (77%) and the H group the smallest (67%). Fully 25% of those in the MI group resided in senior housing compared to 12% in the healthy group. Multiply impaired group members reported the highest (45%) and healthy group members the lowest levels of depressive symptoms (9%).

Environmental profiles varied on all correlates except income. Individuals in the PS-SAA profile subgroup were the oldest ($M = 79$), most likely to be widowed (79%) and most likely to live in senior housing (36%) but less likely to have depressive symptom (18%).

Profile Associations With Depressive Symptoms

Health profiles are significantly related to depressive symptoms (Table 3). Compared to those in the reference group (H), those in the MI group are 4.8 times more likely to be depressed ($p < .001$), and those in the PI group are 2.5 times more likely to be depressed ($p < .001$). The main effects of environment are examined in Models 3 and 4. Model 3 indicates only a marginal effect of PA-SU compared to the PS-SAA group. In Model 4, the interaction terms between health profiles and social-physical environment are included in order to investigate the extent to which the environment moderates the main effect of health on depressive symptoms using the H group as the reference category; for the environment, the PS-SAA group was the reference category. Findings indicated that the social-physical environment profiles differentially moderated the health profile-depression relationships. The MI group was 2.6 times more likely to have depressive symptoms when living in PA-SU environment ($p < .05$ in Model 4). Members of the SCI group were 2.1 times more likely to show depressive

Table 2. Health, Environment, and Background Characteristics of Older Adults Living Alone

Characteristics	Health profiles				Environment profiles				
	SCI	PI	MI	H	Statistics	PA-SU	PU-SS	PS-SAA	Statistics
Age, <i>M (SD)</i>	78.05 (8.31)	77.57 (7.78)	81.38 (8.64)	73.97 (6.70)	$F(3, 2,907) = 94.02^{*,a}$	75.49 (7.85)	76.02 (7.96)	79.10 (7.68)	$F(2,871) = 48.08^{*}$
Women (%)	68	78	78	77	$\chi^2(3) = 31.53^{**}$	75	72	79	$\chi^2(2) = 12.76^{**}$
Education, <i>M (SD)</i>	11 (3.15)	12 (2.86)	11 (3.86)	13 (2.53)	$F(3, 2,900) = 78.90^{*}$	12.12 (2.85)	11.84 (3.17)	12.06 (3.12)	$F(2, 864) = 2.45^{†}$
Non-White (%)	22	15	24	11	$\chi^2(3) = 38.20^{**}$	16	16	11	$\chi^2(3) = 19.47^{**}$
Widowed (%)	71	72	77	67	$\chi^2(3) = 28.10^{**}$	62	67	79	$\chi^2(2) = 53.05^{**}$
Divorced (%)	22	24	16	28	$\chi^2(3) = 20.74^{**}$	30	26	16	$\chi^2(2) = 37.93^{**}$
Wealth (% 50th)	46	42	39	65	$\chi^2(9) = 209.27^{**}$	46	53	49	$\chi^2(6) = 22.61^{**}$
Income (% 50th)	44	46	29	63	$\chi^2(9) = 219.92^{**}$	50	51	48	$\chi^2(6) = 6.77$
Senior housing (%)	15	21	25	12	$\chi^2(3) = 44.13^{**}$	11	10	36	$\chi^2(2) = 235.18^{**}$
Depressive symptoms (%)	14	23	45	9	$\chi^2(3) = 220.60^{**}$	21	15	18	$\chi^2(2) = 12.65^{*}$

Note: H = healthy; MI = multiply impaired; PA-SU = physically average/socially unsupported; PI = physically impaired; PS-SAA = physically supported/socially above average; PU-SS = physically unsupported/socially supported; SCI = sensory-cognitively impaired.

^aThe significance level of p value: $†p < .10$. $^{*}p < .01$. $^{**}p < .001$.

