

LONGITUDINAL ANALYSIS OF OUTPATIENT PHYSICIAN VISITS IN THE OLDEST OLD: RESULTS OF THE AGEQUALIDE PROSPECTIVE COHORT STUDY

A. HAJEK¹, C. BRETTSCHEIDER¹, H. VAN DEN BUSSCHE², H. KADUSZKIEWICZ³, A. OEY⁴,
B. WIESE⁴, S. WEYERER⁵, J. WERLE⁵, A. FUCHS⁶, M. PENTZEK⁶, J. STEIN⁷, T. LUCK⁷, H. BICKEL⁸,
E. MÖSCH⁸, K. HESER⁹, M. BLECKWENN¹⁰, M. SCHERER², S.G. RIEDEL-HELLER⁷, W. MAIER^{9,11,*},
H.-H. KÖNIG^{1,*} FOR THE AGECODE & AGEQUALIDE STUDY GROUPS

1. Department of Health Economics and Health Services Research, Hamburg Center for Health Economics, University Medical Center Hamburg-Eppendorf, Germany; 2. Department of Primary Medical Care, Center for Psychosocial Medicine, University Medical Center, Hamburg-Eppendorf, Germany; 3. Institute of General Practice, Medical Faculty, Kiel University, Germany; 4. Institute of General Practice, Hannover Medical School, Germany; 5. Central Institute of Mental Health, Medical Faculty Mannheim/Heidelberg University, Mannheim, Germany; 6. Institute of General Practice, Medical Faculty, Heinrich-Heine-University Düsseldorf, Germany; 7. Institute of Social Medicine, Occupational Health and Public Health, University of Leipzig, Germany; 8. Department of Psychiatry, Technical University of Munich, Germany; 9. Department of Psychiatry, University of Bonn, Germany; 10. Institute of General Practice and Family Medicine, Medical Faculty at the University of Bonn, Germany; 11. German Center for Neurodegenerative Diseases (DZNE), Bonn, Germany. * Equal contributors. Corresponding author: Dr. André Hajek, University Medical Center, Hamburg-Eppendorf, Department of Health Economics and Health Services Research, Hamburg Center for Health Economics, Telephone +49 40 7410 52877; Fax +49 40 7410 40261, E-Mail: a.hajek@uke.de

Abstract: *Objectives:* The aim of this study was to identify determinants of outpatient health care utilization among the oldest old in Germany longitudinally. *Design:* Multicenter prospective cohort “Study on Needs, health service use, costs and health-related quality of life in a large sample of oldest-old primary care patients (85+)” (AgeQualiDe). *Setting:* Individuals in very old age were recruited via GP offices at six study centers in Germany. The course of outpatient health care was observed over 10 months (two waves). *Participants:* Primary care patients aged 85 years and over (at baseline: n=861, with mean age of 89.0 years±2.9 years; 85–100 years). *Measurements:* Self-reported numbers of outpatient visits to general practitioners (GP) and specialists in the past three months were used as dependent variables. Widely used scales were used to quantify explanatory variables (e.g., Geriatric Depression Scale, Instrumental Activities of Daily Living Scale, or Global Deterioration Scale). *Results:* Fixed effects regressions showed that increases in GP visits were associated with increases in cognitive impairment, whereas they were not associated with changes in marital status, functional decline, increasing number of chronic conditions, increasing age, and changes in social network. Increases in specialist visits were not associated with changes in the explanatory variables. *Conclusion:* Our findings underline the importance of cognitive impairment for GP visits. Creating strategies to postpone cognitive decline might be beneficial for the health care system.

Key words: Health care utilization, outpatient, Andersen’s behavioral model, longitudinal study, oldest old.

Introduction

It is projected that the number of individuals in old age will rise markedly in the upcoming decades in Germany. Particularly, it is expected that the number of individuals in oldest age will triple in size over the next 50 years. Typically, individuals aged 85 years and over are classified as “oldest old” (1–5). These individuals are generally characterized by, for example, high levels of morbidity or markedly increased health care use (6), particularly outpatient physician visits (7). Thus, they cause high economic costs (8). Consequently, the knowledge about factors leading to increased outpatient physician visits among the oldest old might be helpful to develop interventional strategies and consequently might be beneficial for the health care system.

