

Aspects of housing and perceived health among ADL independent and ADL dependent groups of older people in three national samples

Signe Tomsone · Vibeke Horstmann ·
Frank Oswald · Susanne Iwarsson

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Abstract

Aims Good housing solutions are important for the ageing population in order to promote health and maintain functional ability. The objective of this study was to investigate whether and how objective and perceived aspects of housing were related to perceived health among ADL independent and ADL dependent groups of older, single-living people within three national samples.

Methods The current study was based on national samples (German, $n = 450$; Latvian, $n = 303$; Swedish, $n = 397$) from the European ENABLE-AGE Project, using data on ADL dependence, perceived health, objective and perceived aspects of housing. Descriptive statistics, correlations and multivariate ordinal regression models were used to analyze the data.

Results The participants in the ADL dependent groups generally were older, had more functional limitations and perceived their health as poorer compared to ADL independent groups. With regard to perceived housing, usability as well as meaning of home indicators was often lower in the ADL dependent groups, housing satisfaction was at the same level while housing-related external control beliefs were higher. The differences among the

national samples were highly significant for both ADL groups, for all variables except number of outdoor environmental barriers in the ADL independent groups. The relations between perceived health on one hand and objective and perceived aspects of housing on the other show great diversities among the ADL groups and the national samples.

Conclusions The results serve to alert health care practitioners that it is important to draw attention to how older people perceive their housing situation and to the fact that different levels of functional independence demand different interventions.

Keywords Cross-national research · Housing for elderly · Perceived health · Activities of daily living

Introduction

All over Europe, housing issues in old age are very important. Frailty increases with age, and community-residing, single-living persons in advanced age have a pronounced risk of losing independence and becoming socially isolated [1]. In order to promote health and facilitate good housing solutions for this vulnerable group, it is necessary to investigate how different housing aspects are related to health.

Housing is not only the conjunction of the dwelling, the immediate outdoor environment and the community, but is also a process of an ongoing exchange between the individual and his/her objective and perceived immediate socio-physical setting [2–4]. As suggested in the literature, the socio-physical environment of the home covers objective and measurable characteristics as well as hard-to-observe experiential elements of perceived housing in need

S. Tomsone (✉) · V. Horstmann · S. Iwarsson
Department of Health Sciences, Faculty of Medicine,
Lund University, Box 157, 221 00 Lund, Sweden
e-mail: Signe.Tomsone@med.lu.se

S. Tomsone
Department of Rehabilitation, Riga Stradins University,
Riga, Latvia

F. Oswald
Interdisciplinary Ageing Research Group,
Faculty of Educational Sciences, Goethe University,
Frankfurt/Main, Germany

of in depth exploration or other ways of approaching subjective world spheres [5]. One objective aspect of housing, well known in public health, is housing standard that usually comprises the conditions which are essential to good health and which make housing premises safe, sanitary and fit for human habitation, i.e. physical qualities such as heating, electricity and number of rooms [6]. Other objective aspects that may have an impact on the everyday independent living in the community can be described in terms of physical environmental barriers and accessibility [7]. Accessibility can be defined and operationalized as the relationship between a person's functional capacity and the prevalence of physical environmental barriers in the environment. According to this definition, accessibility is an aspect of person–environment fit (P–E fit) [8].

Perceived housing includes aspects such as housing satisfaction, usability, meaning of home, and housing-related control beliefs [9, 10]. Traditionally in research, housing satisfaction has been captured by means of attitudinal single-item evaluation [11]. Usability is defined based on person–environment–occupation (P–E–O) transactions [12] and indicates the extent to which individual housing needs and preferences in terms of activity performance can be fulfilled at home. Another aspect of person–environment transaction is meaning of home, i.e. the perceived relationship between the objective socio-physical environment and subjective evaluations, goals, values, emotions and potential behaviors that people pursue [2]. Finally, housing-related control beliefs reflect psychological control theory applied to the housing situation and explain events at home either as contingent upon one's own behavior, or upon luck, chance, fate or powerful others [9, 13].

Turning to aspects of health, already in 1947 the World Health Organization (WHO) stated that good health is not merely the absence of disease and infirmity but a state of optimal physical, mental and social wellbeing. In health promotion, health is not considered an abstract condition but rather the ability of an individual to achieve her/his potential and to respond positively to the challenges of daily life. From this perspective, health is an asset or a resource for everyday life, rather than a standard or goal to be achieved [14]. Everyday life is influenced by the context, which is different in various countries and cultures. Perceived health and limitations in activities of daily living (ADL) are important aspects of health, but more research investigating how they relate to aspects of housing is needed, in particular involving older people from different national contexts.

An important goal in health promotion is to create environments supporting healthy living and subjective wellbeing [15]. Following a line of thought proceeding from the fact that independence in ADL is an important

health indicator, a physical home environment supporting daily activity independence does most likely promote health [7]. Based on the ecological theory of ageing (ETA) [16] there is reason to assume that the relation between housing and health should be particularly strong in later life because of the increased vulnerability of older adults to environmental challenges [2]. While there is some knowledge on how objective housing characteristics influence health, perceived housing aspects have rarely been discussed as being health-related [2, 4, 17].

