Potentially Inappropriate Medications Use among Older Adults with Comorbid Diabetes and Hypertension

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Research article

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Abstract

Background Potentially inappropriate medications (PIMs) are medications that should be avoided among older adults due to their risk which offsets their benefit. The objective of this study is to estimate the prevalence of PIMs use and to evaluate its associated factors among older adults with comorbid diabetes and hypertension using the 2019 Beers criteria.

Methods A cross-sectional retrospective study design was used. This study included 1,853 older adults (age ≥ 65 years) with comorbid diabetes and hypertension visited an ambulatory care setting in a large hospital in the central region of Saudi Arabia. The primary outcome was the prevalence of PIMs use based on the updated 2019 American Geriatric Society (AGS) Beers Criteria. The secondary outcome was the factors associated with the presence of PIMs use (use of one or more PIMs) by referencing the Beers Criteria list.

Results Almost one out of two individuals had PIMs use with the average number of medication taken was seven; where 40.3% of the older adults taken one PIMs, and about 16% were using two or more PIMs. The most commonly prescribed PIMs were the use of gastrointestinal and endocrine medications. High risk of PIMs use was among those with ischemic heart disease and anxiety comorbidities and those using multiple medications (i.e., polypharmacy).

Conclusions Given higher PIMs use among older adults with diabetes and hypertension comorbidities, tailored strategies and interventions to minimize the PIMs use in this population are warranted. There is a need for greater vigilance when managing patients with comorbid conditions to avoid the use of inappropriate medications.

Background

Comorbid chronic conditions among older adults population presented many challenges to the healthcare system given the growing prevalence and burden of chronic illnesses. The coexistence of two or more chronic conditions, also known as multimorbidity, is very common among older adults [1]. The most common disease cluster is diabetes and hypertension [2]; approximately two-thirds of adults with diabetes have hypertension comorbidity [3]. Managing older adults with multiple chronic diseases is much more complicated than managing those with a single condition. Which might result in a complex treatment regime, in terms of drug-disease interactions [4]. Clinical guidelines have been developed to describe standards of care to improve quality of healthcare. However, most clinical guidelines focus on single diseases and do not always provide management for individuals with comorbidities [5]. Therefore, older adults with comorbidities are at a greater risk of potentially inappropriate medications use due to the use of multiple medications to manage their chronic conditions.

Potentially inappropriate medications (PIMs) are medications that should be avoided among older adults due to their risk which offsets their benefit. Beers criteria are commonly used to identify PIMs, the latest update was in 2019 [6]. Approximately one-third of older adults prescribed at least one potentially

inappropriate medication [7–9]. PIMs use imposes a higher risk of hospital admission, adverse drug events, and other negative health outcomes [10–14]. Besides, PIMs use is associated with an economic burden on the patient, payer, and healthcare system [7, 15]. This can be amplified in older adults with comorbid diabetes and hypertension which are one of the top expensive health conditions [16], and a great economic burden exists when these conditions are comorbid [17].

Despite the growing body of research that has been done among older adults to identify PIMs use, insight into the PIMs use among specific disease clusters is limited. Thus, identifying PIMs use among older adults with comorbidities can provide effective tools in the clinical setting to identify individuals who are at higher risk than others. Likewise, the PIMs identification can improve the understanding of the prevalence and risk factors of PIMs use among older adults with comorbidities and develop strategies for avoiding and limiting the burdens of inappropriate medications. Recent years have witnessed a wide use of the real-world data, the electronic health records (EHRs), to conduct research and answer practical questions that help healthcare providers and policymakers to make informed health care decisions. Using the EHRs, a comprehensive source of inpatient and outpatient health records, the main purpose of this study was to identify the of PIMs use among older adults focusing on diabetes and hypertension comorbidity. These comorbidities are selected as they are the most common disease clusters and impose a higher burden on patients, payers, and the healthcare system.

Methods

Study Design

A cross-sectional retrospective study design was conducted. The study was approved by the institutional review board under protocol number (E-17-2580).

Data Source

This study had used data from the electronic health records database. The Institutional Review Board (IRB) was obtained. Data collected included patient's age, gender, marital status, nationality, prescribed medications, and diagnosed chronic conditions (using the International Classifications of Diseases – 9th edition, Clinical Modification (ICD-9-CM) codes).

Study Population and setting

Older patients, aged 65 years and older, with clinical diagnosis of both diabetes and hypertension were identified over a one year period from the EHRs and included in this study. The study was conducted among patients who received their care from ambulatory care setting in a large hospital in the central region of Saudi Arabia. This hospital provide health services with no cost to Saudi citizens who are mostly residents in Riyadh, the capital city, and also serves as a referral center for the whole country.

