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A 10-year follow-up study on subjective well being and relationships to person-environment (P-E) fit and activity of daily living (ADL)-dependence of older Swedish adults

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Abstract

In order to investigate how well-being and ill health is affected by the process of aging, the main aim was to investigate these self-perceived aspects of health over a 10-year period among older Swedish adults. The aim was also to study how these aspects correlated with objectively assessed functional limitations, use of mobility device, person-environment (P-E) fit; (also denoted accessibility) problems in housing, and activity of daily living (ADL) dependence. Using the Swedish national population register, a baseline sample of persons aged 75-84 years was identified. Out of the 133 participants at baseline (1994), the 31 participants still available 10 years later were included. The data were collected by means of interview and observation at home visits. Overall, the participants rated their subjective well-being as high and a stable prevalence of ill-health symptoms over time was reported. Changes in subjective well-being as related to changes in functional aspects seem to mainly occur earlier in the aging process, while as time goes by these relations weaken. ADL dependence, however, is more influential in more advanced age. The results confirm the complexity of the construct of health. A main contribution is that the results shed light on the importance of taking the impact of environmental factors into consideration.

Keywords: person-environment (P-E) fit (accessibility), environmental barriers and functional limitations, Housing Enabler, longitudinal study

1. Introduction

Health is a broad concept consistently attracting much interest, not least in aging research. Health in old age is an extensive and complex research field, including not only functional capacity in terms of functional limitations and ADL capacity but also morbidity, well-being, etc. Different aspects of health do not necessarily follow the same path along the process of aging (Parker and Thorslund, 2007) and much research remains to be done to fully understand how different aspects of health in old age are related, not least when it comes to environmental influences (Spillman, 2004). This longitudinal study focuses on subjective well-being as related to functional limitations, environmental barriers in the home and its close surroundings and ADL dependence.

Well-being is an aspect of health dealing with personal cognitive evaluations of one's life, and positive and negative feelings for one's life circumstances (Lawton 1991; Smith et al., 2002). It includes perceived ill-health as well as social, physical and mental aspects (Tibblin et al., 1990). Well-being has been proposed to be relatively stable throughout adulthood (e.g., Diener et al., 1999), but research results have also indicated that perceptions of physical and mental well-being are less positive with increasing age (Tibblin et al., 1990). Likewise, there is evidence that positive feelings, i.e. the positive side of well-being, decreases during old age (Smith el al., 2002), but still our knowledge on how well-being is affected by the process of aging is not sufficient. In particular, our knowledge on how perceptions of well-being change in very old age is limited.

An important and much studied part of the aging process is the decline in functional capacity. Functional capacity is in itself another broad concept, defined and operationalized in different ways across studies. One important facet successively increasing along the process of aging is the number of functional limitations (Smith et al., 2002; Iwarsson, 2005). Still another important facet is the capacity to perform ADL. Research has indicated that increased overall activity is related to greater happiness and that the degree of independence in ADL is fundamental for the level of activity (Menec, 2003). It is well known that the need for personal assistance increases along the aging process, starting with dependence in instrumental activities, successively followed by dependence in personal activities (Sonn, 1996).

Beyond personal (P) factors such as those just introduced, environmental (E) factors have an influence on well-being (Evans et al., 2002; Oswald et al., 2007). Focusing on the environmental arena at target for the current study, namely housing, it does not always have a positive influence on well-being; for some older people their housing situation can be experienced as worrisome, sad, or confining (Rubenstein et al., 2004). The relation between housing and health is closely linked to models of P-E fit (Kahana, 1982; Carp, 1987) and the ecological theory of aging (Lawton and Nahemow, 1973). According to the docility hypothesis (Lawton and Simon, 1968; Lawton and Nahemow, 1973), individuals with lower competence are more sensitive to the demands of the environment than those with higher competence. That is, particularly in very old age the relationship between housing and health is significant due to the increased vulnerability to environmental

challenges in very old age (Iwarsson, 2005; Fänge and Dahlin-Ivanoff, in press). Even though the environment as such might have an impact on well-being, recent research has demonstrated that it is rather the magnitude of P-E fit (operationalized as accessibility) problems than the number of environmental barriers that is associated with different aspects of health in old age (Oswald et al., 2007). Using the definition by Iwarsson and Ståhl (2003), accessibility problems represent the relationship between functional limitations and the prevalence of physical environmental barriers as assessed by professionals. Thus, accessibility is an objective aspect of P-E fit.

Few studies have as yet been published on subjective well-being as related to functional capacity and environmental barriers in the home and its close surroundings. For example, Kunzmann et al. (2000) analyzed cross-sectional and longitudinal data of well-being in people aged 70-103 years, and concluded that older people encountering functional limitations are at risk for experiencing decline in subjective well-being. However, their study did not include how this relationship was related to environmental aspects. Menec (2003) investigated successful aging and analyzed longitudinal data on people aged 67-95 years. Their level of activity was a predictor for ADL dependence and significantly related to happiness, but neither these result were related to environmental aspects. Iwarsson and Isacsson (1997) published results on interrelationships between subjective well being, ADL dependence and housing accessibility among older people, demonstrating that different aspects of physical well-being co-varied significantly with ADL dependence, but even more strongly with housing accessibility. To date, that study is one out of few studying subjective well-being as related to functional capacity and environmental aspects, while only cross-sectional. In order to increase our understanding of these dynamics, longitudinal studies are imperative. Thus, the main aim of the current study was to investigate subjective well-being and ill-health symptoms over a 10-year period among older Swedish adults. The aim was also to study how these self-perceived aspects of health correlated with objectively assessed functional limitations, use of mobility device, P–E fit (accessibility) problems in housing, and ADL dependence during the study period.

