

Prevalence and predictors of polypharmacy among older primary care patients in Germany

U Junius-Walker, G Theile and E Hummers-Pradier

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Background. Older people consume an increasing amount of medication. Polypharmacy is associated with an elevated risk of adverse health outcomes resulting in hospitalizations and sometimes death.

Objectives. To describe the prevalence of prescribed and over-the-counter (OTC) medications among older general practice patients living in the community. To determine predictors of polypharmacy (five or more prescribed drugs) from a variety of patient- and doctor-related factors.

Methods. Sixty-seven randomly selected practices in two areas of Germany and 466 of their older patients (70+ years) were recruited for a geriatric assessment study. A cross-sectional analysis of health problems, GPs' awareness and their interventions was conducted. In this *post hoc* analysis, we assessed the medication use as reported by older patients and compared it with doctors' perceived medication regimens for their respective patients. The detailed assessment of patients' health and well-being enabled us to explore a variety of predictors of polypharmacy using logistic regression analysis with forward selection.

Results. Study participants consumed an average of 3.7 prescribed medicines and an additional 1.4 OTC drugs. In all, 26.7% of patients used five and more chronically prescribed drugs. A set of five determinants predicted polypharmacy best: breathlessness, hypertension, dependency on instrumental activities of daily living, low subjective health and medication disagreement between doctors and patients.

Conclusion. This older general practice population in Germany is among the top pharmaceutical user group of European study samples. Apart from disease-specific determinants, GPs should be aware that low subjective health and medication disagreement are independent predictors of polypharmacy.

Keywords. Ageing, preventive medicine, prescribing, patient safety, family medicine.

Introduction

Escalating pharmaceutical costs, new budgetary demands and a growing awareness of health risks for patients with polypharmacy exert pressure on GPs to reduce medication. This necessitates a good understanding of how multiple drug use comes about. There is to date no common definition of polypharmacy available. It is determined either as the simultaneous use of a certain number of medications (two to six and more)^{1–3} or as the unnecessary overuse of drugs.⁴ It can refer to perceptions of prescribers or consumers and may or may not include over-the-counter (OTC) remedies. If defined as use of five or more drugs, between 4%¹ and 34%⁵ of people aged 65 years and

above are affected by polypharmacy. A number of studies investigated determinants of prescribed polypharmacy and reported relevant socio-demographic factors (age, gender, education, employment and socio-economic status),^{6,7} influence of disease (multimorbidity, multiple complaints, well-being and chronic illness)^{8,9} and health system factors (prescriber related, perceived patient pressure and free access to medications).^{10–13} These studies employed either limited numbers of health determinants or looked at overall health as an abstract concept when predicting polypharmacy.

Our analysis is based on a comprehensive health check for older people. Hence, we aimed to look at a large variety of patient- and doctor-related factors

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Department of General Practice, Hannover Medical School, D-30623 Hannover, Germany. Correspondence to U Junius-Walker; Email: junius-walker.ulrike@mh-hannover.de

that predict the simultaneous and regular use of five and more chronically prescribed medications. We also wanted to determine the amount of self-reported medications taken by older primary care patients in Germany as there are very little data available on this issue.

Methods

This *post hoc* analysis is derived from a multicentre cross-sectional study on health complaints of older primary care patients and their GPs' awareness of them. Part of the study was to assess the actual medication use of older patients in comparison to the medication regimen as perceived by their GPs.

All GPs and primary care internists in the area of Leipzig and Hannover were included in a computer-generated randomization process. Practices, which were willing to take part, then provided study participants in a systematic but non-random fashion. This meant that the first two patients of at least 70 years entering the practice 1 hour after opening in the morning and afternoon were chosen every day in the course of 1 week. Patients who required regular home visits or lived in institutions were excluded.

All participants received a precursor version of the STEP-Assessment¹⁴ that had been tested in a pilot feasibility study. The patients were given a set of partly validated questionnaires to rate the presence or absence of 31 somatic diseases, functional limitations and psychological and social problems. The instruments and their sources have been published elsewhere.^{15,16} Additionally, patients were asked to number the different chronically prescribed drugs and OTC remedies in daily use. Likewise, the doctors were independently invited to specify their patients' health problems and the quantity of prescribed medications and OTC drugs. As part of the assessment, the doctors also performed simple standard examinations which included repeated blood pressure measurement, pulse examination, dementia test, get-up-and-go test as well as a blood sample for thyroid stimulating hormone, cholesterol and glucose.