Studies based on the cross-national European ENABLE-AGE Project [1] and other studies [18, 19] concerning housing aspects related to health show that housing accessibility (P–E fit) rather than the presence of environmental barriers alone contributes to healthy ageing and functional health outcomes such as autonomy in everyday living. The exploration of relationships between objective and perceived aspects of the home showed that the magnitude of P–E fit problems is related to more activity-oriented perceived aspects of the home, that is, “activity aspects” of usability in the home and the “behavioural aspect” of meaning of home [20]. In addition, previous results indicated that relations between perceived health and objective and perceived aspects of home differ with respect to ADL capacity. That is, based on the Swedish ENABLE-AGE Survey Study sample, a study on housing and health showed that there were differences as to what aspects of housing were influential on subjective health among very old people with different ADL dependence levels [21]. Since the housing and health situations among very old people differ largely among different countries, it is of interest to investigate such relations in different national contexts.

The main objective of this study was to investigate whether and how objective and perceived aspects of housing were related to perceived health among groups of older, single-living, community-dwelling people with different levels of ADL performance within three national samples.

Methods

This study was based on data from German, Latvian and Swedish samples from the European project “Enabling Autonomy, Participation, and Well-Being in Old Age: The Home Environment as a Determinant for Healthy Ageing” (ENABLE-AGE, 2002–2004, EC funded) [1]. The main objective of the ENABLE-AGE Project was to examine the home environment and its importance for major components of healthy ageing. The project design was explicitly explorative and did not aim for national representativeness [22].

Sample

For each country, the target sample was 400 very old, single-living persons in urban areas, including both genders (stratified to include approximately 25 % men). The initial ambition was to draw participants at random from official national registers, but this was only possible in Germany and Sweden. In Latvia in 2002, official national register were not available for researchers, and thus Latvian participants were recruited based on social care centers client lists and through older people's voluntary organizations [22], striving to apply principles of randomization as far as possible. Due to the life expectancy differences between West/Central and East European countries, in Germany and Sweden the participants were chosen to be aged 80–89 years, while the corresponding age group in Latvia was chosen to be 75–84 years. Geographically, participants were located in south-western Germany (Heidelberg, Mannheim), in the central part of Latvia (Riga, Jurmala), and in south Sweden (Halmstad, Helsingborg, Lund).

Following a sampling flowchart agreed on by the ENABLE-AGE Consortium, project assistants phoned potential participants to verify that they fulfilled all inclusion criteria and asked them for informed consent. Given the fact that the target group for this study was frail and the data collection procedures were rather strenuous, a considerable proportion did not consent to participation. Approximately 40 % of the persons contacted accepted to participate (Sweden 41 %; Germany 33 %; Latvia 44 %); the most common drop-out reasons were poor health or lack of time and interest. The final sample in Germany consisted of 450 persons, in Latvia 303, and in Sweden 397 persons. Since several interviews resulted in incomplete data on the variables chosen for the current study, the analyses were based on 419 participants in the German sample, 292 in the Latvian, and 387 participants in the Swedish sample.

Procedure

In all three countries, the data collection was performed by experienced occupational therapists. Before the data collection started the therapists underwent a 3-day course, afterwards followed a cross-national pilot study with inter-rater reliability testing of core instruments [23]. Thereafter, data collection was accomplished at home visits. The ENABLE-AGE Project followed ethical principles for research according to the Helsinki Declaration. In each country involved the project was subjected to ethical review, followed by formal consent according to national regulations.

Instruments

The comprehensive ENABLE-AGE Survey Study Questionnaire incorporated a wide range of self-report scales

and observational formats along with project-specific questions on housing and health [1] but for the current study only variables on ADL dependence, perceived health, objective and perceived aspects of housing were used. Number of functional limitations was used as descriptive for objective health; in addition, gender, age, self-reported monthly income and indication of cognitive abilities were included in the analyses as potential confounders for the relationship between health and housing (Table 1). Only the instruments used for collecting these data are described below, further details on the instrumentation have been published elsewhere [17].

Perceived health

A global self-rating of perceived health was collected by means of the well-established question “In general would you say your health is?” from the SF-36 questionnaire, rated on a scale with five response alternatives ranging from “excellent” to “poor” [24]. In this study, perceived health was re-coded such that higher values indicated better health.