Most population-based studies focusing on outpatient health care use were limited to cross-sectional samples of older adults (9–11) or were restricted to certain parts of the country (12, 13) and thus were not nationally representative. Population-based longitudinal studies investigating the determinants of outpatient health care use were also mainly restricted to older

adults (14) and therefore did not focus on the oldest old (15). Hence, based on a multicenter prospective cohort study in oldest age, the aim of the present study was to examine the determinants of outpatient physician visits among the oldest old in Germany longitudinally. In accordance with the findings of another study (16) using panel regression methods (which focused on determinants of health care use among older adults), we hypothesize that particularly an increase in need factors (functional impairment, cognitive decline, more depressive symptoms, and an increase in morbidity) is associated with more GP and specialist visits.

Longitudinal studies are important to reveal insights into the relations between the variables over time. Furthermore, longitudinal data are important to control for time-constant unobserved factors (e.g., genetic disposition). Thereby the problem of unobserved heterogeneity is mitigated (17). Therefore, we used panel regression models in the present study.

In this respect, it is important to know main characteristics of the German health care system. Health insurance is compulsory in Germany. While about 90% of the German population

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are insured by social statutory health insurance (SHI) funds, about 10% are covered by private health insurances (PHI). Particularly, employees above a certain income-threshold, self-employed individuals as well as civil servants can opt for PHI. In Germany, both types of health insurance cover most expenses of outpatient treatment. All insurees have access to comprehensive health care and can use outpatient specialist physician services without referral from GPs. Commonly, the waiting time for appointments with outpatient physicians is short (18). Further details concerning the health care system of Germany are delivered elsewhere (19).

Methods

Sample

Data were gathered from the “Study on Needs, health service use, costs and health-related quality of life in a large sample of oldest-old primary care patients (85+)” (AgeQualiDe). AgeQualiDe is the continuation (follow-up 7 – follow-up 8) and extension of the German Study on Ageing, Cognition and Dementia in Primary Care Patients (AgeCoDe), taking place in six study centres (Hamburg, Bonn, Düsseldorf, Leipzig, Mannheim and Munich), including primary care patients ≥ 85 years at follow-up 7. Trained staff interviewed individuals and their proxies.

The present study used data from follow-up 7 and follow-up 8 (10 months later) for reasons of data availability. Initially, participants of the AgeCoDe-study were recruited via general practitioners’ (GP) offices. At baseline, inclusion criteria of the AgeCoDe study were: (1) aged 75 years and over, (2) free of dementia and (3) at least one contact with the GP during the last 12 months. Exclusion criteria were as follows: insufficient German language skills, GP consultation by home visits only, residence in a nursing home, severe illness the GP would deem fatal within 3 months, blindness, deafness, lack of ability to provide informed consent and being an irregular patient of the participating practice. Details regarding the sample composition have been given elsewhere (20). In total, $n=861$ individuals participated in the follow-up wave 7. Main reasons for drop out were death and refusal.

Individuals gave written informed consent prior to participation.

Dependent variables

Individuals were asked about the number of outpatient physician services in the past three months:

1. Number of visits to GP
2. Number of visits to specialists, including: cardiologist, neurologist, psychiatrist, orthopedist, otolaryngologist, dermatologist, ophthalmologist, gynecologist, urologist, surgeon, radiologist, psychologist/psychotherapist, dentist, emergency outpatient service or public insurance/private emergency service, pain therapist, emergency doctor, and telephone contact with physicians/psychologists.

Individuals reported the frequency of visits to GPs and specialists (measured continuously).

Independent variables

A widely used (21) theoretical framework for examining determinants of health care use is the behavioral model developed by Andersen and Newman (22). This model mainly covers three categories of determinants of health care use: (i) predisposing, (ii) enabling, and (iii) need factors. Predisposing factors are, e.g., sex or age. Enabling resources reflect organizational and financial factors that enable individuals to use health care services. They can be considered as a prerequisite of the use of healthcare services. Need factors reflect evaluated or perceived need for care (e.g., GP diagnosed chronic conditions or cognitive impairment). Based on Andersen’s theoretical framework (22), explanatory variables were selected.