All 31 health observations, the two medication variables (number of prescribed and OTC medications) and socio-demographic data (gender, age and formal education) were used in the analysis as well as a medication disagreement item. This parameter was defined as the percentage of patients for whom doctors either over- or underestimated the prescribed medications in reference to the patients' statements. For baseline characteristics, we classified health variables into four groups that constitute the sum of 17 somatic, 3 functional, 4 psychological and 6 social variables. Univariate comparisons for all health variables were performed to describe the polypharmacy group (defined in this study as five and more prescribed

medications) as opposed to the reference group. Probability statements were given using two-tailed *t*-tests and chi-square tests. Logistic regression with forward selection was chosen to explore predictors of prescribed multiple medication use with polypharmacy as the binary outcome and significant univariate coefficients as predictors. The model was internally validated using the Hosmer-Lemeshow test.

Results

Description of the sample

In all, 67 primary care practices agreed to participate. They represented 30% and 65% of the invited practices in the area of Hannover and Leipzig, respectively. In all, 713 patients were systematically recruited in the practices and 466 (65.4%) participated in the survey. Table 1 presents an overview of health and socio-demographic characteristics by gender. Twice as many women as men took part in this study. Significant gender differences existed for formal education and social health problems.

Medication status

Altogether, 419 observations were available for the prescribed and 221 for the OTC medication status. Figure 1 provides a flow chart of available data for each analysis. A total of 418 (99.8%) participants reported to take at least one prescribed drug on a regular basis. In all, 112 patients were affected by polypharmacy,

TABLE 1 Patient characteristics

	♂	♀	P-value
Socio-demographic characteristics			
Participants (N)	133	333	NA
Mean age (years)	77.0	76.3	0.21 ^a
Years in formal education (median)	11	10	0.000 ^b
Self-rated health problems (all and subgroups)			
Number of maximum 31 (mean, SD)	8.4 (±4.3)	9.0 (±4.1)	0.15 ^a
Somatic (maximum 18)	5.9	6.2	0.37 ^a
Functional (maximum three)	0.7	0.7	0.89 ^a
Psychological (maximum four)	1.0	1.0	0.92 ^a
Social (maximum six)	0.7	1.1	0.000 ^a
Regular use of different medications			
Prescribed drugs (mean, SD)	3.8 (±2.2)	3.6 (±1.9)	0.44 ^a
More than five prescribed drugs (% of participants)	26.8	26.7	0.98 ^c
OTC drugs (mean, SD)	1.5 (±1.1)	1.4 (±1.1)	0.70 ^a
More than five prescribed and OTC drugs (% of participants)	53.3	53.6	0.96 ^c

^a*t*-test for unpaired means.

^bMann-Whitney test.

^cChi-square test.

NA, not available; OTC, over the counter.

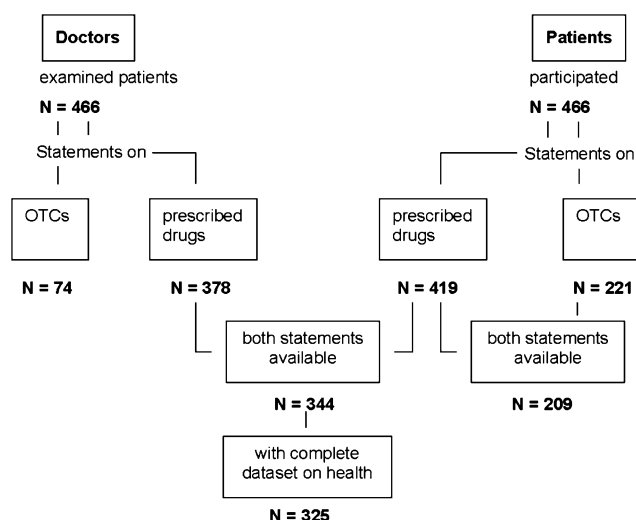


FIGURE 1 Flow chart of available data from doctors and patients

which constitutes approximately a quarter of the study population. A total of 184 (83.3%) consumed at least one non-prescribed remedy daily. For the combined prescribed and OTC medications (209 observations), the proportion of patients with at least five drugs was 53.7% (Table 1). The association between the number of prescribed medication and age was fairly weak and non-significant ($r = 0.36$). Likewise, there was only a small but significant correlation between prescribed medication and the number of health problems ($r = 0.32$, $P < 0.01$).