2. Methods

Based on the previous study just referred to (Iwarsson and Isacsson, 1997; Iwarsson, 1998; Iwarsson, 2005) a longitudinal design was used, where data were collected by means of interviews and observations at home visit during a period of 10 years; at baseline (1994), follow-up 1 (2000) and follow-up 2 (2004). The Ethics Committee at Lund University, Sweden approved the study.

2.1. Study sample

The study district was a rural municipality situated in the south of Sweden. At baseline, 49,458 inhabitants were registered as living in the municipality. Those aged 75–84 years were numbered 3,504 (i.e., 7% of the population). Using the Swedish national population register a random sample of individuals born between 1910 and 1919 was retrieved, resulting in 222 individuals. Out of these, 12 elders who were living in sheltered housing facilities or had moved to an address outside the study district were excluded, consequently leaving 210 possible participants. Four of these died before the study began and another eight had moved to sheltered housing or out of the district, resulting in 198 individuals (Figure 1). Among these, 133 (68%) agreed to participate.

Among those who did not agree to participate, 40 agreed to a telephone interview that covered basic descriptive data and questions on ADL dependence, utilizing part of the ADL instrument used to assess the study participants (see the subsequent description). The only significant difference (the Chi-square test or Fisher exact test) between the dropouts and the study participants was that the latter, to a higher extent, lived in privately owned houses, whereas more of the dropouts lived in rented or privately owned apartments (Iwarsson, 1998; Iwarsson et al., 1998).

At follow-up 1 (6 years later), 42 persons were deceased and 2 had moved out of the study district. Out of the 89 participants possible to reach, 72 (81%) agreed to participate. At follow-up 2 (ten years after baseline), a further 22 persons were deceased or had moved outside the study district, resulting in a remaining target sample of 50 individuals. However, nine individuals were not possible to reach, one person had deceased before data collection was finished and nine suffered from severe illness or did not want to participate. The current study is thus based on the 31 participants possible to follow at three points in time; at baseline, follow-up 1 as well as at follow-up 2 (Figure 1).

The median age of the study sample was 79 years at baseline and the sex distribution was 18 (58%) women and 13 (42%) men. Most of the participants lived in homes with high standard. As described in Table 1, one half (n=15) lived in one-family housing and the other half (n=16) in multi-dwelling houses at baseline. At follow-up 2, six participants had moved to sheltered housing, and another six had relocated to other housing. Two participants were dependent on mobility device at baseline and almost 50% (n=15) were dependent on walking aids at follow-up 2. At baseline, almost two thirds (n=19) of the participants had one or more functional limitations (range 1-3), also resulting in P–E fit (accessibility) problems (Table 1). At follow-up 2, this number had increased to all except three (n=28). At both baseline and follow up 1, 19 participants were dependent in one or more ADL tasks, while 24 were dependent in ADL tasks at follow-up 2. Data on functional limitations, accessibility problems and ADL dependence in the studied sample are extensively reported in Werngren-Elgström et al. (in press).

2.2. Data collection and instruments

Information letters were sent to intended participants, followed by telephone calls in order to get informed consent and to confirm an appointment at baseline, follow-up 1 and follow-up 2. Besides common descriptive data, information on subjective well-being and ill-health symptoms, functional limitations, dependence on mobility device, environmental barriers in housing and close surroundings, and dependence in personal and instrumental activities of daily living (P-ADL and I-ADL) was gathered by means of interviews, self-administered questionnaires and observation instruments (subsequently described). To ensure reliable administration, an experienced occupational therapist trained to administer the instruments collected data during 1-1 ½ hour home visits.

To assess subjective well-being the two-part "Göteborg Quality of Life (QoL) Instrument" (Tibblin et al., 1990) was utilized. Part one included 18 items covering subjective physical, mental and social well-being (the items are listed in Table 2). The participant rated each item on a seven step scale from ‘very bad’ (=1) to ‘excellent, could not be better’ (=7). Thus, the maximum score of the summed well-being scale was 126, indicating excellent overall subjective well-being. The internal consistency of the well-being scale was high; at baseline =0.91, at follow-up 1 =0.90 and at follow-up 2 =0.89. The second part of the instrument covered 30 different ill-health

symptoms (the items are listed in Table 3). The participant answered ‘yes’ or ‘no’ to questions asking if he/she had experienced any of the symptoms during the last 3 months (Tibblin et al., 1990), resulting in a variable labeled “number of symptoms”.

To assess P–E fit problems (accessibility) from a professional, objective perspective, the Housing Enabler instrument (Iwarsson and Slaug, 2001), administered in three steps, was utilized. The first step (personal component) is an assessment of functional limitations (13 items) and dependence on mobility device (2 items). The majority of the functional limitation items concern physical capacity, but also cognition and perception. In the second step (environmental component), environmental barriers are observed (188 items) and assessed as present or absent. The housing environment is divided into four areas; outdoor environment (33 items), entrance (49 items), indoor environment (100 items), and communication features (6 items).