Concerning predisposing factors, age, gender, marital status (“married” as reference category and “others” (“single”, “widowed” and “divorced”)) were used. The Comparative Analysis of Social Mobility in Industrial Nations (CASMIN) (23) classification was used to quantify the level of education (with low, middle and high education). It is worth mentioning that sex and education were only used for sample descriptions (and as moderating variables in additional analyses).

As for enabling factors, the 6-item version of the Lubben Social Network Scale (LSNS) (24) was used to quantify social contacts and social support. It was specifically designed for older persons. The score is an equally weighted sum of the six items, ranging from 0 to 30, with higher values reflecting more social networks and more social support. The scale demonstrated good psychometric properties (24).

As for need factors, depressive symptoms, cognitive impairment, functional decline and comorbidity was used. The 15-item version of the Geriatric Depression Scale (25) was used to assess depressive symptoms (0 = no depressive symptoms to 15 = severe depressive symptoms). Focusing on rather complex instrumental activities of daily living, the Instrumental Activities of Daily Living (IADL) (26) scale by Lawton and Brody measured the functional impairment, ranging from 0 = worst score to 8 = best score. Cognitive impairment was measured using the Global Deterioration Scale (27) (1 = no impairment to 7 = severe cognitive impairment). The GP recorded the presence/absence of 36 chronic conditions (e.g., diabetes, chronic heart failure, peripheral arterial disease, Parkinson’s disease, epilepsy, alcohol abuse, stenosis, transient ischaemic attack, stroke, back pain, obesity, asthma).

In sensitivity analyses, the IADL scale was replaced by the Barthel Index (28) which captures impairments in basic activities of daily living (from 0 = worst score to 100 = best score) to test whether changes in the outcome measures were associated with impairments in basic activities of daily living.

Statistical analysis

A key motivation for using longitudinal data is to solve the problem of omitted variable bias (29). Many panel regression models consider unobserved effects as random variables. The success of this methodology hinges on whether the unobserved effects are associated with the explanatory variables. A violation of this assumption would result in inconsistent estimates when, e.g., pooled OLS estimates or random effects (RE) strategies were used, whereas fixed effects (FE) regressions would deliver consistent estimates (30). As a result, FE regressions were conducted to investigate the determinants of physician visits longitudinally. This choice was corroborated by Hausman tests (31) to identify violations of the RE modeling assumption (i. e. explanatory variables are orthogonal to the unit effects).

It is worth stressing that FE regressions only use changes within units (individuals) over time (intraindividual changes) (17). Consequently, this estimator is also called ‘within-estimator’, resulting in the fact that only time-varying explanatory variables such as depressive symptoms or cognitive impairment can be used as independent variables in FE regression analysis. In FE regression analysis, factors constant within individuals over time (e.g., education in oldest age or sex) cannot be used as independent variables (main effects), though these time-constant variables can be used in FE regressions as moderating variables. As there is evidence that the relationship between need factors and health care use varies by sex and educational level (21), it was examined whether need factors were moderated by the predisposing factors education and gender (by including corresponding interaction terms in additional analysis), respectively.

Outcome measures were (1) GP and (2) specialist visits. The determinants of GP and specialist visits (count data) were estimated using FE Poisson regression analysis. The level of significance was set at $\alpha = .05$. Statistical analysis was performed using Stata Release 14 (Stata Corp., College Station, Texas).

Results

Sample characteristics

Sample characteristics stratified by time (follow-up wave 7 and follow-up wave 8) are shown in Table 1.

Regression analysis

Results of Poisson FE regressions are shown in Table 2. The number of GP visits in the past three months was used as outcome measure in the first column and the number of specialist visits in the past three months was used as outcome measure in the second column.

Panel regressions showed that increases in GP visits were associated with increases in cognitive impairment ($\beta=.17$, $p<.05$). However, changes in GP visits were not significantly associated with changes in marital status, functional decline,

increasing number of chronic conditions, increasing age, and changes in social network. Increases in specialist visits were not associated with changes in the explanatory variables.