Agreement between doctors and patients

There were 344 observations available for cross-tabulation to analyse the patients' and doctors' agreement on the regular intake of prescribed drugs. Overall, doctors and patients agreed on the same number of prescribed drugs in 56.4%. The agreement was greater in the subgroup of patients with zero to four drugs (60.9%). In this low-user group ($N = 256$), 22.3% took more medications than their doctor expected and 16.8% took less. In the polypharmacy group ($N = 88$), the agreement of prescribed medication use was significantly less, only 43.2%. For 54.5% of the cases, doctors underrated the number of consumed medications and they overestimated their use in 2.3%.

Health characteristics of the low-user versus high-user medication groups

We compared the prevalence of health problems for patients on five or more prescribed drugs ($N = 112$) with the low-user group ($N = 307$). For somatic problems, quite a number of conditions were significantly more common in the polypharmacy group (Table 2). These were syncope, dizziness, shortness of breath, pain, difficulty in chewing, chronic bronchitis, hypertension and arrhythmia. In the functional health area,

a problem in either independent or basic activities of daily living was significantly associated with multiple drug use. Only depression as one of four psychological problems was significantly more prevalent in the high-user group. None of the social problems demonstrated a significant relation to polypharmacy.

Low subjective health was defined as having rated the overall health as less good or bad as opposed to good and excellent. In all, 15.6% of the participants who considered themselves to be in good health consumed five and more drugs as opposed to 38.9% with a low rating. Subjective health was moderately correlated with depression ($r = 0.52$, $P < 0.01$) and the number of health problems ($r = 0.55$, $P < 0.01$).

Predictors of polypharmacy

Logistic regression analysis with forward selection was applied to explore into risk factors of polypharmacy. Health problems that had shown a significant difference between high- and low-user groups entered the model as well as self-perceived health and medication disagreement between doctors and patients. Age and gender were added to adjust the model. In all, 325 patients, who presented a complete data set of self-rated problems as well as self- and doctor-rated medication use, were included. Table 3 presents the model derived from logistic regression with stepwise forward selection. Five variables adjusted by age and gender predict the use of polypharmacy best. The odds of being breathless, being hypertensive, being dependent on instrumental activities of daily living, having a low perceived health or having a medication disagreement were between two and three times higher in the polypharmacy group. Syncope, dizziness, pain, problems with chewing, chronic bronchitis, arrhythmia, dependency in basic activities of daily living and depression did not improve the model and were excluded in the process of forward selection. The Hosmer–Lemeshow test demonstrated that the model provides a good fit ($P = 0.93$).

Discussion

Our study population of independent older general practice patients consumed a mean of 3.7 prescribed medicines and an additional 1.4 OTC drugs. In all, 26.7% were on prescribed polypharmacy. This increased to 53.6% when OTC drugs were considered as well. Surprisingly, just one patient out of our sample of 466 did not take any medicines at all. This puts our German practice sample into the top bracket of pharmaceutical consumers in comparison with results of other pharmaco-epidemiological studies in Europe. An Italian practice survey reported that 95% of women and 91% of men aged 75 years and more were on regular medication.¹⁷ Population-based

TABLE 2 Relative frequency of health problems among patient with and without polypharmacy

