Faisal S, Zairina E, Nathishuwan S, Khotib J, Kristina S, Nugrahe G. Prevalence and predictors of discharge polypharmacy in geriatric patients discharged from an Indonesian teaching hospital: a retrospective observational study. Pharmacy Practice 2024 Jan-Mar;22(1):2900.

https://doi.org/10.18549/PharmPract.2024.1.2900

Original Research

Prevalence and predictors of discharge polypharmacy in geriatric patients discharged from an Indonesian teaching hospital: a retrospective observational study

Shah Faisal, Elida Zairina, Surakit Nathishuwan, Junaidi Khotib, Susi Ari Kristina, Gesnita Nugraheni

Received (first version): 09-Jun-2023 Accepted: 06-Jul-2023 Published online: 18-Jan-2024

Abstract

Objective: The study aimed to investigate the prevalence and risk factors for discharge polypharmacy in geriatric patients in Indonesia. **Methods:** The retrospective cohort study used the medical record profiles of geriatric patients aged ≥ 60 years admitted to the inpatient ward between July 2018 and October 2019. Using three logistic regression models, we assessed the association of the patient's demographic, clinical characteristics, and disease condition with discharge polypharmacy. The use of five or more medications was defined as discharge polypharmacy. **Results:** A total of 1533 patients were included in the study. Most patients (78.21%) aged between 60 and 74 years. The male-to-female patient ratio was almost the same (50.16% versus 49.83%). Of the patients (52.51%) were discharged with polypharmacy. According to regression model I, patients who had a chronic condition, comorbidity, stayed in the hospital for ≥ seven days, had a Charlson comorbidity index score (3-4), and received excessive polypharmacy (≥ 10 drugs) during admission had significantly more risk ($p< 0.05$) to receive polypharmacy at discharge. The results of model II investigated myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, chronic obstructive pulmonary disease, diabetes mellitus, diabetes with complications, renal disease, and high blood pressure as significant ($p<0.05$) predictors of discharge polypharmacy. The combined model III evaluated that comorbidity, length of hospital stay (7 or more days), excessive polypharmacy use in the hospital, myocardial infarction, and congestive heart failure were significantly ($P < 0.05$) associated with discharge polypharmacy. **Conclusions:** Polypharmacy is common in Indonesia and is linked to certain chronic conditions and other clinical factors. A particular plan that includes a pharmacist and physician collaborative relationship and awareness of the health outcomes of polypharmacy could be critical.

Keywords: discharge polypharmacy; prevalence; elderly; chronic conditions; Indonesia

INTRODUCTION

A large number of people around the world are living longer. According to the World Health Organization, the population aged 60 years or more is predicted to reach 2 billion by 2050, which was 900 million in 2015.[1] Indonesia is no exception; the population of 60 years and above reached 25.7 million in 2019, accounting for 9.6% of the total population.[2] The elderly population in Indonesia is increasing at a higher rate and is predicted to rise by 20 % in 2040.[3]

In recent decades, as the elderly population is growing, the number of older adults with chronic conditions has dramatically increased in many countries, mostly due to the ageing of the population.[4] Among the chronic diseases, cardiovascular disease, cancer, diabetes mellitus, and dementia are the most common in elderly persons, leading to impaired physical function, dependence, high healthcare costs, and deaths.[4,5] A study found that approximately 92% of the elderly tended to have at least one chronic condition, such as heart disease, diabetes mellitus, stroke and cancer.[6] These chronic conditions account for over two-thirds of all fatalities each year. Due to the increased prevalence of chronic disease among the elderly, they are prone to taking multiple medications that could lead to polypharmacy exposure, which has negative implications.

The term polypharmacy has evolved; polypharmacy was numerically defined as five or more medications daily.[7] Polypharmacy affects several aspects of medication safety. Polypharmacy is associated with an increased risk of adverse events due to altered pharmacokinetics and pharmacodynamics with advancing age.[8] It is also associated with a higher risk of potentially inappropriate medications (PIMs), non-adherence, adverse drug reactions, drug-drug interactions, and poorer health outcomes.[9,10] Nonetheless, studies reported that 20%–65% of elderly patients were taking at least one potentially

Shah FAISAL. Doctoral Program of Pharmaceutical Sciences Study Program, Faculty of Pharmacy, Universitas Airlangga, Surabaya, Indonesia. Shah.faisal-2021@ff.unair.ac.id
Elida ZAIRINA*. Department of Pharmacy Practice, Faculty of Pharmacy, Universitas Airlangga, Surabaya, Indonesia. Elida-z@ff.unair.ac.id
Surakit NATHISHUWAN. Department of Pharmacy, Faculty of Pharmacy, Mahidol University, Bangkok, Thailand. surakit.nat@mahidol.ac.th
Junaidi KHOTIB. Department of Pharmacy Practice, Faculty of Pharmacy, Universitas Airlangga, Surabaya, Indonesia. Junaidi-k@ff.unair.ac.id
Susi Ari Kristina. Department of Pharmaceutics, Faculty of Pharmacy, Gadjah Mada University, Yogyakarta, Indonesia. susiari_k@ugm.ac.id
Gesnita NUGRAHENI. Department of Pharmacy Practice, Faculty of Pharmacy, Universitas Airlangga, Surabaya, Indonesia. gesnita-n@ff.unair.ac.id

www.pharmacypractice.org (eISSN: 1886-3655 ISSN: 1885-642X)

https://doi.org/10.18549/PharmPract.2024.1.2900

inappropriate medication.[11,12] Furthermore, multiple medications could also increase healthcare utilisation due to the increased risk of hospitalisation.[13] The prevalence of polypharmacy is high in developing countries, and studies from Egypt and Vietnam reported the prevalence of polypharmacy as 85.3% and 59.2%, respectively.[14,15] Therefore, it is of prime concern to obtain a comprehensive understanding of the prevalence of polypharmacy in the elderly, particularly in developing countries with a growing number of elderly populations and chronic diseases.