The third step is the calculation of the P–E fit (accessibility problem) score. For each environmental barrier item, the instrument comprises predefined severity ratings (Steinfeld et al., 1979), operationalized as points quantifying the severity of the problems to arise in each case. The scale is scored from 1 (potential accessibility problem) to 4 (very severe accessibility problem or impossibility). The profile of functional limitations identified in each person is juxtaposed with the environmental barriers found present in the housing environment. This analysis is run item by item, and each P–E fit incongruence is quantified by means of the scale. The sum of all the predefined points yields a score predicting the P-E fit (accessibility) problems anticipated. Thus, the magnitude of problems caused by a particular combination of functional limitations and environmental barriers can be calculated; higher scores mean more problems.

Content validity and inter-rater reliability have been established for the personal ($k = 0.87$) as well as for the environmental component ($k = 0.68$) (Iwarsson and Isacsson, 1996). Based on accumulated empirical results, the instrument has been subsequently revised for improved validity and reliability (Iwarsson and Slaug, 2001).

The ADL Staircase (Sonn and Hulter-Åsberg, 1991), revised version (Iwarsson and Isacsson, 1997; Iwarsson, 1998), was administered for assessment of ADL dependence (personal assistance). It comprises five P-ADL items and four I-ADL items. The professional, objective assessment was administered by means of a combination of interview and observation (Sonn and Hulter-Åsberg, 1991), and the

results were scored on a three-graded scale: dependent, partly dependent and independent. In line with earlier studies, Iwarsson and Isacsson 1996, 1997), the ADL Staircase data collected for the current study fulfilled validity and reliability requirements.

2.3. Data analyses

Previous to analyzing the subjective well-being scale and due to a small number of missing data, median value imputation was implemented. Differences over time were computed between baseline and follow-up 1 and between follow-up 1 and 2. Changes over time in subjective well-being were analyzed by means of the Wilcoxon signed rank sum test and changes in number of ill-health symptoms by means of the McNemar's test. For ADL dependence, ADL ranks that respect ordinal scale properties were computed (Iwarsson et al., 1998; Iwarsson and Lanke, 2004). Magnitudes of P–E fit problems were calculated by means of the Housing Enabler software (Slaug and Iwarsson, 2001).

Relationships between subjective well-being and ill-health symptoms on the one hand and dependence on mobility device, number of functional limitations, P–E fit (accessibility) scores and ADL dependence on the other, were calculated by means of the Spearman's rank correlation test. When it comes to the effect sizes of correlation coefficients, the interpretation followed the proposal of Cohen (1992), recommending that a value of $r < 0.2$ is considered as a "small effect", 0.5 or higher as a "medium effect", and 0.8 or higher as a "large effect". Corrections to counter the risk of mass-significance were made according to Bonferroni (1936). Results with $p < 0.05$ were considered statistically significant. In order to illustrate the longitudinal results of the correlation analyses, graphics are presented.

3. Results

Overall, the participants rated their subjective well-being as high, with little variation in the sample (Table 2). The participants were most satisfied with social aspects of subjective well-being, especially with housing where the median score was the highest possible (7) at all three points in time. While rather highly rated, physical well-being was the area they were the least satisfied with. Hearing, vision and memory were the aspects demonstrating the lowest median score (5) at all three

occasions. No significant changes over time were found neither for subjective well-being in total nor on item level.

The most frequently reported ill-health symptoms at all three points in time were eye problems, impaired hearing and pain in back and legs (Table 3). No significant changes in symptom prevalence were found neither between baseline and follow-up 1, nor between follow-ups 1 and 2. The median number of ill-health symptoms at baseline was 6 (range 0-12) and did not change over time (median at follow-up 2 = 7, range 1-17).

As revealed by Table 4, correlation between subjective well-being and dependence on mobility device, number of functional limitations, P–E fit (accessibility) score and ADL dependence were mainly negative (higher subjective well-being = higher negative scores), while correlation's between ill-health symptoms and these functional aspects were generally positive (more ill-health symptoms = higher positive scores). No significant correlation were found at baseline between subjective well-being, neither totally nor on the sub-scale level, and dependence on mobility device, number of functional limitations, P–E fit (accessibility) score and ADL dependence. However, significant relationships were generally found at follow-up 1 and 2, except in mental well-being, which was significantly correlated only to ADL dependence at follow-up 2, but with a substantial, medium effect (r_s = -0.719, $p < 0.001$). At follow-up 1, total subjective well-being was medium-sized correlated with the number of functional limitations (r_s = -0.644, $p < 0.001$) and P–E fit (accessibility) score (r_s = -0.598, $p < 0.001$), and at follow-up 2 with ADL dependence (r_s = -0.686, $p < 0.001$). As concerns relationships between the sub-scale scores of subjective well-being and the variables of interest, medium-sized correlation existed between physical well-being and the number of functional limitations (r_s = -0.682, $p < 0.001$) and P–E fit (accessibility) score (r_s = -0.671, $p < 0.001$) at follow-up 1. Social well-being related significantly to all the variables at both follow-up 1 and 2, with the strongest effect sizes for ADL dependence (r_s = -0.629, $p < 0.001$) at follow-up 2 and the number of functional limitations (r_s = -0.590, $p < 0.001$) at follow-up 1.

Number of ill-health symptoms was significantly correlated with the number of functional limitations (r_s = 0.522, $p < 0.05$) and the P–E fit (accessibility) score (r_s = 0.522, $p < 0.05$) at baseline, both correlation with a medium effect size. Another medium-sized and significant relationship was found with the number of functional limitations (r_s = 0.561, $p < 0.01$) at follow-up 1 (Table 4).