	All patients (%)	Low-user group ^a (%) (N = 307)	High-user group ^b (%) (N = 112)	Crude OR	OR (95% CI)	P-value ^c
Somatic problems						
Falls	30.1	29.4	32.1	1.14	0.71, 1.81	0.59
Syncope	15	12.1	23.2	2.21	1.26, 3.85	0.005
Dizziness	46.5	42.4	57.8	1.86	1.19, 2.90	0.006
Weight loss	13.4	11.8	18.0	1.64	0.91, 2.99	0.1
Shortness of breath	43.2	35.9	63.7	3.13	1.99, 4.93	<0.001
Pain	56.3	50.2	73.0	2.68	1.67, 4.31	<0.001
Hearing difficulty	50.7	50.3	51.8	1.06	0.69, 1.63	0.79
Difficulty seeing	45.2	43.2	50.4	1.34	0.86, 2.07	0.19
Difficulty chewing	44.3	34.6	52.7	1.59	1.02, 2.46	0.04
Chronic bronchitis	11.3	8.5	18.9	2.51	1.35, 4.68	0.003
Claudication	23.6	21.6	28.8	1.47	0.89, 2.40	0.13
Incontinence	61.3	59.7	65.8	1.29	0.83, 2.04	0.26
Thyroid dysfunction ^d	11.8	11.3	13.3	1.21	0.62, 2.37	0.57
Diabetes mellitus ^d	28.9	27.0	34.0	1.39	0.86, 2.24	0.18
High cholesterol ^d	49.4	51.4	43.8	0.74	0.47, 1.16	0.18
Hypertension ^e	37.2	32.9	49.1	1.97	1.27, 3.06	0.002
Atrial fibrillation/arrhythmia	18.3	15.6	26.1	1.93	1.13, 3.27	0.01
Functional problems						
Instrumental activities of daily living	47.8	41.5	64.5	2.57	1.63, 4.04	<0.001
Basic activities of daily living	20.8	17.5	29.5	1.96	1.19, 3.25	0.08
Failed get-up-and-go test	9.8	9.4	10.7	1.15	0.57, 2.34	0.7
Psychological problems						
Anxiety	52.6	52.0	54.5	1.11	0.72, 1.71	0.65
Alcohol abuse	4.5	38.3	6.0	1.71	0.64, 4.52	0.28
Depression	22.5	18.3	34.0	2.29	1.40, 3.75	<0.001
Dementia	22.0	22.1	21.7	0.97	0.57, 1.67	0.93
Social problems						
Having moved house	5.5	4.2	9.0	2.2	0.94, 5.19	0.06
Loneliness	19.3	17.3	24.5	1.55	0.91, 2.63	0.1
Loss of partner/grief	44.6	42.8	49.6	1.31	0.85, 2.03	0.22
Poverty	9.5	8.0	13.6	1.81	0.91, 3.59	0.09
Carer	7.3	6.9	8.0	1.21	0.54, 2.73	0.65
No help	14.8	14.7	15.2	1.04	0.57, 1.91	0.89
Others						
Low perceived health	48.9	14.7	70.6	3.46	2.17, 5.51	<0.001
Medication disagreement ^f	43.6	39.1	56.8	2.05	1.26, 3.35	0.04

^aLess than five different prescribed medications on a regular basis.^bFive and more medications.^cChi-square test.^dInterpretation of GP based on TSH, fasting glucose and total cholesterol.^eTwo readings of either ≥ 160 mm Hg systole or ≥ 95 mm Hg diastole.^fDoctors' perceived medication regimens for 344 patients.

OR, odds ratios, CI, confidence interval.

surveys record user rates from 65% to 96% among older people.^{2,8,5} This substantial variation can also be observed in the average number of prescribed pharmaceuticals within European study samples ranging from 2.7¹⁸ to 4.2⁵ in older community-dwelling people. However, comparability is limited due to differing inclusion criteria between studies, such as age group and independent living. Medication data have been collected in a variety of ways (computer-based practice data, interview, presentation of drugs in surgery and inspection of drugs at home), and they are presented with diverse or in some cases indistinct definitions and specifications on medication use. Our study population was also somewhat selected, as only patients who visited the practice

were invited to participate and patients requiring regular home visits or living in nursing homes were excluded.

The disagreement between drugs simultaneously taken by patients and described by their doctors was lower (45%) than in other studies (53%–58%).^{19,20} However, in our study we based the definition of agreement on the quantity of drug use alone and not on the type of medication. Doctors over- and underrated medication use of the low-user group to an equal extent. Their estimation became unbalanced for the high users. Over half of these patients were assumed to take fewer drugs.