Indonesia, a rapidly growing elderly population,[3] may experience more health issues associated with polypharmacy which could, in turn, increase healthcare expenditure. Since 2000, total health expenditure in Indonesia has tripled with private spending accounts for two-thirds of total health expenditure. The archipelago is facing an additional disease burden on a national scale, even though changing lifestyles have rapidly increased the prevalence of non-communicable diseases (NCDs). The cost of healthcare procurement has risen significantly, as has the cost and difficulty of implementing universal healthcare.[16] The epidemiological trends of NCDs predict a rise in medications for chronic diseases, which entails investigating medications among geriatrics in Indonesia.[16]

Despite the fact that polypharmacy is a public health issue in Indonesia, it has not been adequately investigated. Previous research in Indonesia focused on the outcomes of polypharmacy, such as the link between polypharmacy and PIMs and unnecessary drug therapy.[13,17] Some studies also documented the prevalence of polypharmacy in Indonesia in different settings, and the results showed that the prevalence of polypharmacy in specialised healthcare or tertiary care hospitals was high (24%, 57%, and 70.8%) [18-20] compared with primary health care facilities (5%).[17] However, we could not locate a study that looked into the prevalence and risk factors of discharge polypharmacy in the elderly population of Indonesia. In Indonesia, there is a severe lack of knowledge about administering multiple medications, particularly polypharmacy. As a result, the study sought to determine the prevalence of polypharmacy in a secondary care setting in Indonesia and the risk factors associated with discharge polypharmacy that will help the healthcare prescriber to target the vulnerable population and prescriber carefully.

METHODS

Study design, setting, and study participants

The current study was a retrospective cohort study that collected data from a secondary teaching hospital in Surabaya, one of the biggest hospitals in the city. The secondary data from July 2018 to October 2019 provided by the hospital medical record department was obtained. The study's inclusion criteria were patients aged 60 years or above, having complete medical records, and staying in the hospital for at least 24 hours.

Data collection

The data was obtained over a four-month period from 2 p.m. to 8 p.m. on all working days to avoid interrupting the hospital services during the busy working hours (8 a.m. to 2 p.m.). The patients' files provided by the hospital were reviewed, and those that met the study's inclusion criteria were included. The demographic and clinical characteristics of the patient were obtained from the patient's medical profile. The researcher recorded the medications prescribed based on their generic and brand names. This study protocol was approved by the Research Ethics Committee of Airlangga University Hospital, Surabaya, Indonesia (reference number: 164/KEP/2020). The requirement to obtain written informed consent was waived due to the retrospective nature of the study.

Demographic and clinical variables

The demographic characteristics obtained from the medical profile include gender, age, marital status, and living area. The clinical characteristics of the patients have a diagnosis at the time of admission, medications used during hospital admission and prescribed at discharge, discharge destination, and length of hospital stay (LOS). We define comorbidity as multiple disorders or conditions in an individual.[21] The Charlson's comorbidity index score was calculated according to the weightage of conditions.[22] Length of hospital stay (LOS) was the total days from admission to discharge. Polypharmacy during admission was defined as using 5-9 medications, while excessive polypharmacy used ten or more medications.[13] For better analysis, the author grouped the medication used in the hospital as polypharmacy and excessive polypharmacy. Discharge polypharmacy was the prescription of five or more medicines to patients upon discharge, and several previous studies use this exact definition.[7]

Statistical analysis

Data were analysed using a statistical package for social science (SPSS) version 25. We perform descriptive analysis using frequencies and percentages for the variables. Chi-square non-parametric (Mann U Whitney) tests were performed to find a significant difference between patient characteristics and discharge polypharmacy. Screening the predictors that affecting polypharmacy was done using binary logistic regression. Three different logistic regression models were used to assess polypharmacy at discharge as the outcome.

Model 1. Patient demographic and clinical characteristics (sex, age, marital status, city of living, chronic condition, comorbidity, CCI score, LOS, discharge determination, and medication used in the hospital).

Model II. Myocardial infarction, congestive heart failure (CHF), peripheral vascular disease (PVD), cerebrovascular disease (CVD), plegia, COPD, diabetes mellitus (DM), diabetes with complications, renal disease, mild liver, severe liver, cancer, metastases, dementia, rheumatoid arthritis, human immune deficiency virus (HIV), and high blood pressure.

Model III. The combined model includes all the variables of model I and model II.

The results for model I and II are presented as Crude odds ratio (COR), adjusted odds ratio (AOR) with 95 % confidence interval

https://doi.org/10.18549/PharmPract.2024.1.2900

(CI), and P-value. The results for model III are presented as standard error (SE), AOR with 95% CI, and P-value. A p-value of less than 0.05 was used to report the significant results.

RESULTS

Patients' characteristics

A total of 1533 patients were included in the study. The male-to-female patient ratio was almost the same (50.16% versus 49.83%). A chronic condition was found in 93.67% of patients. Among the patients, 51.59% stayed in the hospital for 4-6 days, while 91.23% took five or more medicines during their admission. The descriptive information on the patient's demographics and clinical characteristics can be seen in table 1.

Discharge polypharmacy was prevalent in the male gender and age group (60-74 years). Among the clinical characteristics, discharge polypharmacy was more prevalent in patients with chronic conditions and comorbidity. Patients' characteristics having significant differences (P < 0.05) with discharge polypharmacy include marital status, chronic condition, comorbidity, CCI score, LOS, discharge destination, and the use of polypharmacy in the hospital. Patients diagnosed with myocardial infarction, CHF, PVD, CVD, COPD, DM, and high blood pressure have significantly received more polypharmacy than those who don't have these health conditions. The prevalence of discharge polypharmacy based on the demographic and clinical characteristics of the patients is shown in table 1. Furthermore, the 35 most prescribed medications at discharge with ATC code (level_5) (23) can be seen in Table A Supplement.

