Polypharmacy in general practice: differences between practitioners

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SUMMARY

Background. *Polypharmacy, the simultaneous use of multiple drugs, is associated with adverse drug reactions, medication errors, and increased risk of hospitalization. When the number of concurrently used drugs totals five or more (major polypharmacy), a significant risk may be present.*

Aim. *To analyse the interpractice variation in the prevalence of major polypharmacy among listed patients, and to identify possible predictors of major polypharmacy related to the practice.*

Method. *Prescription data were retrieved from the Odense Pharmacoepidemiological Database, and individuals subject to major polypharmacy were identified. The age- and sex-standardized prevalence rate of major polypharmacy was calculated for each practice in the County of Funen in Denmark (n = 173), using the distribution of age and sex of the background population as a reference. The practice characteristics were retrieved from the Regional Health Insurance System. Possible predictors of major polypharmacy related to the general practitioners (GPs) were analysed using backward stepwise linear multiple regression.*

Results. *A six-fold variation between the practices in the prevalence of major polypharmacy was found (16 to 96 per 1000 listed patients; median = 42). Predictors related to the practice structure, workload, clinical work profile, and prescribing profile could explain 56% of the variation.*

Conclusion. *A substantial part of the variation in major polypharmacy between practices can be explained by predictors related to practice.*

Keywords: polypharmacy; major polypharmacy; general practice.

Introduction

STUDIES have demonstrated large variations in the practice patterns of general practitioners (GPs).[1] Considerable variations in prescription rates have been demonstrated, and there has been much concern about these and the implications for the cost and quality of care.[2,3] The possible causes of the variations have not been clearly established, but factors related to variations in the demography of the practice population (age and sex distribution) and factors related to the prescriber (age, sex, solo, or group practice) have been suggested.[3]

Polypharmacy (PP), defined as the simultaneous use of more than one drug, has been associated with adverse drug reactions, medication errors, and increased risk of hospitalization.[4] Concurrent usage of five or more drugs (major polypharmacy, MPP) represents a particular risk.[5] Population studies have shown that PP is most frequently observed among women and elderly people;[6,7] however, we have not found any studies that focus on factors related to the prescriber (age, sex, workload, type of practice, etc.). The purpose of the present study, therefore, was to analyse the variation in MPP between general practices, and to analyse possible prescriber-related predictors of MPP as defined above.

Methods

Subjects

The study comprised all general practices in the County of Funen in 1995 (n = 173). For each practice, prescription data for 1995 were retrieved from the Odense Pharmacoepidemiological Database (OPED),[8] which contains person-identifiable records of all prescriptions for inhabitants of the County of Funen (n = 467 695 at 1 January 1995). Drugs were classified by their active substance according to the anatomical therapeutical chemical (ATC) classification code developed by World Health Organization (WHO) Drug Utilization Research Group.[9] Individuals who had purchased five or more drugs during the three months preceding 1 April 1995 were classified as having MPP. We have previously demonstrated that this is a valid estimator of the prevalence of individuals using five or more drugs simultaneously.[7] The prevalence of MPP among the listed patients in each practice was adjusted for age and sex variation by direct standardization,[10] using the distribution of age and sex of the entire population of Funen as a reference.

Possible predictors of PP that related to the practice were retrieved from the database of the Regional Health Insurance System (RHIS), with whom all Danish GPs have an agreement. More than 97% of the Danish population are registered with a local GP (listed patients) and 'doctor shopping' is therefore, in principle, impossible in Denmark.[11] GPs carry out most of the health care and are responsible for more than 90% of all medical prescriptions for outpatients.[8] Medical attendance is free of charge. The GPs are paid a capitation fee and, in addition, receive a fee for service for each contact (surgery consultation, telephone consultation, or home visit) and most supplementary diagnostic procedures. Specified bills for all subsidized services are sent weekly from the GPs to RHIS and are accumulated in the RHIS database, thus providing detailed information about all the contacts and subsidized diagnostic and therapeutic procedures of each practice.