Turning to an overview of changes over the 10-year study period, correlation was generally stronger at follow-up 1 than at baseline, as demonstrated in Figure 2. The only exception is the relationship between number of ill-health symptoms and the P-E fit (accessibility) score. Correlation between physical and social well-being and number of functional limitations and the P–E fit (accessibility) score were stronger at follow-up 1 than at follow-up 2, while the reverse situation was, with one exception, found between physical and social well-being and dependence on mobility device and ADL dependence at these two occasions. The exception was the correlation between physical well-being and dependence on mobility device, which decreased from being strongly significant at follow-up 1 to becoming non-significant at follow-up 2. Mental well-being demonstrated stronger correlation at follow-up 2 than at follow-up 1, except for with number of functional limitations. As for ill-health symptoms, correlation were weaker at follow-up 2 than at follow-up 1, except for the correlation with dependence on mobility device where the situation was the opposite (Figure 2).

4. Discussion

Overall, the results of this study demonstrate that subjective well-being and prevalence of ill-health symptoms are stable over long periods of time among older Swedish adults, at least among that staying put in ordinary housing. Also, it should be noted that the sample studied reported remarkably high levels of subjective well-being, in all three dimensions rated. Utilizing the 10-year follow-up period, we demonstrated a pattern of correlation between subjective well-being and ill-health symptoms and professionally, objectively assessed functional limitations, use of mobility device, P–E fit (accessibility) problems in housing, and ADL dependence. Synthesizing this part of the results, the overall picture (Figure 2) of long-term changes of correlation between subjective well-being and the different variables under study shows that most changes occur during the first part of the 10-year period, while at the latter part correlation become weaker. Further, functional limitations and P-E fit (accessibility) problems seem to impact on physical and social well-being at an earlier stage of the process of aging, while dependence on mobility devices and ADL dependence are more influential further on. It is noteworthy that only at very high age, ADL dependence seems to have a negative relationship to mental well-being.

Studying the results displayed in Table 4 and Figure 2 in some detail, it is obvious that different aspects of health in old age - perceived or professionally, objectively assessed - develop and correlate in a complex pattern over time. Emphasized by recent studies elucidating health and disability trajectories along the process of aging, several authors have concluded that the concept of health in old age needs explicit definition and differentiation (Spillman, 2004; Ahacic et al., 2007). In both studies referred to, the authors conclude that there might be environmental factors playing significant roles, while not sufficiently studied. The current study is a contribution to the knowledge generation urged for.

Thus, since in the current study we collected very detailed data on the housing environment and P-E fit (accessibility) problems, at this point of discussion we turn to the housing situation. In the domain of social well-being all participants assigned to their housing situation high scores. Based on substantial previous research, it is well known that older people tend to do so (Golant, 2003; Oswald et al., 2006), even if from an objective point of view aspects such as housing standard and accessibility indicate that there might be problems (Iwarsson and Isacsson, 1996). Already at baseline, in nearly two thirds of our sample there were housing accessibility problems (Table 1), and according to a parallel study on the same sample (Werngren-Elgström et al., in press), significant increases in P–E fit (accessibility) problems occurred between baseline and follow-up 1 as well as between follow-up 1 and follow-up 2. Still, there were no significant changes in subjective well-being over time, while the data distributions resulted in significant, medium-effect relationships between P-E fit (accessibility) problems and physical as well as social well-being at follow-up 1. As demonstrated in another, larger sample of very old, Swedish people living in ordinary housing (Iwarsson et al., 2007), it seems as if objective aspects of housing have a more pronounced impact on perceived aspects of health at earlier stages of functional capacity decline, while with increasing ADL dependence, more subjective aspects of housing play a role. This kind of results is important for practical interventions in the homes of older people, e.g. when it comes to deciding on at what stage of the aging process to implement environmental adaptations such as home modifications.

It should be kept in mind that the study sample represented the naturally selected sub-group of older people managing to stay in ordinary housing until advanced age, capable and willing to participate in interviews and observations at

home visits. An obvious limitation of this study is the limited sample size, restricting the validity of far-reaching conclusions and generalization. Overall, the finding that subjective well-being was high and with no changes over a decade was surprising, while the influence of selection bias has to be kept in mind. Obviously, the study sample remained highly functioning as they aged; ADL dependence did not change much over time either (Table 1). As reported in our parallel study investigating changes in ADL dependence in depth (Werngren-Elgström et al., in press), only in two activities (cooking and shopping) the change towards more dependence was statistically significant over the 10-year study period. A plausible explanation is of course that the frailest persons died or became too ill or frail to consent to further participation in our study. Turning back to the issue of selection bias, the 31 persons followed over time represent the more high-functioning segment of the aging population. Moreover, the small sample size and the type of data collected restricted the choice of statistical analyze methods to descriptive statistics and non-parametric correlation. Still, the study is valuable as it covers a long study period and is based on detailed and valid data on aging persons and their home environments. According to a recent, comprehensive literature review on studies on home and health in old age, the longest follow-up period found among approximately 500 original articles considered was six years (Wahl et al., 2008). Thus, the current study is quite unique.

5. Conclusions

The results of this study shed light on the trajectory of health along the process of aging and confirm that health is a complex construct composed by a range of different aspects. Changes in subjective well-being as related to changes in functional aspects seem to mainly occur earlier in the aging process, while as time goes by these relations weaken. The results also suggest that the onset of functional limitations and the P-E fit (accessibility) problems arising as a result of this decline in functional capacity are related to on physical and social well-being at an earlier stage of the aging process than ADL dependence is. In order to come up with interventions with potential to have a positive influence on well-being in old and very old age, professionals should be aware of these dynamics and design their intervention programs accordingly.