Table 1

Descriptive statistics over time (follow-up 7 and follow-up 8)

Variables	Follow-up Wave 7 (n=861)	Follow-up Wave 8 (n=750)
Age: Mean (SD); Range	89.0 (2.9); 85-100	89.7 (2.9); 85-100
Female: N (%)	594 (69.0)	517 (68.9)
Level of education: N (%)		
Low	487 (56.5)	422 (56.3)
Middle	258 (30.0)	226 (30.1)
High	116 (13.5)	102 (13.6)
Unmarried: N (%)	651 (75.9)	571 (76.3)
LSNS score: Mean (SD); Range	13.2 (5.5); 0-29	13.0 (5.7); 0-30
IADL score: Mean (SD); Range	5.3 (2.6); 0-8	5.0 (2.7); 0-8
Barthel Index score: Mean (SD); Range	85.9 (22.6); 0-100	84.2 (23.4); 0-100
Global Deterioration Scale score: Mean (SD); Range	2.4 (1.4); 1-7	2.5 (1.5); 1-7
Geriatric Depression Scale score: Mean (SD); Range	2.8 (2.7); 0-15	2.8 (2.6); 0-13
Chronic diseases (Sum score): Mean (SD); Range	5.0 (4.2); 0-19	5.7 (4.4); 0-22
Number of GP visits in the past three months: Mean (SD); Range	2.8 (3.0); 0-30	3.1 (3.8); 0-36
Number of specialist visits in the past three months: Mean (SD); Range	2.6 (3.7); 0-41	2.5 (3.3); 0-42

LSNS (Lubben Social Network Scale) ranges from 0 to 30, with higher values reflecting more social networks and more social support; IADL (Instrumental Activities of Daily Living) scale ranges from 0 (worst score) to 8 (best score); Barthel-Index ranges from 0 (worst score) to 100 (best score); Global Deterioration Scale ranges from 1 (best score) to 7 (worst score); Geriatric Depression Scale ranges from 0 (no depressive symptoms) to 15 (severe depressive symptoms). It is worth mentioning that education was only used for sample descriptions because it is constant within individuals (in old age) over time.

In additional regression analysis (results of additional analyses are not shown, but are available upon request), the IADL scale was replaced by the Barthel Index. Regressions revealed that changes in the Barthel Index were not associated with both outcome measures. In terms of effect sizes and significance, findings remained almost the same. Furthermore, it was examined whether need factors were moderated by the predisposing factors education and gender, respectively. However, the interaction terms did not achieve statistical significance.

Discussion

Based on a multicenter prospective cohort study among individuals aged 85 and over at baseline, the aim of the current study was to examine the determinants of outpatient health care utilization among the oldest-old longitudinally. In sum,

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longitudinal regressions showed that increases in GP visits were associated with increases in cognitive impairment. Increases in specialist visits were not associated with changes in the independent variables.

Table 2

Results of Poisson FE regressions (follow-up wave 7 and follow-up wave 8). Outcome measures were: GP visits in the past three months (first column) and specialist visits in the past three months (second column)

Independent variables	(1) GP visits	(2) Specialist visits
Increasing age	0.01 (0.05)	-0.00 (0.06)
Changes from married to another marital status	0.17 (0.41)	-0.45 (0.35)
Increasing social network (Lubben Social Network Scale)	-0.01 (0.01)	-0.02 (0.01)
Decreasing functional impairment (Instrumental Activities of Daily Living)	-0.05 (0.04)	0.04 (0.04)
Increasing cognitive impairment (Global Deterioration Scale)	0.17* (0.07)	0.00 (0.09)
Increasing depressive symptoms (Geriatric Depression Scale)	0.04+ (0.02)	-0.00 (0.02)
Increasing number of chronic conditions (sum score)	0.01 (0.01)	-0.01 (0.01)
Observations	1,222	1,096
Number of Individuals	611	548

Poisson regression coefficients were reported; Cluster-robust standard errors in parentheses; *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.10$; IADL scale ranges from 0 (worst score) to 8 (best score); Global Deterioration Scale ranges from 1 (best score) to 7 (worst score); LSNS ranges from 0 to 30, with higher values reflecting more social networks and more social support; Geriatric Depression Scale ranges from 0 (no depressive symptoms) to 15 (severe depressive symptoms).