Independence/dependence in activities of daily living (ADL)

ADL independence/dependence was assessed using the ADL Staircase [25], comprising five personal activities of daily living (P-ADL) items (feeding, transferring, going to the toilet, dressing, and bathing) and four instrumental ADL (I-ADL) items (cooking, shopping, cleaning, and transportation). The ADL Staircase was administered using a combination of interview and observation, and the assessment was recorded on a three-graded scale: independent, partly dependent, and dependent, where dependence is defined in terms of assistance from another person. Following the instrument manual, responses were dichotomized into independent/dependent. Validity and reliability of the instrument have been demonstrated in previous studies [25, 26]. While it is a well-known practice to categorize individuals in three groups according to ADL dependence [21], the group dependent in both P- and I-ADL was very small in our national samples (German, $n = 20$; Latvian, $n = 17$; Swedish, $n = 25$). Since most of these participants were dependent only in one P-ADL (bathing, i.e. the most demanding P-ADL), we decided to construct only two groups for the analyses, i.e. ADL independent (independent in all activities) and ADL dependent individuals (dependent in at least one activity).

Functional limitations

Functional limitations were assessed by means of the personal component of the Housing Enabler instrument [27],

Table 1 Background characteristics, functional limitations and perceived health for three national samples and ADL groups

	German sample		p^a		Latvian sample		p^a		Swedish sample		p^a		p^b	
	ADL ind. (<i>n</i> = 149)	ADL dep. (<i>n</i> = 270)	ADL ind. (<i>n</i> = 202)	ADL dep. (<i>n</i> = 90)	ADL ind. (<i>n</i> = 151)	ADL dep. (<i>n</i> = 236)	ADL ind. (<i>n</i> = 151)	ADL dep. (<i>n</i> = 236)	ADL ind. (<i>n</i> = 151)	ADL dep. (<i>n</i> = 236)	ADL ind. (<i>n</i> = 151)	ADL dep. (<i>n</i> = 236)	ADL ind. (<i>n</i> = 151)	ADL dep. (<i>n</i> = 236)
Sex (%)														
Men	18.8	24.1	12.9	n.s.	15.9	31.4	15.9	31.4	15.9	31.4	0.001	n.s.	***	***
Women	81.2	75.9	87.1		84.1	68.6	84.1	68.6	84.1	68.6				
Age (years)														
Median (Q1–Q3)	84 (82–87)	86 (82–88)	78 (77–81)	***	81 (79–82)	86 (83–88)	83 (81–86)	86 (83–88)	83 (81–86)	86 (83–88)	***	***	***	***
Monthly income (Euro)														
Median (Q1–Q3)	1,375 (1,000–2,000)	1,500 (1,000–2,000)	100 (100–100)	n.s.	100 (100–100)	900 (800–1,170)	900 (800–1,025)	900 (800–1,170)	900 (800–1,025)	900 (800–1,170)	n.s.	***	***	***
No. of functional limitations (0–13)														
Median (Q1–Q3)	2 (1–4)	4 (2–6)	2 (2–4)	***	4.5 (3–6.2)	3 (2–5)	2 (1–4)	3 (2–5)	2 (1–4)	3 (2–5)	***	***	***	***
In general would you say your health is (%)														
Poor	2.0	10.4	20.4		55.1	4.7	2.0	4.7	2.0	4.7				
Fair	47.7	54.3	62.2		41.6	28.4	18.5	28.4	18.5	28.4				
Good	39.6	26.8	15.9	***	3.4	32.6	31.1	32.6	31.1	32.6	***	***	***	***
Very good	8.7	7.8	1.0			24.2	29.1	24.2	29.1	24.2				
Excellent	2.0	0.7	0.5			10.2	19.2	10.2	19.2	10.2				
Indication of cognitive abilities ^c														
Median (Q1–Q3)	0.75 (0.75–1.0)	0.75 (0.69–1.0)	0.75 (0.75–1.0)	n.s.	0.75 (0.5–0.75)	1.0 (0.75–1.0)	1.0 (0.75–1.0)	1.0 (0.75–1.0)	1.0 (0.75–1.0)	1.0 (0.75–1.0)	0.003	0.005	***	***

****p* value below 0.0005^a Differences between ADL groups^b Differences between national samples^c Indication of cognitive abilities represented as proportion of correctly performed applicable tasks (in total four tasks) from Mini-Mental State Examination

administered as a combination of interview and observation, dichotomously assessing functional limitations (13 items) and dependence on mobility devices (two items). In this study, these data were used as a sample characteristic variable; a sum-score labelled “no. of functional limitations”.

For indication of cognitive abilities were used four tasks from the Mini-Mental State Examination [28] considered being sensitive to indicate *cognitive deficits* [29]—orientation today, spell the word “world” backwards, recall three words, and write a sentence. As one of the tasks, write a sentence, for some participants was not possible due to physical limitations, the variable used was the proportion of correctly performed applicable tasks.

Objective aspects of housing

Housing standard was expressed by information on the number of rooms in the dwelling. Further, we operationalized objective housing as number of physical environmental barriers in the home, assessed by the environmental component of the Housing Enabler [27]. The Housing Enabler has been developed based on extensive research, supporting its validity and reliability [12, 30], and applicability in empirical studies [27, 31]. For the ENABLE-AGE Project, a cross-national research version was developed and tested for inter-rater reliability [23]. The assessment of physical environmental barriers (188 items) is based on a detailed observation assessing them as present or absent in the immediate outdoor environment (A), in the entrance (B) as well as indoors (C). Data from these assessments were used to describe each part of the environment A–C and to calculate corresponding sum-score variables.