Each practice was described by a series of characteristics, which were analysed as possible explanatory variables for the prevalence of MPP:

- the structure of the practice (solo or group, number of physicians in the clinic, number of patients per GP),
- the workload in the practice (rate of surgery consultations,

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Table 1. Practice characteristics included in the multivariate analysis as possible predictors of major polypharmacy. For each characteristic, the prevalence of major polypharmacy among listed patients (number per 1000 patients) is shown for practices below (or at) and above the median practice.

Practice characteristics	Median value for practice characteristics (range)	Prevalence of major polypharmacy (95% CI)	
		Practices with a characteristic median value	Practices with a characteristic >median value
Practice structure			
Number of doctors in practice	1 (1–6)	45 (43–48)	42 (39–45)
Number of patients listed per doctor	1270 (286–2040)	44 (41–47)	43 (40–46)
Workload in practice			
Rate of surgery consultations per doctor per day	23 (6–45)	41 (38–44)	46 (43–49)
Rate of telephone consultations per doctor per day	13 (2–51)	41 (38–43)	46 (43–49)
Rate of home visits per doctor per day	0.85 (0–3)	41 (38–44)	47 (44–50)
Clinical work profile			
Rate of surgical procedures[a]	8 (1–35)	45 (42–47)	43 (40–46)
Rate of diagnostic procedures[a]	32 (7–100)	46 (43–49)	42 (39–45)
Rate of referrals to specialists[a]	6 (1–16)	45 (42–49)	42 (41–45)
Rate of admissions to hospital[a]	0.5 (0–1)	46 (44–49)	42 (40–45)
Practice prescribing profile			
Rate of prescription per patient contact	0.9 (0.4–2.3)	40 (37–43)	47 (44–49)
Number of medicated individuals per 1000 listed patients during the first quarter of 1995	449 (268–845)	38 (36–40)	50 (47–53)
Number of pharmaceutical agents prescribed during the first quarter of 1995	235 (102–381)	43 (39–46)	45 (42–47)

[a]Rate per 100 consultations.

telephone consultations, and home visits per doctor per day),
- the clinical work profile in the practice (rate of diagnostic procedures, minor surgical procedures, referrals to specialists, and admissions to hospital), and
- the practice prescribing profile (rate of prescriptions per contact, number of medicated individuals per 1000 listed patients during the first quarter of 1995, number of different pharmaceutical agents prescribed during the first quarter of 1995).

Of the 173 practices, 99 were solo practices and 74 were group practices. Their characteristics are presented in Table 1. For group practices, the prescriber profile and the practice characteristics reflect the aggregated data for all doctors working in the same practice. For solo practices, the data reflect only one doctor, for whom we also analysed the influence of age, sex, and the number of years in general practice.

Data analysis and statistical tests

Data were analysed using backward stepwise weighted linear multiple regression (SPSS/PC+, version 7.5).[12] The standardized proportion of MPP for each practice (P_i) was used as the dependent variable. To adjust for right skewness in this proportion, and to avoid nonsense predictions of these proportions (below zero or above unity), we used the logged odds: $\ln([P_i/(1–P_i)])$. The least squares regression was weighted by the reciprocals of the total number (n_i) of listed patients in the practice ($n_i \times P_i/(1–P_i)$) to adjust for heteroskedasticity of the error terms.[13] This method is effectively logistic regression to grouped data and it allows for the interpretation of odds ratios (OR) as effect measures. The OR indicates a factorial change in PP prevalence per unit change in the study variable. ORs below unity reflect an inverse relation between the independent variable studied and the prevalence of PP. Selection of predictors was based on backward stepwise regression at the 5% significance level. The chosen equation was checked for remaining systematic patterns in the regression errors, such as heteroskedasticity and sensitivity to practices with very large errors.

Results

A six-fold variation between practices was found in the age and sex standardized prevalence of MPP (from 16 to 96 per 1000 listed patients; median = 42). Table 1 shows the results of the bivariate analysis testing the influence of practice characteristics on the prevalence of MPP. Each of the practice characteristics were dichotomized according to the median value, and the prevalence of MPP calculated for the groups below and above the median.