Based on a multicenter study among individuals in oldest age, these findings extend current knowledge about a longitudinal association between cognitive impairment and GP service use based on population-based samples among older adults restricted to specific regions (32, 33). A possible explanation for the association between cognitive impairment and GP use might be that an increase in cognitive impairment is associated with more injuries and accidents (34) which in turn is associated with GP visits (35). Furthermore, individuals experiencing cognitive decline might become more willing to seek help from professionals. Patients' perception of cognitive impairment can be a reason for consultation; however, the rate of patients complaining cognitive decline to a general practitioner is rather low (36). A further link between cognition and GP service use may be problems with medication intake or its consequences (37).

As already found in a recent study based on the German Ageing Survey (mean age 64.3 years, 40-95 years) (16) which also used FE regression analysis, changes in marital status or increasing age were not significantly associated with changes in GP and specialist visits. Somewhat counterintuitively,

increasing chronic conditions were not associated with increasing outpatient health care use in the current study. This might be explained by the fact that individuals in oldest age often suffer from multiple chronic conditions (please see Table 1) which might be associated with frequent outpatient physician visits. Thus, an increase beyond the (high) initial level might not change health care use. Concerning the other need factors (functional decline, and depressive symptoms), evidence exists that these factors are associated with outpatient physician visits (38). However, there is also evidence showing that psychiatric morbidity and self-reported depression were not associated with the frequency of attendance among patients aged 65 years and over (39). Using data from the Health and Retirement Study, another study demonstrated that changes in activities of daily living were not associated with physician visits (40). We assume that a lack of statistical power might mainly explain our results (the non-significant associations with outpatient health care use) - the present study was restricted to intraindividual changes from two waves.

To the best of our knowledge, this is the first study examining the determinants of health care use among the oldest-old in Germany longitudinally. Widely used and well-established scales were used in the present study (e.g., Geriatric Depression Scale, Global Deterioration Scale). Data were gathered from a multicenter prospective cohort study in Germany. Individuals were recruited via GP offices and nearly everyone in old age has regular GP visits. Moreover, the longitudinal structure of the data was exploited using FE regressions to provide controls for unobserved factors associated with health care use that might bias the estimates. Consequently, the problem of unobserved heterogeneity has been remedied.

A limitation of the present study is that a sample selection bias is likely to occur. Therefore, it might be difficult to generalize our results to, e.g., individuals with very severe cognitive impairment. In addition, panel attrition might bias the results. However, several ageing studies have shown that panel attrition is not a major problem in longitudinal studies which are particularly interested in the relationship between the variables (41, 42). Furthermore, our findings were based on two follow-up waves of the AgeQualiDe-study (with 10-month interval). Thus, while short-term relations might be captured adequately, it remains an open question how the factors investigated are related over a longer period, which should be examined in future longitudinal studies. Moreover, enabling resources deemed to be important (e.g., income, or accessibility of doctors) were not included in regression analysis for reasons of data inavailability. However, given the assumption that the accessibility of physicians did not vary within individuals in the 10-month interval, at least this factor does not bias the FE-estimates. Furthermore, health care use was measured retrospectively for several months preceding the interview. Consequently, the possibility cannot be dismissed that the individuals used health care services that

affect the explanatory variables (endogeneity bias). In other words: The health care use that drives our analysis preceded our assessments of independent variables.

Conclusion

Our results stress the importance of cognitive impairment as a driving factor of GP visits among the oldest old longitudinally. Communicative strategies of GPs to broach cognitive problems and consider subjective complaints are needed. Treatments with the aim to postpone cognitive decline might also help to reduce GP visits.

It is projected that the number of individuals in old age with severe cognitive impairment will rise due to demographic change in many countries. These needs will be challenging to address.

Ethical standards: The AgeCoDe as well as the AgeQualiDe study have been approved by the ethics committees of all participating study centres and comply with the ethical standards of the Declaration of Helsinki.