Perceived aspects of housing

As suggested in the literature, perceived housing is represented by four domains [9]: *Housing satisfaction* was assessed by single question adapted from the Housing Option for Older People (HOOP) questionnaire [32], estimating housing satisfaction using a 5-graded rating scale ranging from 1 (definitely not satisfied) to 5 (yes, definitively satisfied). *Usability* was assessed by the self-administered Usability in My Home questionnaire (UIMH) [12], consisting of 16 items to be rated on a 5-graded scale, from 1 (not at all) to 5 (fully agree), targeting “activity aspects”, “personal and social aspects”, and “physical environmental aspects”. Due to low internal consistency (Cronbach’s $\alpha < 0.50$) in the ENABLE-AGE Project, the six items in the “personal and social aspects” sub-scale were excluded. Thus, the sub-scales “physical environmental aspects” (6 items, $\alpha = 0.84$) and “activity aspects”

(4 items, $\alpha = 0.84$) were retained for analysis. For one of the four items targeting “activity aspects” and for two of the 6 items targeting “physical environmental aspects”, there was a substantial number of the optional rating alternative “not applicable”. Consequently, a rating “not applicable” was substituted by the mean of the regular ratings and using these, finally mean scores were calculated. *Meaning of home* was assessed with the Meaning of Home Questionnaire (MOH), a self-assessment questionnaire developed to capture older peoples’ subjective meanings [9]. Each item is to be judged on a scale ranging from 0 (strongly disagree) to 10 (strongly agree). The 28-item questionnaire captures four different aspects of meaning of home: “physical” (7 items), “activity” (6 items), “cognitive/emotional” (10 items) and “social” (5 items) and mean scores for the four subscales were calculated. Since the items of each aspect purposefully were developed to represent a wide range of meaning related to the home, the internal consistency was limited (physical aspects $\alpha = 0.69$; activity aspects $\alpha = 0.67$; cognitive/emotional aspects $\alpha = 0.66$; and social aspects $\alpha = 0.55$) [9]. *Housing-related control beliefs* were assessed with the Housing-related Control Beliefs Questionnaire, HCQ [13]. This 24-item questionnaire, where each item is assessed in terms of agreement to a statement using a scale ranging from 1 (not at all) to 5 (very much), was based on the psychological dimensions of “internal control” (8 items), “external control: powerful others” (8 items), and “external control: chance” (8 items). “Internal control” indicates that housing-related events are highly contingent upon a person’s own behaviour, where personal responsibility implies that the individual itself is responsible for what happens. “External control” includes two dimensions: either that some other person is responsible (powerful others) or that things happen by mere luck, chance, or fate. Analyses of the ENABLE-AGE dataset indicated low internal consistency ($\alpha < 0.50$) for “internal control”, while each of two dimensions of “external control” reached medium level. Thus, the dimension of “internal control” was excluded and the two dimensions of external control were combined to one dimension including 16 items and a mean score were calculated [9].

Analysis design and statistics

To present the material, descriptive statistics were used. For each of the three national samples differences between the two ADL groups were tested by means of Mann–Whitney’s U test for all variables except for gender, where a χ^2 test was used. Similarly, differences between the national samples were tested by the Kruskal–Wallis test, again except for gender where a χ^2 -test was used.

Moreover, Spearman's correlations between perceived health and all housing variables were calculated; this was done for each of the two ADL groups within each of the three national samples.

In order to study the multivariate relationships between the objective and perceived aspects of housing and perceived health, regression models were used. As the outcome variable was a polytomous ordered categorical variable, we used ordinal regression analysis that is a generalization of logistic regression [33, 34]. Depending on the distribution of the categories of the outcome variable, different link functions are suitable. The categories of perceived health were fairly evenly distributed; hence the logit function was appropriate as the link function.

For each national sample separately, the regression models were analyzed in the two ADL groups simultaneously. In this manner, the variables that were the least significant in both ADL groups were excluded one by one, until only variables that were significant in at least one of the ADL groups remained. Thus, as a result of the design, the final model for the ADL groups within each national sample contained the same variables, making comparisons of the coefficients possible. Variables not included in these models thus do not add significant information about the perceived health in any of the two ADL groups. After the models had been established in this way, they were later controlled for possible confounding from sex, age, monthly income and indication of cognitive abilities. Assessment of explained variance is given by Nagelkerke's Pseudo R-square.

For the data analysis the Predictive Analytics Software (PASW) 18.0 was used. *p* Values below 0.05 indicate statistical significance.