Table 1. Patient's demographics and clinical characteristics based on discharge polypharmacy (n=1533)

Characteristics	n (%)	Discharge Polypharmacy		P-Value*
		No (n = 728)	Yes (n = 805)	
Gender				
Male	769 (50.16)	353 (48.5%)	416 (51.7%)	0.213
Female	764 (49.83)	375 (51. 5%)	389 (48.3%)	
Age				
60-74 years	1199 (78.21)	552 (75.8)	647 (80.4)	0.073
75-84 years	266 (17.35)	143 (19.6)	123 (15.3)	
≥ 85 years	68 (4.43)	33 (4.5)	35 (4.3)	
Marital status				
Single	36 (2.34)	24 (3.3%)	12 (1.5%)	0.032
Married	1121 (73.12)	517 (71%)	604 (75%)	
Divorced	376 (24.52)	187 (25.7%)	189 (23.5%)	
City of living				
Outside of Surabaya	94 (6.13)	35 (4.8%)	59 (7.3%)	0.040
Surabaya	1439 (93.86)	693 (95.2%)	746 (92.7%)	
Chronic condition				
Absent	97 (6.32)	80 (11%)	17 (2.1%)	<0.001
Present	1436 (93.67)	648 (89%)	788 (97.9%)	
Comorbidity				
Absent	625 (40.76)	428 (58.8)	197 (24.5)	<0.001
Present	908 (59.23)	300 (41.2)	608 (75.5)	
CCI Score				
1 - 2	1033 (67.38)	575 (79)	458 (56.9)	<0.001
3 - 4	438 (28.57)	130 (17.9)	308 (38.3)	
≥ 5	62 (4.04)	23 (3.2)	39 (4.8)	
Length of hospital stay				
≤ 3 days	560 (36.52)	287 (39.4)	273 (33.9)	0.038
4 - 6 days	791 (51.59)	366 (50.3)	425 (52.8)	
≥ 7 days	182 (11.87)	75 (10.3)	107 (13.3)	
Discharge destination				
To Home	1485 (96.86)	682 (93.7%)	803 (99.8%)	<0.001
To another hospital	48 (3.13)	46 (6.3%)	2 (0.2%)	
Medications used in hospital				
Polypharmacy (5-9 drugs)	1400 (91.32)	684 (94%)	716 (88.9%)	<0.001
Excessive polypharmacy (≥10)	133 (8.63)	44 (6%)	89 (11.1%)	
Diseased condition				
Myocardial Infraction	287 (18.72)	65 (8.9%)	222 (27.6%)	<0.001
Congestive Heart Failure	302 (19.69)	81 (11.1%)	221 (27.5%)	<0.001
PVD	25 (1.63)	6 (0.8%)	19 (2.4%)	0.018
CVD	271 (17.67)	90 (12.4%)	181 (22.5%)	<0.001
PLEGIA	85 (5.54)	32 (4.4%)	53 (6.6%)	0.062
COPD	299 (19.50)	163 (22.4%)	136 (16.9%)	0.007
Diabetes Mellitus	525 (34.24)	210 (28.8%)	315 (39.1%)	<0.001
Diabetes with complications	49 (3.19)	17 (2.3%)	32 (4%)	0.068
Renal disease	104 (6.78)	47 (45.2%)	57 (7.1)	0.627
Mild liver	7 (0.45)	3 (0.4%)	4 (0.5%)	0.806
Sever liver	5 (0.32)	2 (0.3%)	3 (0.4%)	0.737
Ulcer	17 (1.10)	9 (1.2%)	8 (1%)	0.651
Cancer	23 (1.50)	15 (2.1%)	8 (1%)	0.086
Metastases	17 (1.10)	12 (1.6%)	5 (0.6%)	0.055
Dementia	22 (1.43)	12 (1.6%)	10 (1.2%)	0.504
Rheumatoid arthritis	4 (0.26)	3 (0.4%)	1 (0.1%)	0.270
HIV	3 (0.19)	2 (0.3%)	1 (0.1%)	0.506
High Blood Pressure	716 (46.70)	269 (37%)	447 (55.5%)	<0.001

CCI Charlson comorbidity index, PVD Peripheral Vascular Disease, CVD Cerebrovascular Disease, COPD chronic obstructive pulmonary disease, HIV human immune deficiency virus

https://doi.org/10.18549/PharmPract.2024.1.2900

Prevalence of polypharmacy

Of the patients (52.51%) received polypharmacy upon discharge, while 47.8% received less than five drugs (See Figure 1). Of patients who received five drugs, 377 (24.6%), were followed by 280 (18.3%) patients who received four drugs. The frequencies and percent of drugs described to patients upon discharge are illustrated in Figure 2.

Predictors of discharge polypharmacy

The regression analysis of Model I is illustrated in Table 2. Patients who had chronic conditions and comorbidity had significantly more risk (AOR = 2.197; 95% CI: 1.253 - 3.853) and (AOR = 3.452; 95% CI: 2.662 – 4.477), respectively, to receive polypharmacy at the time of discharge. The results also showed that patients who stayed in the hospital for ≥ seven days (AOR = 1.695), had a CCI score (3-4) (AOR = 1.565), and received excessive polypharmacy during admission (AOR = 1.647) had significantly (p = <0.05) increased likelihood of receiving polypharmacy compared to their counterparts, as shown in Table 2.

The results of model II showed that patients who had a myocardial infarction, CHF, PVD, CVA, COPD, diabetes mellitus, diabetes with complications, renal disease, and high blood pressure had a significantly increased risk (P < 0.05) of receiving discharge polypharmacy as shown in Table 2.