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References

Ahacic, K., Parker, M.G., Thorslund M., 2007. Aging in disguise: age, period and cohort effects in mobility and edentulousness over three decades. Eur. J. Aging 4, 83-91.

Bonferroni, C.E., 1936. Teoria statistica delle classi e calcolo delle probabilitá. Pubblicazioni dell' Istituto Superiore di Scienze Economiche e Commercialo di Firenze 8, 3-62 (in Italian).

Carp, F.M., 1987. Environment and aging, in: Stokols, D., Altman, I. (Eds.). Handbook of Environmental Psychology, Wiley, New York, pp. 330-360.

Cohen, J., 1992. A power prime. Psychol. Bull. 112, 155-159.

Diener, E., Suh, E.M., Lucas, R.E., Smith, H.L., 1999. Subjective wellbeing: Three decades of progress, Psychol. Bull. 125, 276-302.

Evans, G.W., Kantrowitz, E., Eshelmann, P., 2002. Housing quality and psychological well-being among the elderly population. J. Gerontol. B. Psychol. Sci. Soc. Sci, 57B, P381-P383.

Fänge, A., Dahlin-Ivanoff, S., in press. The home is the hub of health in very old age: Findings from the ENABLE-AGE project. Arch. Gerontol. Geriatr, doi: 10.1016/j.archger.2008.02.015.

Golant, S., 2003. Conceptualizing time and behavior in environmental gerontology: A pair of old issues deserving new thought. Gerontologist 43, 638-648.

Iwarsson, S., 1998. Environmental influences on the cumulative structure of instrumental ADL: An example in osteoporosis patients in a Swedish rural district. Clin. Rehabil. 12, 221-227.

Iwarsson, S., 2005. A long–term perspective on person-environment fit and ADL dependence among older Swedish adults. Gerontologist 45, 327-336.

Iwarsson, S., Isacsson, Å., 1996. Development of a novel instrument for occupational therapy assessment of the physical environment in the home. A methodological study on “The Enabler”. Occup. Ther. J. Res. 16, 227-244.

Iwarsson, S., Isacsson, Å., 1997. On Scaling methodology and environmental influence in disability assessments: The cumulative structure of personal and instrumental ADL among older adults in a Swedish rural district. Can. J. Occup. Ther. 4, 240-251.

Iwarsson, S., Lanke, L., 2004. Alternative data treatment principals for categorical ADL data. Int. J. Rehabil. Res. 27, 195-201.

Iwarsson, S., Slaug, B., 2001. The Housing Enabler. An instrument for assessing and analyzing accessibility problems in housing, Veten and Skapen HB and Slaug Data Management, Nävlinge and Staffanstorp, Sweden.

Iwarsson, S., Ståhl, A., 2003. Accessibility, usability, and universal design – Positioning and definition of concepts describing person-environment relationships. Disabil. Rehabil. 25, 57-66.

Iwarsson, S., Isacsson, Å., Lanke, L., 1998. ADL dependence in the elderly: The influence of functional and physical environmental demand. Occup. Ther. Int. 5, 173-193.

Iwarsson, S., Horstmann, V., Slaug, B., 2007. Housing matters in very old age – yet differently due to ADL dependence level differences. Scand. J. Occup. Ther. 14, 3-15.

Kahana, E., 1982. A congruence model of Person-Environment interaction. In: Lawton, M.P., Windley, P.G., Byerts, T.O. (Eds.). Aging and the Environment, Theoretical Approaches. Springer, New York, pp. 97-121.

Kunzmann, U., Little, T.D., Smith, J., 2000. Is age-related stability of subjective well-being a paradox? Cross-sectional and longitudinal evidence from the Berlin Aging Study. Psychol. Aging 15, 511-526.

Lawton, M.P., 1991. A multidimensional view of quality of life in frail elders, in: Birren, J.E., Lubben, J.E., Rowe, J.C., Deutchman, D.E. (Eds). The Concept and

Measurement of Quality of Life in the Frail Elderly, Academic Press, Inc, San Diego, pp.: 4-23.

Lawton, M.P., Nahemow, L., 1973. Ecology and the aging process, in: Eisdorfer, C., Lawton, M.P. (Eds.). The Psychology of Adult Development and Aging, American Psychological Association, Washington, DC. pp.: 619-674.

Lawton, M.P., Simon, B., 1968. The ecology of social relationships in housing for the elderly. Gerontologist 8, 108-115.

Menec, V.H., 2003. The relation between everyday activities and successful aging: A 6-year longitudinal study. J. Gerontol. B, Psychol. Sci. Soc. Sci. 58B, S74-S82.

Oswald, F., Schilling, O., Wahl, H.W., Fänge, A., Sixsmith, J., Iwarsson, S., 2006. Homeward bound: Introducing a four-domain model of perceived housing in very old age. J. Environ. Psychol. 26, 187-201.

Oswald, F., Wahl, H.W., Schilling, O., Nygren, C., Fänge, A., Sixsmith, A., Sixsmith, J., Széman, Z., Tomsone, S., Iwarsson, S., 2007. Relationships between housing and healthy aging aspects in very old age: Results from the European ENABLE-AGE Project. Gerontologist 47, 96-107.

Parker, M.G., Thorslund, M., 2007. Health trends in the elderly population: Getting better and getting worse. Gerontologist 47, 150-158.