Measurements

The updated 2019 American Geriatric Society (AGS) Beers Criteria was used to identify

PIMs use [6]. This study identified the presence of PIMs use (use of one or more PIMs) by referencing the Beers Criteria list. PIMs use was further classified into (one, two, and three or more PIMs).

Demographic variables included age, gender, nationality, and marital status. Information about the diagnosed chronic health conditions was identified using the ICD-9-CM codes. This study identified the following chronic conditions: dyslipidemia, ischemic heart disease (IHD); asthma, osteoarthritis and osteoporosis, and anxiety. These conditions were selected as they are highly prevalent among older adults with diabetes and hypertension. Polypharmacy use among older adults was also measured and measured as the use of five or more medications.

Statistical Analysis

Descriptive and inferential statistics were used to identify the prevalence and associated factors of PIMs use in older adults. Chi-square tests, bivariate analysis, were used to assess the difference between older adults with and without PIMs in regards to sociodemographic and clinical characteristics. All factors with a probability value of < 0.05 were included in the regression analysis. Binary logistic regression was used to examine the factors associated with a higher likelihood of PIMs use. All statistical tests were performed using the Statistical Analysis Software, version 9.2 (SAS Institute Inc., Cary, NC).

Results

Table 1 displays the demographic characteristics and health conditions of the study population. There were 1,853 older adults (age $\geq$ 65 year) with comorbid diabetes and hypertension with an average age of seventy-two. Approximately 62% of the study population was women and the average number of diagnosed coexisting chronic conditions being three. Nearly 64%, 11%, 10%, 7% of the study population were diagnosed with dyslipidemia, asthma, osteoarthritis, and anxiety, respectively.

Findings of this study indicate that PIMs use occurred in 56% of older adults with comorbid diabetes and hypertension (Table 2). In addition, 40%, 13%, and 3% were prescribed one, two, and three or more PIMs, respectively. The most common PIMs use was gastrointestinal medications (54%), followed by endocrine agents (28%). The use of PIMs was significantly higher among those with IHD, anxiety disorder and those who were taking five or more medications (i.e., polypharmacy) ($p < .0001$). Older adults who were taking five or more medications were more likely to have PIMs use (adjusted odds ratio (AOR) = 4.14; confidence interval (CI): 3.06–5.60; $p < 0.001$) compared to those with four or fewer medications (Table 3). PIMs use was more likely among older adults with comorbid IHD (AOR = 2.12; CI: 1.35–3.32; $p < 0.001$) and anxiety (AOR = 3.08; CI: 1.87–5.07; $p < 0.001$) compared to older adults without these comorbidities.

Discussion

This study found that the higher use of potentially inappropriate medications among older adults with comorbid diabetes and hypertension when safer alternatives exist. This population is most vulnerable as

they suffer from other coexisting chronic conditions and take multiple medications to manage these conditions.

The updated 2019 Beers criterion were used to examine PIMs use. Findings from this study indicate that one out of two older adults with comorbid diabetes and hypertension are taking at least one inappropriate medication. Bazargan et al. in their cross-sectional study among 193 older adults with hypertension have found that one out of two participants had inappropriate medication use [18]. Published studies among older adults from the outpatient setting reported a lower rate, about one-third of older adults are prescribed of PIMs [7–9]. The rate of PIMs use in this study is considerably higher than the previously reported PIMs use among older adults. The higher rate of PIMs use may reflect the fact that this study focused on older adults with the most common disease cluster, diabetes and hypertension. These comorbidities usually require the use of multiple medications to manage their conditions. It has to be noticed that a commonly prescribed PIMs in the present study was the use of endocrine agents. Given that several drugs to manage diabetes are listed in Beers' criteria, it was not surprising to find a higher rate of inappropriate endocrine medications uses which should be avoided due to the increased risk of hypoglycemia. Other commonly prescribed PIMs were the use of gastrointestinal agents that include mainly proton pump inhibitors (PPIs). Studies examining PIMs use among older patients also documented a higher rate of inappropriate use of PPIs common among older adults [7, 18, 19]. Healthcare providers should carefully monitor the duration of the use of PPIs in older adults except for high-risk patients (e.g., chronic NSAID use) as recommended by the AGS. Besides, it is important that healthcare providers avoid prescribing potentially inappropriate endocrine medications listed as PIMs, and be aware of the Beer's criteria list. A systematic review of twenty-two published studies has shown that one of the barriers for prescribers to stop PIMs include the knowledge gap and lake of awareness about stopping or changing PIMs [20]. Coexisting chronic conditions were important factors for PIMs use. Seventy percent of the present study population who had dyslipidemia uses at least one PIM. Further, individuals with anxiety and IHD are more likely to use PIMs. Anxiety disorder has been identified as a predictor of PIMs use in other published studies [9, 21]. One of the most likely factors associated with PIMs use in this study was the use of five or more medications. Indeed, it is not surprising that using multiple medications leads to PIMs use. This is consistent with many studies that reported a higher likelihood to use PIMs among older adults using multiple medications [9, 22].