Results

The participants in the ADL dependent groups were older, had more functional limitations and perceived their health as poorer compared to the ADL independent groups (Table 1). In the German and Swedish samples the proportions of men in the ADL dependent groups were higher than in the independent groups, but this proportion was smaller in the Latvian sample. With regard to these variables except for the sex there were statistically significant differences among the national samples for both ADL groups.

With regard to the objective aspects of housing there were statistically significant differences between the ADL groups only for environmental barriers outdoors and barriers at entrances in the German sample (Table 2). With regard to perceived housing indicators, usability as well as meaning of home was generally lower while external

control beliefs were higher in the ADL dependent groups and housing satisfaction was at the same level in both ADL groups.

The differences among the national samples were highly significant for all housing variables for both ADL groups, except for number of outdoor environment barriers in the ADL independent groups. The Latvian participants had fewer rooms, a lower number of environmental barriers, and revealed lower housing satisfaction in both ADL groups in comparison with the Swedish and German national samples. Further, the various aspects of usability and meaning of home showed significantly lower scores in the Latvian sample in both ADL groups, while the score of external housing-related control beliefs was higher than in the German and Swedish samples.

All correlations between perceived health and single indicators of aspects of housing (in total 24) were calculated for each of the three national samples, showing considerable differences among them (Table 3). That is, in the Swedish national sample 15 correlations were statistically significant, compared to four in the German and nine in the Latvian sample. The overall pattern of significant correlations varied between ADL groups as well as among the national samples. For example, in the German sample none of the objective aspects of housing were related to perceived health. Strongest association for the German sample was found between environmental aspects of usability and perceived health in the dependent group ($r = 0.25$), for the Latvian sample between social aspects of meaning and perceived health in the independent group ($r = 0.26$) and for the Swedish sample between physical aspects of meaning and perceived health in the independent group ($r = 0.32$). In general, perceived health was more often related to environmental aspects of usability and activity aspects of meaning of home than to the remaining perceived aspects of housing.

The multivariate ordinal regression models gave almost the same picture as did the bivariate correlations with great diversities among the ADL groups and the national samples (Table 4). The most remarkable difference between the two types of analyses was that the number of environmental barriers outdoors and activity aspects of meaning of home did not reach statistical significance in any of the ADL groups in any of the three national samples. Apart from that, the picture in the two ADL groups in the German sample remained, while now the environmental aspect of usability in the home turned out statistically significant in the Latvian ADL dependent group. Finally, in the Swedish ADL independent group, number of rooms turned out as significantly related to perceived health, while the activity aspect of usability lost its significance. When the models were controlled for confounding effects (sex, age, monthly income and indication of cognitive abilities) there were

Table 2 Objective and perceived aspects of housing for three national samples within ADL groups

	<i>p</i> ^a			<i>p</i> ^a			<i>p</i> ^b		
	Germany	Latvia	Sweden	ADL ind. (n = 202)	ADL dep. (n = 90)	ADL ind. (n = 151)	ADL dep. (n = 236)	ADL ind.	ADL dep.
Objective aspects of housing	ADL ind. (n = 149)	ADL dep. (n = 270)							
Environmental barriers (HE)^c									
No. of EB_outdoors (0–33)	13 (11–14)	13 (12–15)	0.004	13 (10–15)	10.0 (8.0–12.3)	n.s.	12 (10–15)	n.s.	***
No. of EB_on entrance (0–49)	13 (11–15)	12 (10–15)	0.010	10 (8–13)	10.0 (8.0–12.3)	n.s.	11 (8–15)	0.075	***
No. of EB_indoors (0–100)	37 (32–41)	37 (33–43)	n.s.	30 (26–30)	30 (26–34)	n.s.	37 (33–42)	n.s.	0.005
Housing standard, no of rooms	3 (2–3)	3 (2–3)	n.s.	1 (1–2)	1 (1–2)	n.s.	3 (2–4)	n.s.	***
Perceived aspects of housing									
Usability (UIMH)^d									
Activity aspects (1–5)	5.0 (4.6–5.0)	5.0 (4.3–5.0)	0.010	4.0 (3.6–5.0)	3.6 (3.3–4.0)	***	5.0 (4.5–5.0)	n.s.	***
Environmental aspects (1–5)	5.0 (4.5–5.0)	4.5 (4.0–5.0)	***	4.0 (3.5–4.3)	3.5 (2.8–4.0)	***	4.8 (4.5–5.0)	0.045	***
Housing satisfaction ^e (1–5)	5 (4–5)	5 (4–5)	n.s.	4 (2–4)	4 (3–5)	n.s.	5 (5–5)	n.s.	***
Meaning of home (MOH) ^f									
Physical aspects (0–10)	9.6 (8.6–10.0)	8.9 (8.4–9.7)	***	6.9 (6.0–7.8)	6.1 (5.3–7.2)	***	9.1 (8.4–10.0)	n.s.	***
Activity aspects (0–10)	9.8 (8.8–10.0)	8.8 (7.7–9.8)	***	7.8 (7.0–8.3)	5.8 (4.7–7.0)	***	8.3 (7.0–9.5)	***	***
Cognitive/emotional aspects (0–10)	9.0 (8.3–9.5)	8.8 (8.1–9.3)	n.s.	7.8 (7.1–8.5)	7.3 (6.4–7.9)	0.001	8.5 (7.7–9.0)	0.002	***
Social aspects (0–10)	8.0 (7.0–8.8)	8.0 (7.0–9.0)	n.s.	7.0 (6.0–8.2)	6.3 (5.1–7.7)	0.002	8.8 (7.6–10.0)	n.s.	***
Housing-related control beliefs (HCQ) ^g									
External control (1–5)	2.6 (2.1–3.1)	2.9 (2.4–3.4)	***	3.0 (2.7–3.3)	3.3 (3.1–3.6)	***	2.9 (2.6–3.3)	***	***