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References

- Brünnler T, Drey M, Dirrigl G, Weingart C, Rockmann F, Sieber C, Hoffmann U. The oldest old in the Emergency Department: Impact of renal function. *The Journal of Nutrition, Health & Aging* 2016;20 (10):1045-1050
- Campion EW. The oldest old. *Mass Medical Soc* 1994,
- García-Peña C, Pérez-Zepeda MU. Validity of knee-estimated height to assess standing height in older adults: A secondary longitudinal analysis of the Mexican health and aging study. *The Journal of Nutrition, Health & Aging* 2017;21 (3):262-265

- Ling CH, Taekema D, de Craen AJ, Gussekloo J, Westendorp RG, Maier AB. Handgrip strength and mortality in the oldest old population: the Leiden 85-plus study. *Canadian Medical Association Journal* 2010;182 (5):429-435
- Suzman RM, Manton KG, Willis DP. *Introducing the oldest old*. The oldest old. Oxford University Press, New York, 1992
- Smith J, Borchelt M, Maier H, Jopp D. Health and well-being in the young old and oldest old. *Journal of Social Issues* 2002; 58 (4):715-732
- van den Bussche H, Schön G, Kolonko T, Hansen H, Wegscheider K, Glaeske G, Koller D. Patterns of ambulatory medical care utilization in elderly patients with special reference to chronic diseases and multimorbidity-results from a claims data based observational study in Germany. *BMC Geriatrics* 2011;11 (1):54
- Schneider EL, Guralnik JM. The aging of America: impact on health care costs. *JAMA* 1990;263 (17):2335-2340
- Bowling A, Farquhar M, Browne P. Use of services in old age: data from three surveys of elderly people. *Social Science & Medicine* 1991;33 (6):689-700
- Fernández-Olano C, Hidalgo JL-T, Cerdá-Díaz R, Requena-Gallego M, Sánchez-Castaño C, Urbistondo-Cascales L, Otero-Puime A. Factors associated with health care utilization by the elderly in a public health care system. *Health Policy* 2006;75 (2):131-139
- Nie JX, Wang L, Tracy CS, Moineddin R, Upshur RE. A population-based cohort study of ambulatory care service utilization among older adults. *Journal of Evaluation in Clinical Practice* 2010;16 (4):825-831
- Counte MA, Glandon GL. A panel study of life stress, social support, and the health services utilization of older persons. *Medical Care* 1988; :348-361
- Rosner TT, Namazi KH, Wykle ML. Physician use among the old-old: Factors affecting variability. *Medical care* 1988;982-991
- Dunlop DD, Manheim LM, Song J, Chang RW. Health care utilization among older adults with arthritis. *Arthritis Care & Research* 2003;49 (2):164-171
- Jacobs JM, Rottenberg Y, Cohen A, Stessman J. Physical activity and health service utilization among older people. *Journal of the American Medical Directors Association* 2013;14 (2):125-129
- Hajek A, Bock J-O, König H-H. Which factors affect health care use among older Germans? Results of the German ageing survey. *BMC Health Services Research* 2017;17 (1):30
- Brüderl J, Ludwig V. Fixed-effects panel regression. In: Wolf C (ed) *The Sage handbook of regression analysis and causal inference*. SAGE, Los Angeles, 2015:pp 327-357
- Zok K. Warten auf den Arzttermin. Ergebnisse einer Repräsentativumfrage unter GKV- und PKV-Versicherten WIdO-monitor 2007;4:1-7
- Passon A, Lungen M, Gerber A, Redaelli M, Stock S. *Das Krankenversicherungssystem in Deutschland*. 2009:105-136
- Luck T, Riedel-Heller S, Lupp M, Wiese B, Wollny A, Wagner M, Bickel H, Weyerer S, Pentzek M, Haller F. Risk factors for incident mild cognitive impairment—results from the German Study on Ageing, Cognition and Dementia in Primary Care Patients (AgeCoDe). *Acta Psychiatrica Scandinavica* 2010;121 (4):260-272
- Babitsch B, Gohl D, von Lengerke T. Re-revisiting Andersen's Behavioral Model of Health Services Use: a systematic review of studies from 1998–2011. *GMS Psycho-Social-Medicine* 9, 2012
- Andersen RM. Revisiting the behavioral model and access to medical care: does it matter? *Journal of Health and Social Behavior* 1995;36 (1):1-10
- Brauns H, Steinmann S. Educational reform in France, West-Germany, the United Kingdom and Hungary: updating the CASMIN educational classification. *ZUMA-Nachrichten* 1999;44 (23):7-44
- Lubben J, Blozik E, Gillmann G, Iliffe S, von Renteln Kruse W, Beck JC, Stuck AE. Performance of an abbreviated version of the Lubben Social Network Scale among three European community-dwelling older adult populations. *The Gerontologist* 2006;46 (4):503-513
- Yesavage JA, Sheikh JJ. 9/ Geriatric Depression Scale (GDS) recent evidence and development of a shorter version. *Clinical Gerontologist* 1986;5 (1-2):165-173
- Lawton MP, Brody EM. Assessment of Older People: Self-Maintaining and Instrumental Activities of Daily Living. *The Gerontologist* 1969;9 (3 Part 1):179-186.
- Reisberg B, Ferris SH, de Leon MJ, Crook T. The Global Deterioration Scale for assessment of primary degenerative dementia. *The American Journal of Psychiatry* 1982;139:1136-1139
- Mahoney FI. Functional evaluation: the Barthel index. *Maryland state Medical Journal* 1965;14:61-65
- Wooldridge JM. *Econometric analysis of cross section and panel data*. MIT Press, Cambridge, 2010
- Cameron AC, Trivedi PK. *Microeconometrics: methods and applications*. Cambridge University Press, New York, 2005
- Hausman JA. Specification tests in econometrics. *Econometrica: Journal of the Econometric Society* 1978;46 (6):1251-1271.
- Fowler NR, Morrow LA, Tu L-C, Landsittel DP, Snitz BE, Rodriguez EG, Saxton JA. Association between cognitive decline in older adults and use of primary care physician services in Pennsylvania. *Journal of Primary Care & Community Health* 2012;3 (3):201-209
- O'Donoghue Jenkins L, Butterworth P, Anstey KJ. A Longitudinal Analysis of General Practitioner Service Use by Patients with Mild Cognitive Disorders in