Multiple practical implications can emanate from the present study findings. The findings can be used to alert prescribers to the potential for improving prescribing in this vulnerable population. Endocrinologists and primary care healthcare providers need to provide routine screening for older adults mainly for those who are taking multiple medications. These screenings can detect PIMs early, thereby preventing the subsequent negative health consequences of inappropriate medications. Wang-Hansen et al. in their study among 232 acutely hospitalized older adults with multimorbidity in a Norwegian regional hospital found that 44% of the serious adverse drug events could have been prevented by adherence to the Screening tool for PIMs [23]. Further, stakeholders can incorporation Beers criteria as an indicator to evaluate the quality of prescribing in older adults and support the need for medication therapy management service to older adults with diabetes. There is also a need for increasing awareness of

healthcare providers of the PIMs that should be avoided by older adults, especially those taking care of patients with diabetes and hypertension.

Findings of this study highlighted that the 2019 AGS Beers criteria provide a valuable guide for improving quality of care for older adults. Given higher PIMs use among older adults with diabetes and hypertension comorbidities, tailored strategies and interventions to reduce the PIMs use in this population are warranted. There is a need for greater vigilance when managing patients with comorbid conditions to avoid the use of inappropriate medications. Medication review and management are important interventions as PIMs use and polypharmacy are connected and both are linked to poor health outcomes among older adults. With the projected growth of the rate of diabetes and hypertension, strategies to minimize the use of avoidable medications among this population are needed.

Strengths and Limitations

The uniqueness of this study is evaluating the factors affecting PIMs use among older patients with diabetes and hypertension comorbidities, a vulnerable population. Using electronic health records enabled us to use a large sample size and comprehensive data to identify the prescribed PIMs. Therefore, this study provides more understanding of the unnecessary use of PIMs and provides a knowledge base for stakeholders to minimize medications risk. Accordingly, this study addresses important information to policymakers about a serious of the problem of the PIMs use to take a lead in providing effective interventions s such as medication therapy management (MTM) service and proper diabetic care to reduce the use of PIMs. However, this study has some limitations. First, the findings of this study cannot be generalized to all older adults with comorbid diabetes and hypertension entirely as this study was conducted in a single setting in Saudi Arabia. Second, the unmeasured confounders such as the severity of chronic conditions, patients' beliefs and attitudes, prescriber and healthcare system factors are not available in the EHRs and were not adjusted in the analysis. Besides, given the nature of the study design, a causal relationship cannot be identified.

Declarations

Ethics approval and consent to participate

A secondary database "the Medical Expenditure Panel Survey (MEPS) database" a publically available database was used, therefore no ethical approval or consent to participate is required.

Consent for publication

Not applicable.

Availability of data and materials

The dataset supporting the conclusions of this article is available from the Medical Expenditure Panel Survey (MEPS) database, and openly made available for researchers at the following website: https://meps.ahrq.gov/data_stats/download_data_files.jsp.

Competing interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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Authors' Contributions

Dr.Monira Alwhaibi has participated in designing the study, drafting the manuscript, analysis, interpretation of the findings, revising the manuscript content and gave final approval of the final version of this manuscript.

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Tables

Table 1

Characteristics of the Study Population

Number and Raw Percentage of Characteristics by Potentially Inappropriate Medication Use among Older Adults with Comorbid Diabetes and Hypertension