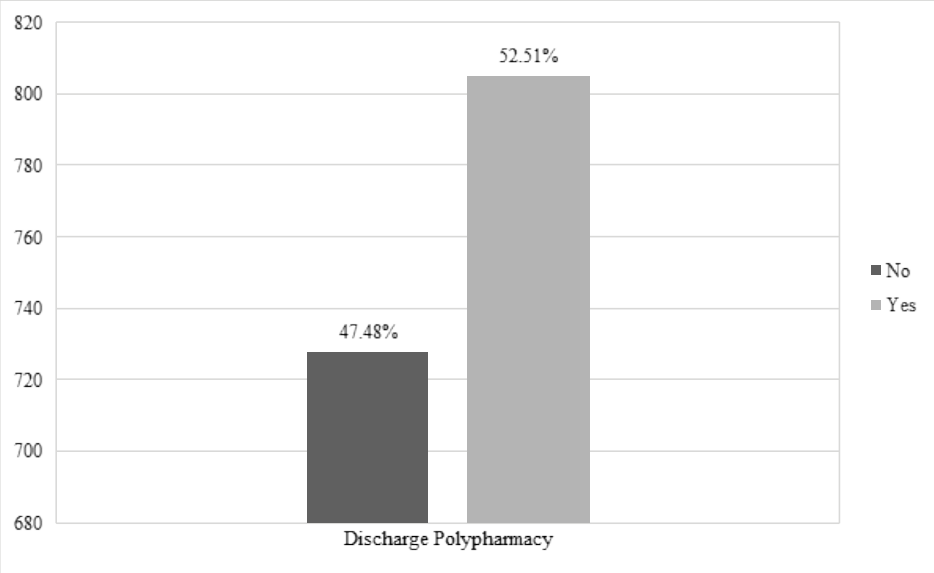

Figure 1. Prevalence of Discharge polypharmacy

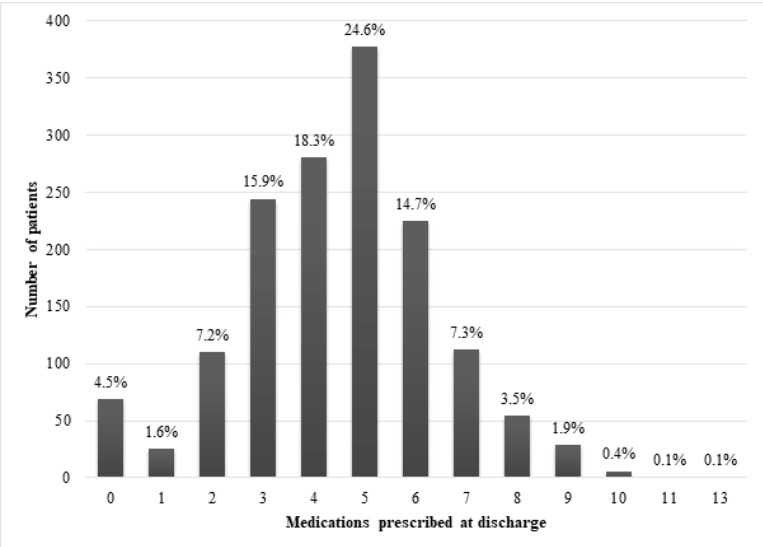

Figure 2. Frequency of medications prescribed to patients during discharge (n=1533)

www.pharmacypractice.org (eISSN: 1886-3655 ISSN: 1885-642X)

https://doi.org/10.18549/PharmPract.2024.1.2900

Table 2. Risk factors of polypharmacy based on Regression Model I and Model II (n = 1533)

Variables	COR	95% CI	P value	AOR	95% CI	P value*
Regression Model I						
Gender						
Male	Reference					
Female	0.880	0.720 – 1.076	0.213	0.897	0.706 - 1.141	0.376
Age						
60 - 74 Years old	Reference					
75 - 84 Years old	0.734	0.562- 0.598	0.023	0.794	0.587 - 1.073	0.133
≥85 Years old	0.905	0.555 - 1475	0.689	0.833	0.485 - 1.430	0.508
Marital status						
Single	Reference					
Married	2.337	1.157 – 4.719	0.018	1.897	0.864 - 4.162	0.110
Divorced	2.021	0.982 – 4.160	0.056	1.911	0.852 - 4.285	0.116
Area of living						
Outside of Surabaya	Reference					
Surabaya	0.639	0.415 – 0.982	0.041	0.632	0.394 - 1.015	0.057
Chronic condition						
Absent	Reference					
present	5.723	3.356 – 9.758	<0.001	2.197	1.253 - 3.853	0.006
Comorbidity						
Absent	Reference					
Present	4.403	3.540 – 5.477	<0.001	3.452	2.662 - 4.477	<0.001
Length of hospital stay						
≤ 3 days	Reference					
4 - 6 days	1.221	0.983 – 1.516	0.071	1.095	0.861 - 1.394	0.458
≥ 7 days	1.500	1.069 – 2.104	0.190	1.695	1.154 - 2.491	0.007
CCI score						
1 - 2	Reference					
3 - 4	2.974	2.342 – 3.777	<0.001	1.565	1.177 - 2.079	0.002
≥ 5	2.129	1.253 – 3.616	0.005	1.084	0.606 - 1.939	0.785
Medication used in hospital						
Polypharmacy (5-9 drugs)	Reference					
Excessive polypharmacy (≥10 drugs)	1.932	1.327 – 2.815	<0.001	1.647	1.069 - 2.538	0.024
Discharge destination						
Home	Reference					
Another hospital	0.37	0.009 – 0.153	<0.001	0.020	0.005 - 0.087	<0.001
Regression Model II						
Myocardial Infarction	3.884	2.883 – 5.232	<0.001	4.842	3.472 - 6.755	<0.001
Congestive heart failure	3.023	2.289 – 3.992	<0.001	3.803	2.802 - 5.161	<0.001
PVD	2.909	1.155 – 7.324	0.023	3.757	1.403 - 10.060	0.008
Cerebrovascular disease	2.056	1.561 – 2.709	<0.001	2.475	1.817 - 3.371	<0.001
PLEGIA	1.533	0.977 – 2.406	0.063	1.003	0.778 - 1.294	0.981
COPD	0.705	0.547 – 0.908	0.007	1.426	1.062 - 1.913	0.018
Diabetes mellitus	1.586	1.280 – 1.964	<0.001	2.174	1.701 - 2.779	<0.001
Diabetes with complications	1.731	0.953 – 3.145	0.072	1.880	1.357 - 2.603	<0.001
Renal disease	1.104	0.740 – 1.647	0.627	1.278	1.025 - 1.594	0.030
Mild liver	1.207	0.269 – 5.410	0.806	1.455	0.642 - 3.299	0.369
Sever liver	1.358	0.226 – 8.149	0.738	1.272	0.686 - 2.361	0.445
Ulcer	0.802	0.308 – 2.089	0.651	2.151	0.780 - 5.929	0.139
Cancer	0.477	0.201 – 1.132	0.093	1.115	0.706 - 1.763	0.641
Metastases	0.373	0.131 – 1.064	0.065	1.009	0.843 - 1.208	0.924
Dementia	0.751	0.322 – 1.748	0.506	1.009	0.392 - 2.595	0.985
Rheumatic disease	0.301	0.031 – 2.896	0.298	0.716	0.073 - 7.067	0.775
HIV	0.451	0.041 – 4.990	0.517	0.926	0.607 - 1.413	0.721
High Blood Pressure	2.131	1.736 – 2.615	<0.001	2.103	1.677 - 2.636	<0.001