Slaug and Iwarsson, 2001. Housing Enabler 1.0 – A Tool for Housing Accessibility Analysis. Software for PCs. Staffanstorp & Nävlinge: Slaug Data Management AB & Veten & Skapen HB.

Smith, J., Borchelt, M., Maier, H., Jopp, D., 2002. Health and well-being in the young old and oldest old. J. Soc. Issues 58, 715-732.

Sonn, U., 1996. Longitudinal studies of dependence in daily life activities among elderly persons. Scand. J. Rehabil. Med. Suppl. 34, 1-35.

Sonn, U., Hulter-Åsberg, K., 1991. Assessment of activities of daily living in the elderly. Scand. J. Rehabil. Med. 23, 193-202.

Spillman, B.C., 2004. Changes in elderly disability rates and the implications for health care utilization and cost. Milbank Q. 82, 157-194.

Steinfeld, E., Schroeder, S., Duncan, J., Faste, R., Chollet, D., Bishop, M., Wirth, P, Cardell, P. 1979. Access to the Built Environments: A review of the Literature, Government Printing Office, Washington DC.

Tibblin, G., Tibblin, B., Pecciva, S., Kullman, S., Svärdsudd, K., 1990. 'The Göteborg, Quality of Life Instrument' - an assessment of well-being and symptoms among men born 1913 and 1923. Scand. J. Prim. Health Care 1, 33-28.

Wahl, H-W., Oswald, F., Fänge, A., Gitlin, L., Iwarsson, S., in press. The home environment and disability-related outcomes in aging individuals: What is the empirical evidence? Gerontologist.

Werngren-Elgström, M., Carlsson, G., Iwarsson, S., 2008. Changes in person-environmental fit and ADL dependence among older Swedish adults: A 10-year follow-up. Aging Clin. Exp. Res.

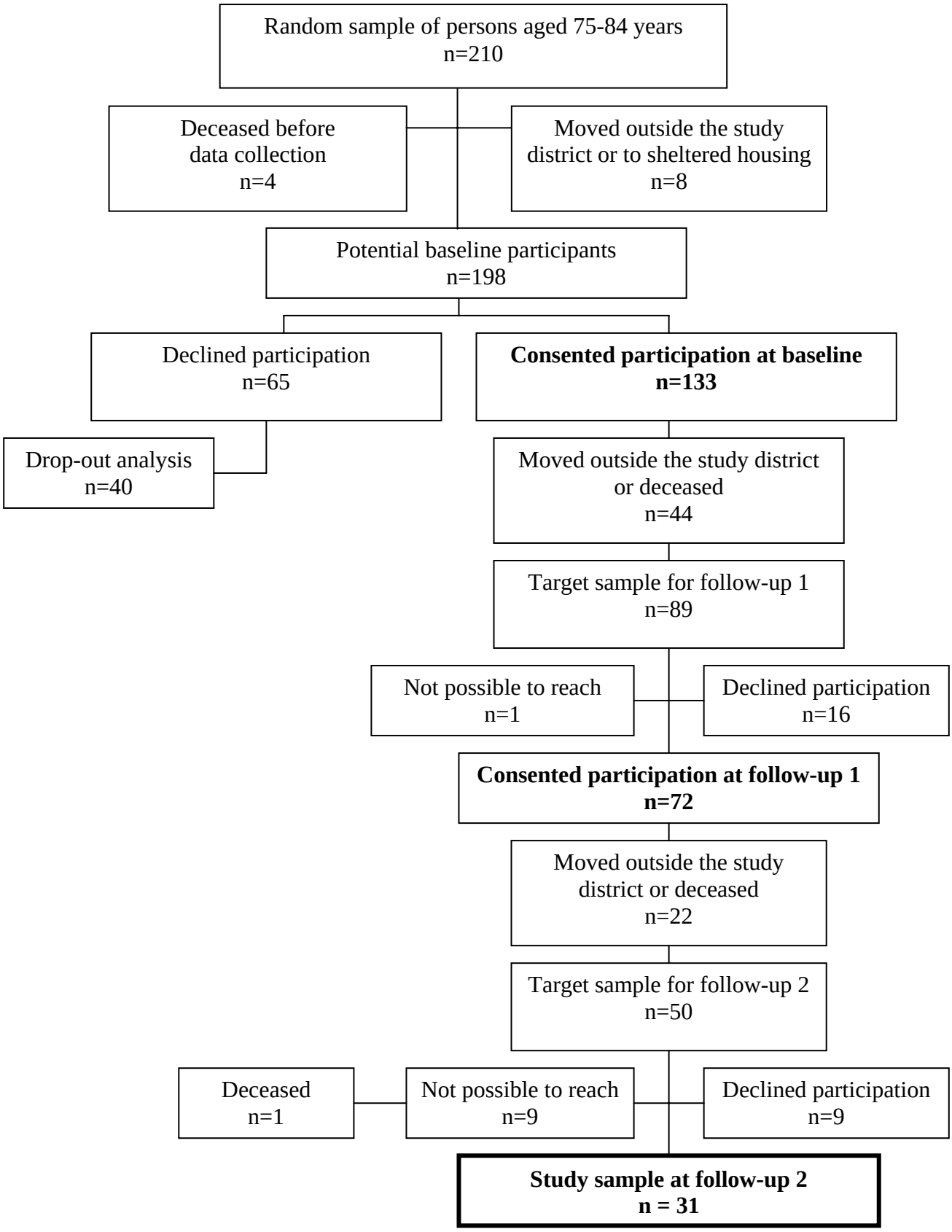
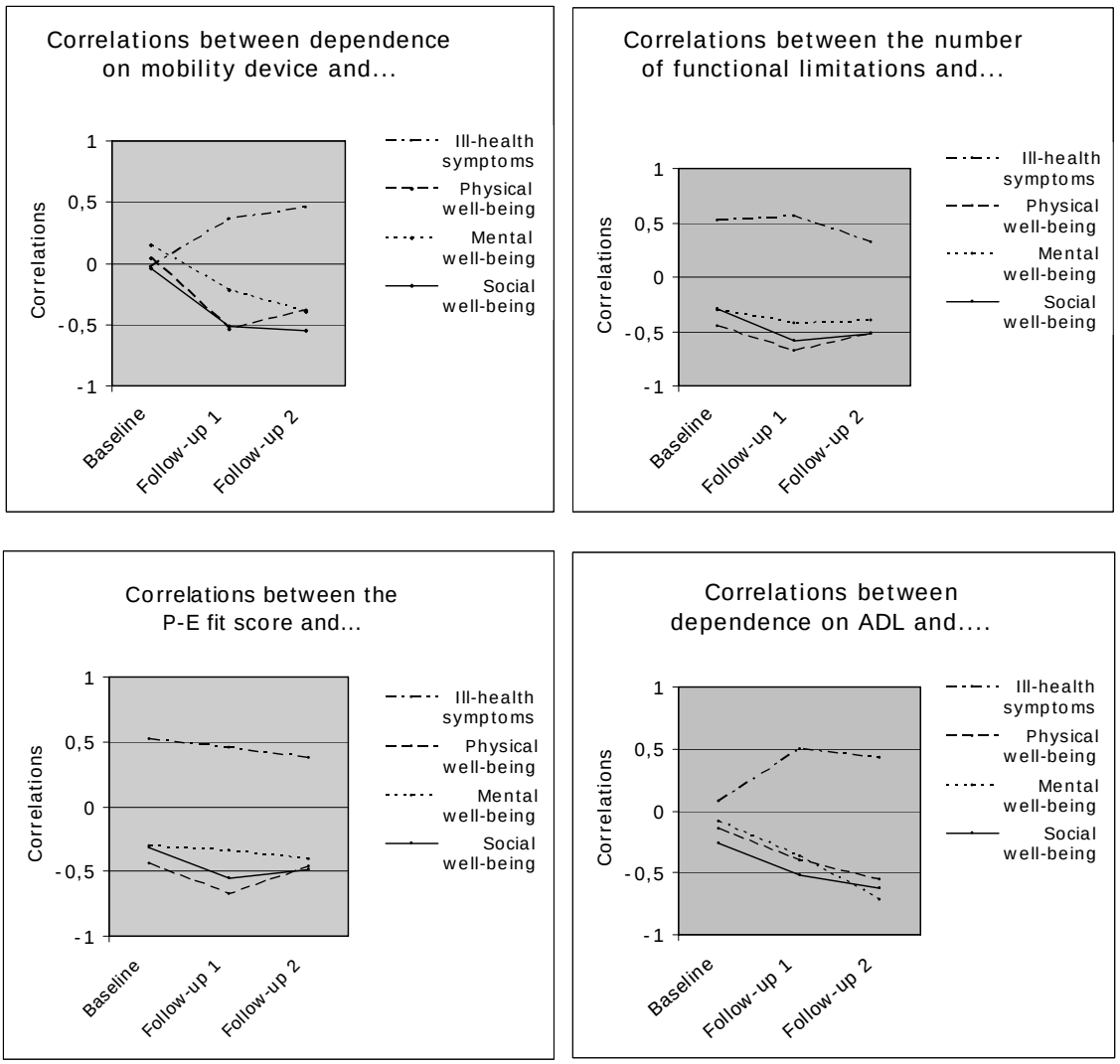