This was confirmed in our prediction model for the use of five and more prescribed medications. Besides

TABLE 3 Predictors of polypharmacy derived from logistic regression with forward selection

	Coefficient	Standard error around coefficient	Wald	P	Exponentiation of B coefficient (odds ratio)	95% Confidence interval lower upper value	
Constant	-4.66	2.12	4.85				
Age	0.01	0.03	0.15	0.70	1.01	0.96	1.07
Sex	0.45	0.32	2.05	0.15	1.57	0.85	2.91
Breathlessness	1.05	0.29	12.86	<0.001	2.86	1.61	5.06
Hypertension	0.92	0.30	9.42	0.002	2.52	1.40	4.54
IADL	0.65	0.32	4.21	0.04	1.91	1.03	3.56
Low subject health	1.03	0.31	10.99	0.001	2.80	1.52	5.13
Medication disagreement	0.98	0.30	10.91	0.001	2.68	1.49	4.80

N = 325 out of 344 included.

Hosmer–Lemeshow test: chi-square = 3.13, P = 0.93.

medical problems, most notably hypertension and breathlessness, the medication disagreement was an equally powerful and innovative predictor of polypharmacy. One reason for the disagreement is likely to be ‘different prescribers’, a risk factor previously identified for polypharmacy.¹¹ The German health system with its community specialists, who work relatively independent without referrals from GPs, promotes professional ignorance about patients’ medication status. Another cause may be an insufficient patient–doctor communication on medications. This may be determined by consultation lengths, which are among the shortest of European countries.²¹ A somewhat neglected determinant is the generally low subjective health rating among multiple drug users. Subjective health and morbidity were only moderately correlated and both had an independent influence on the quantity of prescribing. Whether patients with low perceived health exert the well-known perceived pressure on doctors to prescribe¹² remains unclear. Several other known determinants could not be verified in our sample, such as being female and advancing age within the old age group.¹⁸ Secondary prescription data collected by a German health insurance company support our latter finding that the number of prescribed medications decreases in the highest age group.²²

It is well known that multiple medication use entails health risks. According to several European primary care studies, inappropriate drug prescribing occurs in approximately 20% of older general practice patients.²³ Older people exposed to potential drug interactions rise from 25% in the age group of between 60 and 80 years to 36% in the 80+ age category.²⁴ The average prevalence of drug-related hospitalizations lies within 2.5%–6% among all hospitalized patients with increasing age and polypharmacy as significant predictors for admission, length of stay, re-admission and indeed death.²⁵ Therefore, we can reasonably assume that a continuous medication assessment by primary care prescribers will reduce adverse outcomes. However, a recent meta-analysis on this subject showed no benefit when primary health care professionals conducted a medication

review. Pharmacist-led interventions fared better, but there was a significant heterogeneity between studies.²⁶

Our findings have to be interpreted with caution in view of it being a *post hoc* analysis. It was not the primary intention to assess the medication status of older primary care patients in detail but to merely identify patients with polypharmacy. The overall study aim was rather to describe self-reported health and the effects of geriatric assessment in German general practice. For reasons of practicality, we therefore only assessed the number of simultaneously and chronically used medications and did not attempt to record type and dosage. However, the similarity of pharmaco-epidemiological findings previously reported in Germany is reassuring.²⁷ The intention to analyse OTC data had to be discarded because of high missing values for these items in the patient—as well as the doctor—questionnaires. Generally, there is a lack of understanding on self-administered remedies for different reasons such as complexity and the grey area of the definition of OTC drugs.²⁸ Consequently, OTC drugs are hardly ever taken into account when drug-related problems or drug interventions are assessed.

Conclusion

Our study indicates that many older people in German general practice are high consumers of prescribed and OTC drugs. GPs underrate the number of prescribed drugs especially for multiple medication users. When issuing prescriptions, doctors should consider the possibility of polypharmacy and its predictors. In addition to disease, specific predictor knowledge of non-specific disease determinants such as poor subjective health and medication disagreement may facilitate good prescribing. Solutions to improve the quality of prescribing are not established in Germany yet, such as regular medication assessments, an electronic medication card or computer-aided prescribing. Future research could focus on medication assessment methodology as well as targeting high-risk groups for adverse drug effects for intervention.

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Declaration

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