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- Australia. Dementia and Geriatric Cognitive Disorders 2016;41 (5-6):324-333
34. van Dijk PT, Meulenberg OG, Van de Sande HJ, Habbema JDF (1993) Falls in dementia patients. *The Gerontologist* 1993;33 (2):200-204
35. Kiel DP, O'sullivan P, Teno JM, Mor V (1991) Health care utilization and functional status in the aged following a fall. *Medical Care* 1991; 29 (3): 221-228
36. Archer HA, Newson MA, Coulthard EJ (2015) Subjective memory complaints: symptoms and outcome in different research settings. *Journal of Alzheimer's Disease* 2015;48 (s1):S109-S114
37. Hayes TL, Larimer N, Adami A, Kaye JA (2009) Medication adherence in healthy elders: small cognitive changes make a big difference. *Journal of Aging and Health* 2009;21 (4):567-580
38. Thode N, Bergmann E, Kamtsiuris P, Kurth B-M (2005) Einflussfaktoren auf die ambulante Inanspruchnahme in Deutschland. *Bundesgesundheitsblatt Gesundheitsforsch Gesundheitsschutz* 2005;48 (3):296-306
39. Gilleard CJ, Francis V, Brown M (1998) Frequent attendance in primary care amongst older patients. *Aging & Mental Health* 1998;2 (3):194-198
40. Manski RJ, Moeller JF, Chen H, Schimmel J, Clair PAS, Pepper JV (2013) Patterns of older Americans' health care utilization over time. *American Journal of Public Health* 2013;103 (7):1314-1324
41. Kempen GI, van Sonderen E (2002) Psychological attributes and changes in disability among low-functioning older persons: Does attrition affect the outcomes? *Journal of Clinical Epidemiology* 2002;55 (3):224-229
42. Wurm S, Tesch-Römer C, Tomasik MJ (2007) Longitudinal findings on aging-related cognitions, control beliefs, and health in later life. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 2007;62 (3):P156-P164