Results are presented in the order–median, (Q1–Q3)

*** *p* value below 0.0005^a Differences between national samples^b Differences between ADL groups^c Higher scores indicate more environmental barriers (The Housing Enabler)^d Higher scores indicate greater subjective housing usability (Usability of My Home questionnaire)^e Higher scores indicate higher satisfaction (Housing Options for Older People questionnaire)^f Higher scores indicate higher agreement in satisfaction (Meaning of Home questionnaire)^g Higher scores indicate stronger beliefs in external control (Housing-related control beliefs questionnaire)

Table 3 Spearman Correlations (*p* values) between aspects of housing and perceived health, for three samples within ADL groups

	Germany		Latvia		Sweden	
	ADL ind. (<i>n</i> = 149)	ADL dep. (<i>n</i> = 270)	ADL ind. (<i>n</i> = 202)	ADL dep. (<i>n</i> = 90)	ADL ind. (<i>n</i> = 151)	ADL dep. (<i>n</i> = 236)
Objective aspects of housing						
Environmental barriers (HE)						
No. of EB_outdoor (0–33)	0.136 (0.098)	0.055 (0.371)	0.080 (0.258)	–0.135 (0.209)	–0.195 (0.016)	–0.215 (0.001)
No. of EB_entrance (0–49)	0.039 (0.635)	0.050 (0.411)	0.219 (0.002)	–0.127 (0.234)	0.019 (0.821)	–0.150 (0.021)
No. of EB_indoor (0–100)	0.118 (0.153)	0.003 (0.957)	0.124 (0.080)	–0.048 (0.654)	0.222 (0.006)	–0.111 (0.088)
Housing standard, no of rooms	0.026 (0.756)	0.021 (0.729)	0.158 (0.026)	–0.123 (0.253)	0.126 (0.128)	0.049 (0.452)
Perceived aspects of housing						
Usability (UIMH)						
Activity aspects (1–5)	0.012 (0.889)	0.086 (0.163)	0.142 (0.044)	0.187 (0.084)	0.203 (0.013)	0.262 (<0.001)
Environmental aspects (1–5)	–0.125 (0.131)	0.254 (<0.001)	0.171 (0.015)	0.179 (0.104)	0.169 (0.040)	0.277 (<0.001)
Housing satisfaction	0.026 (0.756)	–0.064 (0.010)	–0.024 (0.739)	–0.072 (0.511)	0.284 (<0.001)	0.132 (0.043)
Meaning of home (MOH)						
Physical aspects (0–10)	0.148 (0.073)	0.084 (0.185)	0.120 (0.092)	0.071 (0.514)	0.318 (<0.001)	0.185 (0.005)
Activity aspects (0–10)	0.143 (0.085)	0.163 (0.010)	0.225 (0.001)	0.208 (0.053)	0.233 (0.004)	0.137 (0.039)
Cognitive/emotional aspects (0–10)	0.035 (0.673)	0.028 (0.662)	0.207 (0.003)	0.227 (0.034)	0.116 (0.161)	0.078 (0.241)
Social aspects (0–10)	–0.065 (0.436)	–0.025 (0.692)	0.255 (<0.001)	0.193 (0.073)	0.174 (0.035)	0.122 (0.066)
Housing-related control beliefs (HCQ)						
External control (1–5)	–0.173 (0.037)	–0.164 (0.010)	–0.100 (0.162)	–0.072 (0.511)	–0.159 (0.055)	–0.302 (<0.001)

Results represented in the order-correlation coefficient, *p* value. Results with *p* values below 0.05 are represented in bold

Table 4 Ordinal regression models with perceived health as dependent variable, assessed simultaneously for the two ADL groups within three samples