Figure 1. Sampling overview (n = 31).



Note: Scale direction differences result in positive or negative correlation coefficients (more ill-health symptoms = higher positive scores; higher subjective well being = higher negative scores).

Figure 2. Graphical display based on Spearman rank correlation between dependence on mobility device, number of functional limitations, P-E fit[b] score and ADL-dependence, number of ill health symptoms, sub-scores of physical, mental and subjective well being at baseline follow-up 1 and 2 (n = 31).

Table 1.

Characteristics of the study sample and occurrence of dependence on mobility device[a], functional limitations[a], P-E fit problems[a] and ADL-dependence[b] at baseline, follow-up 1, and follow-up 2 (n = 31)

Characteristic/variable	Baseline n	Follow-up 1 n	Follow-up2 n
Living alone	16	22	23
Housing conditions			
Sheltered living	0	1	6
Ordinary housing	31	30	25
One-family housing	15	15	12
Multi-dwelling house	16	15	13
Dependence on mobility device	2	11	15
Functional limitations (range)	19 (1-3)	27 (1-6)	28 (1-9)
Overall P-E fit problems	19	27	28
Overall ADL-dependence	19	19	24

[a]The Housing Enabler (Iwarsson and Slaug, 2001).
[b]The ADL staircase (Sonn and Hulter-Åsberg, 1991; Iwarsson, 1998).

Table 2.