Table 3. Person–Environment and Depressive Symptoms (*N* = 2,657)

Covariates	Model 1	Model 2	Model 3	Model 4
Age (reference age 65–74)				
Old-old (age 74–84)	0.832	0.723*	0.721*	0.722*
The oldest (aged 85+)	0.853	0.544***,a	0.551***	0.554**
Women	1.046	1.033	1.023	1.018
Education (>12)	0.937**	0.957*	0.953*	0.953*
Non-White	1.363*	1.463*	1.447*	1.443*
Widowed	1.234	1.214	1.236	1.238
Divorced	1.179	1.219	1.227	1.243
Wealth (reference highest)				
1	1.717*	1.384	1.323	1.317
2	1.049	0.908	0.893	0.898
3	1.042**	1.063	1.055	1.053
Income (reference highest)				
1	1.967**	1.627*	1.661**	1.705**
2	1.515*	1.430*	1.422*	1.440*
3	1.217	1.149	1.147	1.171
Senior housing	0.886	0.817	0.833	0.845
Health profile (reference H)				
MI		7.992***	7.700***	4.761***
PI		2.888***	2.860***	2.457***
SI		1.609*	1.586**	1.044
Environment profiles (reference PS-SAA)				
PA-SU			1.316†	0.988
PU-SS			0.904	0.655
Health × Environment interaction ^b				
MI × PA-SU				2.666*
MI × PU-SS				1.501
PI × PA-SU				1.298
PI × PU-SS				1.142
SCI × PA-SU				1.145
SCI × PA-SS				2.143*
Constant	0.085***	0.055***	0.055***	0.068***
Log likelihood	–1,183.21	–1,112.25	–1,108.06	–1,101.19
LR χ^2 (df)	101.00	242.90 (17)	251.28 (19)	265.03
$\Delta\chi^2$	—	141.91 (3)**	8.38 (2)**	13.75 (6)**

Notes: H = healthy; MI = multiply impaired; PA-SU = physically average/socially unsupportive; PI = physically impaired; PS-SAA = physically supportive/socially average average; PU-SS = physically unsupportive/socially supportive; SCI = sensory-cognitively impaired. Values are odds ratios. Highest wealth = 4th quartile; highest income = 4th quartile.

^aThe significance level of *p* value: †*p* < .10. **p* < .05. ***p* < .01. ****p* < .001. ^bReferences = H; PS-SAA.

symptoms when living in PU-SS environment (*p* < .05 in Model 4).

With regard to the covariates included in all models, we note that although age-group membership was not significant in Model 1, the significance of this predictor emerged in Model 2 with the introduction of the health-profile subgroups and remained significant in all later models. In contrast, low wealth was significant in the first model but this effect disappeared in later models. Follow-up analyses revealed that the effects of age group on depressive symptoms in Model 1 were unsuppressed when health was included in the model. In addition, both income and wealth interact with health to predict depressive symptoms. These covariate interrelationships were not the focus

of the present study but are worthy of follow-up in future studies.

Discussion

This research contributes to the literature by seeking to understand the conditions that lead to mental health problems among various subgroups of older adults living alone. Our analyses revealed that men and women aged older than 65 years living alone are a heterogeneous population group with a range of health and social–physical environment profiles. We identified particular subgroups in our sample at risk for depression and examined the kinds of environments that could moderate depression for these subgroups.

To address the first research question, we identified subgroups of older adults living alone based on their health and their physical and social environment. Consistent with previous health-profile research with samples including multiple living arrangements (e.g., Lafortune et al., 2009; Liu et al., 2014), we found a wide range of health-limitation subgroups. Although some previous research suggested older adults who live alone are a positive selected and resilient section of the older population, only 38% of people aged 65 and older in our study were classified in the healthy profile (H). This percentage is similar to the proportion found by Lafortune et al., 2009. Furthermore, with increasing age, fewer people were classified into the healthy profile in our study: 60% of this profile subgroup was young-old, 32% old-old, and only 8% of the oldest-old. It is important to note, however, that 16% (93 of the 579 oldest-old in the present study) could be characterized as resilient in terms of health.

The less healthy subgroups identified in the present study were the following: SCI, PI, and MI. There appears to be a gradient with respect to disability (Lafortune et al., 2009; Liu et al., 2014; Schüz et al., 2009) from impaired to healthy subgroups. This gradient with respect to disability indicates the pattern of health changes among older adults living alone seems to mirror that for adults aged older than 65 years. Regarding the SCI subgroup, it is important to note previous research found sensory and cognitive impairment to be highly correlated (Wahl et al., 2013), suggesting this profile may be a better reflection of the prevalence of health limitations among the elderly in general. More research examining health profiles is needed to determine if this is a typical subgroup among adults aged older than 65 years or if it is unique to those who live alone.