	Germany		Latvia		Sweden	
	ADL ind. (<i>n</i> = 149)	ADL dep. (<i>n</i> = 270)	ADL ind. (<i>n</i> = 202)	ADL dep. (<i>n</i> = 90)	ADL ind. (<i>n</i> = 151)	ADL dep. (<i>n</i> = 236)
Objective aspects of housing						
Environmental barriers (HE)						
No. of EB_entrance (0–49)	–	–	0.09 (0.03; 0.15) 0.003	–0.07 (–0.18; 0.04) 0.207	0.03 (–0.03; 0.09) 0.309	–0.05 (–0.09; –0.004) 0.069
No. of EB_indoor (0–100)	–	–	–	–	–0.08 (–0.14; –0.02) 0.014	–0.04 (–0.09; 0.007) 0.092
Housing standard, no of rooms	–	–	0.61 (0.06; 1.15) 0.029	–0.65 (–1.50; 0.21) 0.138	0.42 (0.01; 0.74) 0.010	0.00 (–0.26; 0.26) 0.999
Perceived aspects of housing						
Usability (UIMH)						
Activity aspects (1–5)	–	–	–	–	0.30 (–0.39; 0.98) 0.398	0.57 (0.02; 1.17) 0.060
Environmental aspects (1–5)	–0.99 (–1.78; 0.19) 0.015	0.68 (0.19; 1.18) 0.007	0.50 (0.04; 0.96) 0.033	0.71 (0.07; 1.36) 0.031	–	–
Housing satisfaction	–	–	–	–	0.68 (0.17; 1.19) 0.009	0.26 (–0.25; 0.72) 0.338
Meaning of home (MOH)						
Physical aspects (0–10)	–	–	–	–	0.49 (0.13; 0.84) 0.007	0.35 (0.08; 0.62) 0.012
Social aspects (0–10)	–	–	0.19 (0.01; 0.38) 0.043	0.18 (–0.09; 0.46) 0.190	–	–
Housing-related control beliefs (HCQ)						
External control (1–5)	–0.67 (–1.3; –0.03) 0.040	–0.42 (–0.90; –0.07) 0.092	–	–	–0.34 (–1.13; 0.44) 0.392	–0.73 (–1.36; –0.09) 0.024
Pseudo R–Square (Nagelkerke)	0.113	0.157	0.228	0.225	0.275	0.237

Models adjusted to the possible confounders: age, sex, income and indication of cognitive status. The results are presented in following order-regression coefficient, 95% CI, *p* value. Results with *p* values below 0.05 are represented in bold. Empty cells indicate for a variable that it was not significant in any of the ADL groups within the samples

only minor changes in the coefficients; some variables (environmental aspects of usability in the German ADL independent group) changes from slightly significant to just significant and vice versa (number of environmental barriers and activity aspects of usability in the Swedish ADL dependent group, external housing-related control beliefs in the German ADL dependent group). The results presented in Table 4 are adjusted for the possible confounders.

Discussion

The results of this cross-national study on the relations of housing and health in old age give a highly complex picture and indicate that housing issues for very old people need more differentiated considerations. The comparison of the housing and health situation among reasonably large samples of older people in three different European national contexts is an asset deserving attention. As cross-national research on older people living in the community still is in its infancy, the findings have potential to nurture the evolution of cross-national research in Europe. In particular in Eastern Europe, research involving detailed data collection with very old people in private homes is virtually non-existing. That is, already on a descriptive level our results are quite unique.

The current study is part of the extensive the ENABLE-AGE project, where the overarching aim was to explore the home environment as a determinant for healthy ageing in very old age, using a longitudinal perspective. Originally, data were collected in five countries; Germany, Hungary, Latvia, Sweden and the UK. The project was multi-professional and cross-national in nature. One major challenge regarding data collection was issues of validity and reliability, and already early on the research team was well aware of the need to make efforts to safeguard data quality. However, despite sufficient inter-rater reliability results [23] and continuous quality monitoring during the data collection process, comparative data on environmental barriers and accessibility problems collected in the ENABLE-AGE Survey Study revealed inconsistencies [22]. Accounting possible reasons that might have influenced data quality regarding objective aspects of housing, such as data collector competency and practice differences within national teams, and staff discontinuity in some of the national data collector teams, for the current study only data from Germany, Latvia and Sweden were used. Such experiences are very valuable to consider when planning for future cross-national research including multi-professional teams.

The new knowledge generated in the current study is the pattern of different housing and health relationships among sub-groups of older, single-living, community-dwelling

people in different national contexts. The results emphasize that besides objective aspects of housing also perceived aspects are important for health in old age. Obviously, feelings of not being in control of the housing situation in old age have a negative influence on the perception of health. In contrast, perceiving the home environment as usable has a positive influence, but it should be noted that the overall pattern seen here was complex and the situation across the different national samples was not consistent, e.g. regarding housing-related psychological control beliefs and meaning of home, low levels of external control is linked to perceived health only in Germany and Sweden, but not in Latvia, whereas, in contrast, only the Latvian participants showed considerable links between social aspects of meaning of home and perceived health, particularly for those who were independent in their daily life. The results from a previous, similar study [21] based solely on the Swedish national sample of the ENABLE-AGE Project support reflections that perceived aspects of housing are more influential among ADL dependent than among ADL independent older people; however, this was not confirmed by the current study. Since there obviously are differences in housing and health relationships among older people with different levels of ADL capacity, our approach to problematisation and analysis is fruitful for further studies to elucidate such intriguing discrepancies. From a methodological point of view, we considered four domains of perceived housing [9] as useful, but it should be noted that we have identified needs for further psychometric optimization of the set of these instruments. That is, more efficient methodologies remain to be developed for use in this field of research, and probably there would be much to gain from combining quantitative and qualitative methods [35].