CCI Charlson comorbidity Index, COR crude odds ratio, AOR adjusted odds ratio, CI confidence interval, PVD peripheral vascular disease, COPD chronic obstructive pulmonary disease, HIV human immune deficiency virus, COR crude odds ratio, AOR adjusted odds ratio, CI confidence interval.

Table 3 explains the results of model III. The risk factor of discharge polypharmacy based on model III were comorbidity (AOR = 2.029; 95% CI: 1.225 - 3.362), LOS (7 or more days) (AOR = 1.810; 95% CI: 1.210 - 2.706) excessive polypharmacy use during admission (AOR = 1.789; 95% CI: 1.141 - 2.806), myocardial infarction (AOR = 3.380; 95% CI: 2.063 - 5.537), and CHF (AOR = 2.396; 95%CI: 1.471 - 3.902). Patients' discharge to another hospital was inverse to discharge polypharmacy (AOR = 0.016; 95% CI: 0.004 - 0.069).

https://doi.org/10.18549/PharmPract.2024.1.2900

Table 3. Regression model III with polypharmacy as the outcome (n = 1533)

Variables	S.E	AOR	95% CI	P value*
Gender				
Male	Reference			
Female	0.128	0.937	0.729 - 1.204	0.611
Age				
60 - 74 Years old	Reference			
75 - 84 Years old	0.161	0.810	0.591 - 1.110	0.189
≥85 Years old	0.293	1.002	0.564 - 1.780	0.994
Marital status				
Single	Reference			
Married	0.422	2.015	0.881 - 4.608	0.097
Divorced	0.433	2.048	0.877 - 4.786	0.098
Area of living				
Outside of Surabaya	Reference			
Surabaya	0.258	0.666	0.402 - 1.104	0.115
Chronic condition				
Absent	Reference			
Present	0.349	1.714	0.865 - 3.397	0.123
Comorbidity				
Absent	Reference			
Present	0.258	2.029	1.225 - 3.362	0.006
Length of hospital stay				
≤ 3 days	Reference			
4 -6 days	0.129	1.112	0.863 - 1.432	0.413
≥ 7 days	0.205	1.810	1.210 - 2.706	0.004
CCI score				
1 - 2	Reference			
3 - 4	0.230	1.516	0.966 - 2.379	0.070
≥ 5	0.597	1.505	0.467 - 4.850	0.494
Medication used in hospital				
Polypharmacy (5-9 drugs)	Reference			
Excessive polypharmacy (≥10 drugs)	0.230	1.789	1.141 - 2.806	0.011
Discharge destination				
Home	Reference			
Another hospital	0.757	0.016	0.004 - .069	0.000
Conditions				
Myocardial Infarction	0.252	3.380	2.063 - 5.537	0.000
CHF	0.249	2.396	1.471 - 3.902	0.000
PVD	0.560	2.444	.816 - 7.319	0.110
CVA	0.244	1.384	.858 - 2.232	0.183
PLEGIA	0.379	0.549	0.261 - 1.153	0.113
COPD	0.244	0.876	0.543 - 1.414	0.589
Diabetes mellitus	0.230	1.297	0.827 - 2.035	0.257
Diabetes with complications	0.440	2.007	0.846 - 4.758	0.114
Renal disease	0.362	0.840	0.413 - 1.707	0.629
Mild liver	0.890	1.014	0.177 - 5.808	0.987
Sever liver	1.028	0.739	0.098 - 5.547	0.769
Ulcer	0.594	1.141	0.356 - 3.658	0.824
Cancer	0.547	0.539	0.184 - 1.575	0.259
Metastases	0.932	0.452	0.073 - 2.812	0.395
Dementia	0.498	0.756	0.284 - 2.007	0.574
Rheumatic disease	1.193	0.453	0.044 - 4.697	0.507
HIV	1.401	0.273	0.018 - 4.259	0.355
High Blood Pressure	0.231	1.255	0.799 - 1.972	0.325

CHF congestive heart failure, PVD peripheral vascular disease, CVA cerebrovascular disease, COPD chronic obstructive pulmonary disease, HIV human immune deficiency virus, S.E standard error AOR adjusted odds ratio, CI confidence interval.