Median scores and quartiles of total subjective well being[a] as well as separate items; at baseline, follow-up 1[b] and follow-up 2[c] (n = 31), median and (range)

Subjective well being[a]	Baseline	Follow-up 1	Follow-up 2
Total scores	107 (94-116)	103 (92-115)	101 (89-112)
Physical well being			
Health	6 (5–7)	6 (5–6)	5 (4–5)
Fitness	5 (5–6)	6 (4–7)	5 (4–6)
Hearing	5 (4–7)	5 (3–6)	5 (3–6)
Vision	5 (4–6)	5 (3–6)	5 (3–6)
Memory	5 (5–6)	5 (5–6)	5 (5–6)
Appetite	7 (6–7)	7 (6–7)	6 (5–7)
Mental well being			
Mood	6 (5–7)	6 (5–7)	6 (5–7)
Energy	6 (5–7)	6 (5–7)	6 (4–6)
Endurance	6 (5–6)	6 (5–7)	6 (5–6)
Self-esteem	6 (5–7)	6 (5–7)	6 (5–6)
Sleeping	6 (5–7)	6 (5–7)	6 (5–7)
Social well being			
Work	6 (6–7)	6 (5–7)	7 (5–7)
Family	7 (6–7)	6 (6–7)	7 (6–7)
Economy	6 (6–7)	6 (5–7)	6 (5–7)
Housing	7 (6–7)	7 (6–7)	7 (6–7)
Leisure[d]	6 (5–7)	6 (5–7)	7 (5–7)
Sense of significance and appreciation at home[d]	7 (6–7)	6 (6–7)	6 (6–7)
Sense of significance and appreciation, outside home[d]	6 (5–7)	6 (6–7)	6 (5–7)

[a]The Göteborg QoL Instrument (Tibblin et al., 1990), with three items[d] from a later version added to the well-being scale.
[b]No significant differences between baseline and follow-up 1.
[c]No significant differences between follow-up 1 and follow-up 2.

Table 3.
Occurrence (n) of ill-health symptoms[a] at baseline, follow-up 1[b] and 2[c] (n = 31)

Ill-health symptoms	Baseline	Follow-up 1	Follow-up 2
Head symptoms			
Dizziness	5	12	15
Eye-problems	15	17	17
Headache	5	3	1
Impaired hearing	14	18	20
Depression symptoms			
Exhaustion	2	2	2
Sleeping disturbance	5	8	8
General fatigue	8	11	8
Depression	6	8	10
Cries easily	12	10	6
Tension symptoms			
Irritability	5	2	1
Nervousness	4	7	9
Impaired concentration	3	2	4
Difficulty to relax	5	5	7
Restlessness	4	8	8
Gastrointestinal-urinary tract symptoms			
Abdominal pain	5	5	5
Constipation	3	5	7
Diarrhoea	2	3	3
Nausea	3	3	1
Anorexia	0	4	4
Difficulty in passing urine	1	4	6
Musculo-skeletal symptoms			
Pain in the legs	15	13	15
Back pain	11	14	12
Pain in the joints	7	12	13
Metabolism symptoms			
Overweight	8	2	5
Loss of weight	3	1	4
Sweating	3	2	1
Feeling cold	2	8	6
Heart-lung symptoms			
Coughing	7	8	7
Chest pain	2	7	6
Breathlessness	8	8	12
Sum of ill-health symptoms median (range)	6 (0-12)	7 (0-16)	7 (1-17)

[a]The Göteborg QoL Instrument (Tibblin et al., 1990).
[b]No significant differences between baseline and follow-up 1.
[c]No significant differences between follow-up 1 and follow-up 2.

Table 4.
Spearman rank correlation (r_s) between dependence on mobility device[a], number of functional limitations[a], P-E fit score[a] and ADL- dependence[b] the number of ill health symptoms[c], total and sub-scale scores of subjective well-being[c] at baseline, follow-up 1 and 2.

	Baseline	Follow-up 1	Follow-up 2
r_s between	dependence on mobility device and…		
No. of ill-health symptoms	-0.030	0.356	0.454*
Total subjective well being	0.037	-0.453	-0.473*
Physical well being	0.044	-0.540**	-0.380
Mental well-being	0.148	-0.220	-0.398
Social well-being	-0.037	-0.515*	-0.546**
r_s between	no of functional limitations and…		
No. of ill-health symptoms	0.522*	0.561**	0.323
Total subjective well being	-0.403	-0.644***	-0.513*
Physical well being	-0.452	-0.682***	-0.522*
Mental well-being	-0.305	-0.429	-0.394
Social well-being	-0.292	-0.590***	-0.516*
r_s between	P-E fit score and…		
No. of ill-health symptoms	0.522*	0.451	0.370
Total subjective well being	-0.396	-0.598***	-0.492*
Physical well being	-0.440	-0.671***	-0.460*
Mental well-being	-0.305	-0.338	-0.409
Social well-being	-0.320	-0.558**	-0.491*
r_s between	ADL dependence and…		
No. of ill-health symptoms	0.071	0.499*	0.428
Total subjective well being	-0.212	-0.495*	-0.686***
Physical well being	-0.141	-0.408	-0.555**
Mental well-being	-0.089	-0.367	-0.719***
Social well-being	-0.258	-0.518*	-0.629***

Note: Scale direction differences result in positive or negative correlation coefficients (more ill health symptoms = higher positive scores; higher subjective well being = higher negative scores).
[a]The Housing Enabler (Iwarsson and Slaug, 2001);
[b]The ADL staircase (Sonn and Hulter-Åsberg, 1991, Iwarsson, 1998);
[c] The Göteborg QoL Instrument (Tibblin et al., 1990) , with three items from a later version added to the well-being scale. *$p < 0.05$; **$p < 0.01$; *** $p < 0.001$ (corrected according to Bonferroni, 1936).