In the multivariate model (Table 2) produced by the regression analysis, only variables with an OR significantly different from 1 were included. Six of the introduced variables were identified as significant predictors of MPP: number of patients listed per doctor, rate of surgery consultations, rate of telephone consultations, rate of admission to hospital, rate of prescriptions per patients contact, and number of pharmaceutical agents prescribed during the first quarter of 1995. The multiple correlation coefficient was 0.76, indicating that the six predictors explained 56% of the variation in MPP between practices.

Among GPs working single-handed (Table 3), the prevalence of MPP was significantly lower for female GPs (36 per 1000 listed patients; CI = 30–42) than for male GPs (46 per 1000; CI = 43–49). We found no influence of age of the doctor or number of years in general practice on the prevalence of MPP.

Discussion

This study showed a six-fold interpractice variation in the prevalence of MPP. In a previous study we found that the patient's age, sex, and the type of health problem were predictors of PP.[6] The variation found in the present study could not be explained by different age and sex distributions among listed patients because the proportion of MPP was standardized for age and sex. However, unequal distribution of health problems (casemix) might be responsible for some of the differences in prevalence of PP between practices. Studies of the pattern of 'reasons for encounter' in Danish general practice do not demonstrate

Table 2. Predictors of major polypharmacy in general practice. Partial odds ratios calculated from multiple regression analysis. Number of practices n = 173; multiple regression coefficient R = 0.76.

Predictors of major polypharmacy in general practice	Odds ratio (95% CI)[a]
Number of patients listed per doctor[b]	0.90 (0.84–0.97)
Rate of surgery consultationsc	1.46 (1.34–1.58)
Rate of telephone consultations[c]	1.32 (1.22–1.45)
Rate of admissions to hospital[d]	0.70 (0.60–0.82)
Rate of prescriptions per patient contact	2.05 (1.74–2.42)
Number of pharmaceutical agents prescribed during the first quarter of 1995[e]	1.25 (1.11–1.35)

[a]The partial odds ratio (OR) measures the impact of the predictor variable on PP when effects of all other practice characteristics are controlled for. An OR below unity indicates a negative association between the predictor and MPP, and an OR above unity a positive association. The OR value of 0.9 associated with 'number of patients listed per doctor' (patients measured in 100s) implies that an increase in the number of listed patients by 100 patients decreases the risk of PP by 10%. The OR value of 1.46 associated with 'rate of surgery consultations' (consultations measured in IDs) implies that an increase in the number of surgery consultations by 10 per day increases the risk of PP by 46%. [b]OR per 100 listed patients in practice; [c]OR per 10 consultations per doctor per day; [d]OR per 100 consultations; [e]OR per 100 pharmaceutical agents (ATC code, fifth level).

Table 3. Prevalence of major polypharmacy (number per 1000 listed patients) in solo practices (n = 99) as a function of the doctor's sex, age, and the number of years in general practice.

Characteristic	Prevalence of MPP (95% CI)
Sex of the doctor	
female	36 (30–42)
male	46 (43–49)
Age of the doctor	
£39 years old	40 (31–49)
40–49 years old	45 (41–48)
50–59 years old	47 (41–52)
³60 years old	43 (26–59)
Number of years in general practice	
<10 years	45 (40–49)
³10 years	46 (41–50)

substantial interpractice variation.[14-17] Furthermore, studies focusing on the underlying medical problems among patients attending general practice have not been able to explain the marked differences found in prescribing rates between general practices.[18,19] It is therefore unlikely that casemix plays an important role for the variation in PP in this study.

Denmark is a rather small country with less variation in sociodemographic composition than most other countries,[20] and the Danish health system is characterized by strong similarities across regions. Less than 4% of the Danish population have a foreign citizenship,[20] and the potential influence of ethnic mix as seen in other countries' inner-city practices is relatively low in Denmark. A recent study of determinants of general practice use in Denmark did not find any association between use of the doctor and sociodemographic factors among the listed patients.[21] Therefore, we believe that the potential variation in socioeconomic deprivation between listed patients is rather small and may only have little influence on the variation in PP between practices.