DISCUSSION

In the current study, the weightage prevalence of polypharmacy among geriatric patients discharged from the hospital was high, at 52.15%. The prevalence of discharge polypharmacy is lower than in the study conducted in Oman, where the prevalence of polypharmacy at discharge was (76.3%).[24] In a study conducted in Malaysia among elderly patients over 60, polypharmacy was 45.9% using the exact definition,[26] in Slovakia, polypharmacy at discharge was 62.3% .[25] The high prevalence in our study can be attributed to 96.3% of the patients admitted to the hospital had chronic condition. In comparison, 59.23% had comorbidities that may result in an increased number of medicines prescriptions at discharge. Surprisingly, the current study found no significant difference in the prevalence of discharge polypharmacy between gender supported by the previous studies.[26, 27] However, some studies showed that the prevalence of polypharmacy was high in the female gender.[28-31] Due to behavioural factors of female individuals, such as their attitude towards health and willingness to seek care or gender-associated variation in prescriber diagnosis and treatment. Like the previous one,[24] this study found no significant difference in the prevalence of polypharmacy across age groups, although medication use increased with age.[32,33] Patients' characteristics with significant differences (P< 0.05) between polypharmacy include the patients' marital status consistent with the previous multicentre study in the elderly.[32] The chronic condition was also found to influence polypharmacy use at discharge. Previous international studies conducted in Singapore and Saudi Arabia support our findings.[9,34]

Similarly, we investigated the prevalence of polypharmacy in comorbid patients, consistent with the prior studies.[25,33] This study also found that the prevalence of polypharmacy increases with a high CCI score supported by prior studies.[35] Of those patients who received excessive polypharmacy in the hospital, the majority received polypharmacy at discharge. A previous study investigated an apparent increase in the number of medications received at release compared with the

https://doi.org/10.18549/PharmPract.2024.1.2900

drugs received at admission.[36] The study's findings suggest that patients who received excessive polypharmacy at admission needed sound therapy for management results in prescribing at discharge. Polypharmacy was also significantly more prevalent in elderly patients diagnosed with cardiovascular diseases like MI, CHF, CVD, and HTN. The results are expected, as clinical guidelines for managing cardiovascular diseases advocate using multiple medications.[37] Some prior studies also found an increased prevalence of polypharmacy with cardiovascular diseases.[38,39] Surprisingly, in the current study, polypharmacy was less prevalent in COPD patients than in previous studies.[33,38,40] The use of multiple medications in patients with COPD is also recommended in international guidelines.[41] The results also showed a significant increase prevalence of polypharmacy in patients with DM, in line with the previous studies (33, 38, 40).

Our study found a significant increase in the risk of polypharmacy use among those with chronic conditions (model I, AOR = 2.197) and comorbidity (model I, AOR = 3.452, and model III, AOR = 2.029). The association of polypharmacy with multiple chronic conditions is proved in prior international studies.[42,43] The current results suggest that there is a need for multiple medications to address comorbidities. However, on the other hand, polypharmacy can result in adverse events that increase the burden of illness, resulting in comorbidity.[44,45] Regression model II of our study revealed clear evidence that patients who were diagnosed with cardiovascular diseases like MI (AOR = 4.842), CHF (AOR = 3.803), PVD (AOR = 3.757), CVA = 2.475), HTN (AOR = 2.103), DM (AOR = 2.174), DM with complications (1.880), and renal disease (AOR = 1.278) had significantly more risk to receive polypharmacy at discharge. A patient diagnosed with myocardial infarction (AOR = 3.380) and CHF (2.396) was also proved in Model III to have a higher probability of receiving polypharmacy at discharge. In previous studies conducted in different parts of the world, polypharmacy has been linked to several cardiovascular diseases, as investigated in our study.[46,47] It is not new that polypharmacy has been associated with cardiovascular diseases. Evidence-based guidelines recommend the use of multiple drugs for the management of cardiovascular diseases. Diabetes mellitus was the significant determinant of polypharmacy supported by various prior studies.[25,38,37] According to regression model II, the presence of renal disease was also the significant predictor of polypharmacy in line with the prior study,[38]; however, regression model III did not record any association of polypharmacy with renal disease. The results also showed that patients receiving polypharmacy at discharge are inversely associated with discharge to another hospital (model I, OR = 0.031, (model III OR = 0.0160). The results suggest that patients were discharged with fewer medications to another hospital where they can get proper treatment, and the medicines for homes will be prescribed accordingly in the other hospital. Our study also found that patients with CCI scores (3-4) had significantly more risk of receiving polypharmacy at discharge, in line with the study conducted in Ethiopia that CCI score (mean ± SD = 3.39 ± 1.85) was the significant predictor of polypharmacy.[48] Those patients who received excessive polypharmacy (≥10 drugs) at admission had significantly more risk (Model I, AOR = 1.674) (model III, OR = 1.789) of receiving polypharmacy at discharge.

The study's major results reported chronic conditions and comorbidity as the critical risk factors associated with discharge polypharmacy. The relationship between chronic health conditions and polypharmacy exists because chronic conditions are primarily associated with complications, and multiple medications are used to manage the disease to treat these complications.[49] Although polypharmacy substantially increased with multimorbidity,[50,51] it could also be associated with one chronic disease,[52] The links between multiple chronic health conditions and polypharmacy use stem from these conditions being frequently associated with multiple complications. Older patients should have their medications reviewed regularly and carefully to reduce the risk of overprescription and polypharmacy, especially if they have multiple chronic conditions.