This study identified three environmental profiles with unique combinations of physical and social supportive characteristics. To our knowledge, this is one of the few studies to characterize the heterogeneity of the physical-social environmental profiles of older adults living alone. We recommend caution, however, when comparing findings in this study with previous profile research given the different variables included in the analyses and sample selection. In particular, we acknowledge that, although we labeled subgroup profiles as supportive or unsupportive, this interpretation is based on global rather than granular measures of the presence of environment and social support. Our findings should not be viewed as firm categories of the physical-social environmental contexts of older adults living alone until replicated in future research.

To address the second research question, we examined the extent to which different environments moderate health impairments. We found older individuals in the sensory-cognitively impaired subgroup are more likely to be depressed if they live in a PU-SS environment. It appears that the physical environment plays a profound role in the mental well-being of people with sensory-cognitive impairment. Perhaps due to the nature of their sensory-cognitive

limitations, older adults who live alone with this health profile may benefit more from compensatory physical supportive environmental features than from increased social environmental support. Multiply impaired older adults living alone, although comprising the smallest percentage (9%) of the four identified subgroups, were the most vulnerable to depression. They comprise the most vulnerable group of older adults in terms of all known social stratification factors, including minority status, widowhood, and low SES. The concentration of risk factors in this subgroup suggests the need for identifying which aspects of the environment could compensate for multiple impairments. Our findings indicate multiply impaired older adults living alone are more likely to be depressed if they live in physically and socially less-supportive environments. Previous research has also reported characteristics of the physical and social environment can moderate the effects of living alone on depression (Russell & Taylor, 2009; Stahl et al., 2016).

Interestingly, social support as assessed in this study (i.e., children and/or friends living nearby) did not have a significant effect for members of the sensory-impaired group. We speculate this might be related to a sense of autonomy. Improving the physical features of the home helps elders feel secure and in control (Wahl et al., 2012), enabling them to maintain their psychological autonomy. Such personal sense of mastery and control is assumed in the P-E fit literature but the role of personal control has rarely been examined directly in empirical research. An emerging theoretical and empirical literature incorporates psychological constructs, such as control beliefs and a sense of agency (Oswald et al., 2007). Future research could empirically examine the mediating role of these psychological constructs in addition to exogenous physical and social environmental factors.

Limitations and Future Directions

This research used a cross-sectional design. A longitudinal design would further enhance profile research on living alone in old age in key respects. Underlying the P-E fit perspective lies proposals about the dynamic association between personal competence, health, and the environment. Generalizations about health profiles and environment profiles, as well as their influence on depressive symptoms, and well-being in general would be substantially improved if we were able to examine the profiles of individuals over time and observe whether changes in the profiles lead to or are a result of changes in depression. Older adults tend to maintain a high level of subjective well-being despite sociodemographic disadvantages and declining health conditions (e.g., Steptoe, Deaton, & Stone, 2015) and the prevalence of major depression is low relative to younger age groups (Fiske et al., 2009). A longitudinal examination of the extent to which health, environment, and changes in the fit between health and the environment affect well-being and mental health will make a further contribution to the literature.

Second, we did not examine in detail specific kinds of housing situations. It would be particularly important to tease out the role of senior housing residence for the most vulnerable group of elderly. Is it, as suggested by the P-E perspective, behaviorally adaptive for most multiply impaired elderly living alone to reside in senior housing? It may be that people with this health profile choose to relocate into more supportive environments (Wahl & Tesch-Romer, 2001).

The present research is the first attempt to identify profiles of the elderly living alone. In this study, multiply impaired older adults living alone were more likely to be depressed if they lived in physically and socially unsupportive environments. Our research findings reinforce the need for interventions that are tailored to the health and environmental conditions of older adults. We encourage others to continue this line of research to identify the constellations of characteristics shared by subgroups of older adults.

Supplementary Material

Supplementary data are available at *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences* online.

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