	Total		PIMs Use		No PIMs Use			
	N	%	N	%	N	%	P value	Sig.
Total	1,853	100	1,039	56	814	44		
Age Mean(SD)	72(6.16)		72(6.11)		72(6.25)		0.183	
Average number of medications (SD)	7(0,19)		8(2,19)		5(0,16)		<0.0001	***
Average number of conditions (SD)	3(2,8)		3(2,8)		3(2,7)		<0.0001	***
Gender							0.121	
Male	710	38	382	54	328	46		
Female	1,143	62	657	58	486	43		
Marital Status							0.086	
Single	71	4	32	45	39	55		
Married	1,573	96	872	55	701	45		
Nationality							0.351	
Saudi	1,728	93	965	56	763	44		
Non-Saudi	123	7	74	60	49	40		
Dyslipidemia							0.124	
Yes	1,181	64	678	57	503	43		
No	672	36	361	54	311	46		
IHD							0.000	***
Yes	128	7	97	76	31	24		
No	1,725	93	942	55	783	45		
Asthma							0.341	
Yes	194	11	115	59	79	41		
No	1,659	90	924	56	735	44		
Osteoarthritis							0.185	
Yes	179	10	92	51	87	49		
No	1,674	90	947	57	727	43		
Osteoporosis							0.692	
Yes	163	9	89	55	74	45		
No	1,690	91	950	56	740	44		
Anxiety							0.000	***
Yes	126	7	99	79	27	21		
No	1,727	93	940	54	787	46		
Depression							0.572	
Yes	26	1	16	62	10	39		
No	1,827	99	1,023	56	804	44		
Polypharmacy							0.000	***
>=5	1,558	84	957	61	601	39		
0 to 4 drugs	295	16	82	28	213	72		

Note: Study Population Comprised of 1,853 older adults, age 65 years and older, with comorbid diabetes and hypertension

T-test was used to assess the association between age and number of medications and PIMs use

IHD: Ischemic Heart Disease; N:Number; PIMs: Potentially Inappropriate Medications; Rx: Medications; Sig: Significance

Asterisks (*) represent significant differences in PIMs use, ***P< .001

Table 2

Summary of the Findings of Potentially Inappropriate Medications to Be Avoided For Most Older Adults According to the 2019 Beers criteria

	N	%
Average number of PIMs (SD)	0.96 (0.86)	
Average number of medications (SD)	7.26 (3.16)	
Potentially Inappropriate Medications Use		
Yes	1,039	56.1
No	814	43.9
Number of Potentially Inappropriate Medications		
No PIM	814	43.9
One PIM	746	40.3
Two PIMs	245	13.2
Three or more PIMs	48	2.6
Classification of most common PIMs prescribed		
Gastrointestinal	675	36.43
Endocrine	535	28.87
Pain Medications (NSAIDs)	136	7.34
Antidepressants	9	0.49
Antispasmodics	8	0.43
Antipsychotics	4	0.22
Anti-infective	4	0.22
Genitourinary	1	0.05
Antiparkinsonian agents	1	0.05

Note: Study Population Comprised of 1,853 older adults, age 65 years and older, with comorbid diabetes and hypertension

N:Number; NSAIDs: Nonsteroidal anti-inflammatory drugs; PIMs: Potentially Inappropriate Medications

No use was reported for central or alpha blocker agents, first-generation antihistamines, antithrombotic, barbiturates, benzodiazepines, hypnotics, or skeletal muscle relaxants

Table 3

Adjusted Odds Ratios and 95% Confidence Intervals

From Logistic Regression on PIM Use among Older Patients with Comorbid Diabetes and Hypertension

	PIMs Use		
	AOR	95% CI	Sig.
Age	1.01	[0.99-1.02]	
Gender			
Male	0.96	[0.77-1.21]	
Female (Ref.)			
Marital Status			
Single	0.67	[0.40-1.11]	
Married (Ref.)			
Nationality			
Saudi	0.79	[0.52-1.20]	
Non-Saudi (Ref.)			
Dyslipidemia			
Yes	1.1	[0.88-1.38]	
No (Ref.)			
IHD			
Yes	2.12	[1.35-3.32]	**
No (Ref.)			
Asthma			
Yes	1.17	[0.83-1.64]	
No (Ref.)			
Osteoarthritis			
Yes	0.75	[0.54-1.06]	
No (Ref.)			
Osteoporosis			
Yes	0.92	[0.63-1.34]	
No (Ref.)			
Anxiety			
Yes	3.08	[1.87-5.07]	***
No (Ref.)			
Depression			
Yes	0.9	[0.36-2.31]	
No (Ref.)			
Polypharmacy			
>=5	4.14	[3.06-5.60]	***
0 to 4 drugs (Ref.)			

Note: Study Population Comprised of 1,853 older adults, age 65 years and older, with comorbid diabetes and hypertension. Reference group for PIMs was “No PIMs use”

IHD: Ischemic Heart Disease; AOR: Adjusted Odds Ratio; PIMs: Potentially Inappropriate Medications; Ref: Reference group; Sig: Significance.

Asterisks (*) represent significant differences in PIMs use

***P< .001; **.001 ≤ p < .01