As a limitation, the current study is single-centred; therefore, the results should be used cautiously considering the whole population. However, this study was conducted in a large teaching hospital that receives patients from different backgrounds. Furthermore, the other limitation of the study is the lack of information about patients' previous medications and self-medications that might keep the patients in the non-polypharmacy group. A multicentre prospective observational study including patients from primary to tertiary healthcare centres is require, which can be generalised for the whole population to develop policies and interventions to overcome this global issue. Despite this, the study's limitation provides a framework to thoroughly evaluate the impact of polypharmacy on quality of life, mortality, and health care utilisation in Indonesia.

Moreover, this is the first study to investigate the prevalence and predictors of discharge polypharmacy in Indonesia, and very few studies investigated discharge polypharmacy globally. In addition, the study was conducted in a teaching hospital that provides better quality care than regular hospitals. This study will be used as a benchmark in future studies exploring other risk factors of discharge polypharmacy in Indonesia.

CONCLUSION

The study found a high rate of polypharmacy at discharge (52%) in the geriatric population with certain chronic conditions. Chronic conditions, comorbidity, Charlson Index score, length of hospital stay, and multiple medications in the hospital were all significantly associated with discharge polypharmacy. Cardiovascular diseases were investigated as the major risk factor associated with polypharmacy. The combined efforts of healthcare prescribers and pharmacists are necessary to improve medication use and minimise inappropriate polypharmacy.

ACKNOWLEDGEMENTS

The authors thank all medical record staff at Universitas

Airlangga Hospital, Surabaya, Indonesia, for assistance in data collection.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

FUNDING INFORMATION

This work was supported by Universitas Airlangga from the research grant Hibah Riset Mandat NO: 722/2021

AUTHOR CONTRIBUTIONS

All authors contributed to the study's conception and design. Material preparation, data collection, and analysis were performed by SF, JK, and EZ managed to secure the funding for this study. Shah Faisal wrote the first draft of the manuscript, and all authors (EZ, JK, SN, SAK and GN) have commented on the previous versions of the manuscript. All authors have read and approved the final version of the manuscript.

References

1. Guarner J. Three emerging coronaviruses in two decades: the story of SARS, MERS, and now COVID-19. Oxford University Press US. 2020;420-421.
2. world Health Organisation. Novel Coronavirus – China. https://www.who.int/csr/don/12-january-2020-novel-coronavirus-china/en/: WHO; 2020 8/June. Available from: https://www.who.int/csr/don/12-january-2020-novel-coronavirus-china/en/.
3. Centers for disease control and prevention. COVID-19. CDC; 2021 16-June. Available from: https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html.
4. World Health Organisation. WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020. https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020: WHO; 2020 8/June. Available from: https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020.
5. European Medicines Agency. Availability of medicines during COVID-19 pandemic European Medicines Agency; 2021 11-April. Available from: https://www.ema.europa.eu/en/human-regulatory/overview/public-health-threats/coronavirus-disease-covid-19/availability-medicines-during-covid-19-pandemic.
6. Haque M, Kumar S, Charan J, et al. Utilisation, availability and price changes of medicines and protection equipment for COVID-19 among selected regions in India: Findings and implications. Frontiers in pharmacology. 2021;11:582154.. https://doi.org/10.3389/fphar.2020.582154
7. Reyes MV. STUDENT ESSAY The Disproportional Impact of COVID-19 on African Americans. http://www.ncbi.nlm.nih.gov/pmc/articles/pmc7762908/
8. WOrld Health Organisation. COVID-19 dynamic infographic dashboard Iraq 2020-2022. WHO; 2022 7-June. Available from: https://app.powerbi.com/view?r=eyJrIjoiNjljMDhiYmItZTlhMS00MDlhLTg3MjItMDNmM2FhNzE5NmM4IiwidCI6ImY2MTBjMGI3LWJkMjQtNGIzOS04MTBiLTNkYzI4MGFmYjU5MCIsImMiOjh9
9. Weekly epidemiological update on COVID-19 - 1 June 2021, (42, 2021).
10. Organization WH. WHO medicines strategy 2004-2007: countries at the core. 2004. World Health Organization.
11. Treasury HMs, Revenue I. Increasing access to essential medicines in the developing world: UK Government policy and plans.
12. Organization WH. The world medicines situation. 2004. World Health Organization.
13. McIntyre D, Thiede M, Dahlgren G, et al. What are the economic consequences for households of illness and of paying for health care in low-and middle-income country contexts? Social science & medicine. 2006;62(4):858-865. https://doi.org/10.1016/j.socscimed.2005.07.001
14. Bale H. Consumption and trade in off-patented medicines. WHO Commission for Macroeconomics and Health Working Paper, February. 2001.
15. Organization WH. WHO guideline on country pharmaceutical pricing policies. World Health Organization; 2015. ISBN: 9241549033.
16. Wagner JL, McCarthy E. International differences in drug prices. Annu Rev Public Health. 2004;25:475-495. https://doi.org/10.1146/annurev.publhealth.25.101802.123042
17. Kasapçopur Ö. A Big Problem and debate in COVID-19 pandemics: equitable and effective access of the COVID-19 vaccines and waiver of intellectual property. Turkish Archives of Pediatrics. 2021;56(4):283. https://doi.org/10.5152/turkarchpediatr.2021.180621
18. Myhr K. Comparing prices of essential drugs between four East African countries and with international prices. Amsterdam: Health Action International. 2000;22:158-165.
19. Bala K, Sagoo K. Patents and prices. HAI news. 2000;112:1-11.
20. Gencarelli D. Average wholesale price for prescription drugs: is there a more appropriate pricing mechanism? 2002;1(775):1-19. http://www.ncbi.nlm.nih.gov/books/nbk561162/