We used a population-based prescription database covering all inhabitants of Funen (about 10% of the Danish population). The age and sex distribution of this population is similar to the total Danish population,[20] and the total sale volume of various drugs corresponds to the national average.[8] We therefore assume that the study population is representative for the whole country.

Our data clearly demonstrate a relationship between the prevalence of MPP and the characteristics of the practice, since six factors related to the practice were significant predictors of MPP, and more than half (56%) of the total variation between practices could be explained by the identified predictors.

The inverse relationship between list size and prevalence of MPP may be explained by a reduced number of individual patient contacts and a low availability of the doctor in practices with many listed patients. The observation is in agreement with other studies of the relationship between doctor availability and prescribing patterns; these have shown that practices with a large number of listed patients prescribed significantly fewer drugs per patient than practices with a low number of listed patients.[22,23]

We found that busy working doctors were more inclined to prescribe multiple drug prescriptions than doctors with more time and lower pressure. Two factors of workload significantly influenced the prevalence of PP: the surgery consultation rate (OR = 1.46) and the telephone consultation rate (OR = 1.32). Other studies have also found that practices with a high workload tended to have a high prescribing rate.[24,25] A substantial number of prescriptions in general practice are issued following telephone contacts,[26] and it has been shown that telephone consultations may be associated with over-prescribing and inadequate care.[27]

Patients registered with practices that demonstrated a high level of prescribing in general also had a high prevalence of MPP. At first glance, this relation may seem evident, as a high prevalence of MPP in itself may lead to a high prescribing rate. However, the contribution of individuals with MPP to the practice prescribing rate was negligible. Exclusion of individuals with MPP before calculating the practice prescribing rate did not significantly change our estimate of the relation between practice prescribing rate and the prevalence of MPP.

In Denmark, one-third to a half of consultations in general practice result in a prescription.[28] In addition, some prescriptions are issued as repeat prescriptions, without an accompanying consultation. Repeat prescriptions are most often processed by the secretary of the practice for later authorization by the doctor. For such prescriptions it may be difficult for the doctor to decide whether continuation of the medication is necessary because there is no accompanying examination of the patient. Studies of drug regimes in individuals subject to multiple drug use have shown that many repeat prescriptions are superfluous and a substantial number of treatments should be stopped.[29-30] There is thus an increased risk of PP in practices with a high number of patients on repeat prescriptions.

Practices using a wide range of different drugs showed a high prevalence of MPP. It has been postulated that physicians are able to master only a limited number of drugs,[31] and high-quality

prescribing may therefore be associated with the use of a limited number of pharmaceutical products that are well known to the prescriber with respect to pharmacodynamics, pharmacokinetics, adverse effects, potential interactions, price, package sizes, and methods of administration.

The negative effect of admission rate on the prevalence of MPP may reflect the fact that all treatments are scrutinized on admission to hospital, and unnecessary or inappropriate drugs are likely to be discontinued. In a study from a geriatric ward,[32] 40% of all drugs were discontinued and not replaced by others during a hospital stay.

In our study, the prevalence of MPP was calculated as the proportion of individuals who purchased five or more prescription drugs within a period of three months. Non-subsidized drugs and over-the-counter (OTC) drugs were not included in the analysis. Studies of drug use in the population have shown a highly specific association between use of prescription drugs and OTC drugs. The actual number of individuals who were subject to MPP may thus be higher than the figures that were calculated in our study.

Conclusion

More than half of the six-fold variation in MPP between general practices can be explained by predictors related to the practice structure, the workload, the clinical work profile, and the practice prescribing profile.

Keypoints

- Polypharmacy, the simultaneous use of multiple drugs, may be associated with adverse drug reactions, medication errors, and increased risk of hospitalization.
- The concurrent use of five or more drugs (major polypharmacy) represents a particular risk.
- A substantial interpractice variation in the prevalence of major polypharmacy among listed patients was found.
- Predictors related to practice structure, workload, clinical work profile, and prescribing profile could explain 56% of the variation in major polypharmacy between practices.

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