Based on other studies from the ENABLE-AGE Project [1, 17, 20], we know that accessibility, defined as person–environment fit [8] is related to aspects of health. Accessibility is a complex indicator, constructed by combinations of functional limitations and environmental barriers. In the current study we isolated the influence from objective housing by using only the environmental component of accessibility. Consequently, the significant relations between objective housing and health were few, but results revealed that it seems as if persons have more environmental barriers they could perceive their health as better. That is in contrast to the common notion that, for example, environmental barriers have a negative impact on activity and thus also health among older people.

However, the fact that the activity and environmental aspects of usability turned out as significantly related to perceived health (Tables 3, 4) deserves attention, since it indicates that the physical environment of the home is important in old age, but presumably not until the

individual perceives that it compromises usability. Since per definition activity is one of the components of usability [8], one could expect that aspects of usability would turn out as significantly related to perceived health particularly in the ADL dependent groups. This holds for all three samples (Table 4), while in the Latvian sample a significant positive relation to perceived health was seen for environmental aspects of usability also in the ADL independent group. It is here important to keep in mind that ADL dependence is defined in terms of assistance from another person and that there are differences regarding the assistance received among the participants in this study. In an earlier study [36] it was demonstrated that socio-cultural care, service context factors and socio-economic indicators impact on ADL dependence, with marked cross-national differences. Important findings were the differences in the types of support in daily life that were available, and that the financial situation could allow the participants to pay for services. As can be seen in Table 1, the monthly income in the Latvian sample was significantly lower than in the Swedish and German national samples. That is, the Latvian participants assessed as ADL independent might in reality have had at least as much difficulty in daily activity and in negotiating the physical home environment as the German and Swedish participants assessed as dependent, since they presumably received home help much easier. This kind of knowledge is important for valid interpretations of complex analysis results on housing and health in old age, in research as well as in clinical work, not the least in cross-national activities.

Another result, likewise interpreted as a consequence of challenges in cross-national research and in contrast to common sense expectations, is that there were smaller numbers of environmental barriers in the Latvian sample, compared to the two others samples (Table 2). Also here, knowledge on country-specific situations is necessary to be able to make valid interpretations. Since the variable “number of environmental barriers” is based on very detailed data collection, it means that the value on this variable is closely linked to whether a dwelling has all necessary functions, or not. For example, if there is a bathroom there will most often also be a number of environmental barriers associated to it. Consequently, for a dwelling without a bathroom, the total number of environmental barriers indoors will be lower. That is, in the current study differences in numbers of environmental barriers is most likely a methodological artifact, resulting from differences in housing standard; this must be compensated in future research.

It should be noted that samples of ENABLE-AGE Project were not nationally representative. Starting out from the marked differences in life expectancy among the participating countries [22], the sampling criteria were developed based on notion of the fourth age [37]. That is, we aimed to

include participants in the phase of life when the incidence and prevalence of somatic and psychiatric diseases tend to rise, leading to the consequences in terms of functional limitations and disability. In this age group, quite many potential participants decline taking part in strenuous procedure of data collection because of health problems, leaving us with study samples most likely representing those being in a better situation. One consequence of this was that, while it would have been of interest to study three ADL dependence levels as often done in ageing research [21, 25], the sizes of the groups dependent in both I- and P-ADL in our three national samples were not sufficient to allow the use of such approach. Still, the samples we had are useful for studies targeting new research questions.

Besides their value for future research, the results of this study are useful for health care and social services practitioners. The results of the current study can be used to develop the now widespread practice of preventive home visits to older people. Such practices differ between countries, and usually measures on the housing environment are not included [38]. One recent study [39], involving older people in rural areas in the US, indicated that there was no significant difference in perceived aspects of home environment between those who modified their homes and those who did not. The results of our study draw the attention to the fact that interventions in the homes of older people are not only a technical matter of housing design, removal of physical environmental barriers and risk factors. Our results emphasize that perceived aspects of housing should not be neglected, with important implications for community-based practices.

Conclusions

This study demonstrates that there are differences in health and housing aspects among ADL dependent and ADL independent groups of very old, single-living people, and also differences among national samples across Europe. The pattern of relations between objective and perceived aspects of housing and perceived health shows great diversities. While there is a need for more research within this field, our results demonstrate that it is important to pay attention to how older people perceive their housing situation as such perceptions seem to be important indicators of health in very old age.

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Conflict of interest None.

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