21. Srivastava D, McGuire A. Analysis of prices paid by low-income countries-how price sensitive is government demand for medicines? BMC Public Health. 2014;14(1):1-12. https://doi.org/10.1186/1471-2458-14-767
22. Cameron A, Ewen M, Ross-Degnan D, et al. Medicine prices, availability, and affordability in 36 developing and middle-income countries: a secondary analysis. The lancet. 2009;373(9659):240-249. https://doi.org/10.1016/s0140-6736(08)61762-6
23. Saeed A, Saeed H, Saleem Z, et al. Evaluation of prices, availability and affordability of essential medicines in Lahore Division, Pakistan: A cross-sectional survey using WHO/HAI methodology. PloS one. 2019;14(4):e0216122. https://doi.org/10.1371/journal.pone.0216122
24. The World Bank. GDP per capita (current US$). The World Bank; 2022 14-May. Available from: https://data.worldbank.org/indicator/NY.GDP.PCAP.CD.
25. International Organization for Standardization. Country Codes Collection. 2023 11-June. Available from: https://www.iso.org/obp/ui/#search/code/.
26. Haque M, Islam S, Iqbal S, et al. Availability and price changes of potential medicines and equipment for the prevention and treatment of COVID-19 among pharmacy and drug stores in Bangladesh; findings and implications. Bangladesh Journal of Medical Science. 2020:36-S 50.
27. Aljadeed R, AlRuthia Y, Balkhi B, et al. The impact of COVID-19 on essential medicines and personal protective equipment availability and prices in Saudi Arabia. Healthcare; 2021. Multidisciplinary Digital Publishing Institute. 2021;9(3):290. https://doi.org/10.3390/healthcare9030290
28. Ayati N, Saiyarsarai P, Nikfar S. Short and long term impacts of COVID-19 on the pharmaceutical sector. Daru. 2020;28(2):799-805. https://doi.org/10.1007/s40199-020-00358-5
29. Cohen J, Neumann P, Ollendorf D. Valuing and pricing remdesivir: should drug makers get paid for helping us get back to work. Health Affairs Blog https://www healthaffairs https://doi.org/101377/hblog20200518. 2020;966027
30. Institute for Clinical and Economic Review. Alternative pricing models for remdesivir and other potential treatments for COVID-19. Institute for Clinical and Economic Review; 2020 5-June. Available from: https://icer.org/news-insights/press-releases/alternative_pricing_models_for_remdesivir/.
31. Akour A, Elayeh E, Tubeileh R, et al. Role of community pharmacists in medication management during COVID-19 lockdown. Pathogens and Global Health. 2021 2021/04/03;115(3):168-177. https://doi.org/10.1080/20477724.2021.1884806.
32. Global Initiative for Asthma. Global Strategy for Asthma Management and Prevention Global Initiative for Asthma; 2022 5-June. Available from: https://ginasthma.org/wp-content/uploads/2022/05/GINA-Main-Report-2022-FINAL-22-05-03-WMS.pdf
33. Szafranski W, Cukier A, Ramirez A, et al. Efficacy and safety of budesonide/formoterol in the management of chronic obstructive pulmonary disease. European Respiratory Journal. 2003;21(1):74-81. https://doi.org/10.1183/09031936.03.00031402
34. Yamaya M, Nishimura H, Deng X, et al. Inhibitory effects of glycopyrronium, formoterol, and budesonide on coronavirus HCoV-229E replication and cytokine production by primary cultures of human nasal and tracheal epithelial cells. Respiratory investigation. 2020;58(3):155-168. https://doi.org/10.1016/j.resinv.2019.12.005
35. Heinen N, Meister TL, Klöhn M, et al. Antiviral Effect of Budesonide against SARS-CoV-2. Viruses. 2021;13(7):1411. https://doi.org/10.3390/v13071411.
36. National Institutes for Health and Care Excelence. COVID-19 rapid guideline: critical care in adults. NICE; 2020 5-June. Available from: https://www.nice.org.uk/guidance/ng159.

Supplementary Table A. Top 35 most prescribed medications at discharge with ATC code (level_5)

ATC code (level_5)	Drug name	Frequency, n (%)
C08CA01	Amlodipine	378 (5.44)
J01DD08	Cefixime	363 (5.23)
C07BB07	Bisoprolol	319 (4.59)
C09CA06	Candesartan	312 (4.49)
C03CA01	Furosemide	294 (4.23)
N02BA01	Acetyl salicylic acid	263 (3.78)
B01AC04	Clopidogrel	238 (3.42)
A10AE04 + A10AB04	Insulin (glargine+lispro)	234 (3.37)
R05CB01	Acetylcysteine	226 (3.25)
C03DA01	Spironolactone	223 (3.21)
C10AA01	Simvastatin	215 (3.09)
A02BA02	Ranitidine	198 (2.85)
N02BE01	Paracetamol	191 (2.75)
A02BC01	Omeprazole	180 (2.59)
C10AA05	Atorvastatin	152 (2.19)
C01DA08	Isosorbide dinitrate	129 (1.85)
A10BB12	Glimepiride	119 (1.71)
C08CA05	Nifedipine	116 (1.67)
J01MA12	Levofloxacin	113 (1.62)
A10BA02	Metformin	104 (1.49)
R03CC02	Salbutamol	98 (1.41)
A02BC03	Lansoprazole	89 (1.28)
C09BX03	Ramipril	83 (1.19)
A02BX02	Sucralfate	82 (1.18)
M04AA02	Allopurinol	78 (1.12)
A03FA03	Domperidone	75 (1.08)
M01AG01	Mefenamic acid	71 (1.02)
H02AB04	Methyl prednisolone	61 (0.87)
QA03FA1	Metoclopramide	54 (0.77)
B03BB01	Folic acid	54 (0.77)
C09AA03	Lisinopril	47 (0.67)
P01AB01	Metronidazole	46 (0.66)
J01CA04	Amoxicillin	45 (0.64)
B01AA03	Warfarin	44 (0.63)
N07CA01	Betahistine	39 (0.56)