Original Article

Polypharmacy and Medication Compliance among Patients with Type 2 Diabetes in Oman: *A Cross-Sectional Study*

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Abstract

The goal of this study was to estimate the prevalence of polypharmacy and medication compliance among patients with T2DM at a primary care clinic in Muscat, Oman, to determine whether various sociodemographic and clinical factors were associated with polypharmacy and to assess relationships between polypharmacy, compliance, and self-related health. It is a cross-sectional study conducted between September and November 2019 and included all adult T2DM patients attending the clinic. Data were collected using a questionnaire, face-to-face interviews, and electronic medical records. A total of 202 T2DM patients were included. The majority were female (56.9%) and ≥60 years old (45.5%). Most had two or more chronic health conditions (66.3%). The prevalence of polypharmacy was 83.1%. Overall, 65% and 92% of patients reported a high level of adherence to treatment and good-to-excellent health, respectively. In conclusion, Polypharmacy was common among T2DM patients and was significantly associated with age, common comorbidities, and T2DM duration.

Keywords: Polypharmacy, Medication compliance, Type 2 diabetes mellitus, Hypertension, Dyslipidaemia, Oman

Introduction

Polypharmacy refers to the concurrent use of multiple medications by a single patient [1, 2]. The precise criteria vary, with polypharmacy defined as any number of multiple medications from 2–6 or more, with the use of ≥10 drugs sometimes classified as hyper-polypharmacy; however, most researchers define polypharmacy as the concomitant administration of ≥5 medications [2-5]. Polypharmacy has been reported as a serious public health concern in many countries [4-7]. Due to the adverse health risks posed by polypharmacy, general practitioners are often encouraged to reduce the number of medications prescribed at a time to each patient [2, 4].

Globally, the prevalence of type 2 diabetes mellitus (T2DM) is increasing, particularly among the elderly (i.e. individuals over 65 years old); according to data from the International Diabetes Federation, the rate of diabetes in adults in 2019 was approximately 10% [8-10]. Patients with diabetes are at a particularly high risk of polypharmacy, especially since most require an assortment of medications to appropriately treat their diabetes and associated comorbidities like cardiovascular disease, hypertension, and cerebrovascular disease [3, 4, 11]. Unfortunately, there is evidence to suggest that the rate of polypharmacy is increasing among patients with T2DM [1, 12]. In Saudi Arabia, the prevalence of polypharmacy among diabetic patients has been observed to be alarmingly high at 77.9% [13].

Various factors have been associated with polypharmacy, including age, gender, socioeconomic status, education level, self-perceived health, body mass index (BMI), and the number of associated comorbidities [3-6, 13, 14]. In particular, elderly patients, those diagnosed with cardiovascular, endocrine, and gastrointestinal disorders, and those who use supplements are at higher risk of polypharmacy [6-8, 14, 15]. This study aimed to estimate the prevalence of polypharmacy and medication compliance among a sample of T2DM patients, and assess whether certain sociodemographic and clinical characteristics (i.e. BMI, smoking status, age, gender, education level, and the presence of chronic health conditions) were associated with polypharmacy and, finally, determine the relationships

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between polypharmacy, medication compliance, and self-related health.

Materials and Methods

This cross-sectional mixed-methods study was conducted between September and November 2019 at a family medicine clinic at the Sultan Qaboos University Hospital (SQUH), a tertiary university hospital in Muscat, Oman. The patient population at this clinic is composed primarily of local citizens from all over Oman, as well as expatriate employees working at the university and their families. The target population was T2DM patients attending the clinic during the study period. All adult patients aged ≥18 years old of both genders were included. No specific exclusion criteria were applied.

An English language questionnaire was designed to assess the patients' sociodemographic and clinical characteristics, disease-related factors, the number of medications prescribed, and self-rated health (one item). In addition, the Morisky-Green-Levine score was incorporated into the survey to determine the level of medication adherence [16]. Data were initially collected from the hospital information system; subsequently, face-to-face interviews with patients were conducted (after taking informed consent) to confirm the information gathered. Both the data collection procedures and interviews were conducted by trained healthcare personnel, including medical students, pharmacists, and doctors.

For this study, polypharmacy (i.e. the dependent variable) was defined as the concomitant use of ≥5 single therapeutic medication categories over six months, including both prescription and over-the-counter (OTC) medications. The independent variables consisted of age (<50, 50–59 or ≥60 years old), gender (male or female), marital status (single, married, divorced, or widowed), coexisting chronic health conditions (i.e. hypertension, dyslipidemia, etc.), an education level (illiterate, school or higher education), BMI category (normal, overweight, obese or extremely obese), blood pressure control (i.e. <140/90 mm/Hg), duration of T2DM in years and type of T2DM treatment (oral drugs only, oral drugs and one type of insulin or at least two types of insulin).

The data were analyzed using the Statistical Package for the Social Sciences (SPSS) software, Version 23 (IBM Corp., Armonk, New York, USA). For the descriptive analysis, categorical variables were presented as frequencies and percentages, while continuous variables were presented as means and standard deviations. A Chi-squared test was used to assess associations between variables. A *P* value of <0.050 was considered statistically significant.

Ethical approval was granted by the Medical Research Ethics Committee (MREC), College of Medicine & Health Sciences, Sultan Qaboos University (MREC approval #1968). Verbal informed consent was obtained from each participant.

Results and Discussion

A total of 202 T2DM patients who attended the clinic during the three-month study period were included in the study. Of these, 115 were female (56.9%) and 87 were male (43.1%). The mean age was 58.6 ± 10.4 years old, with 45.5% of the patients being ≥60 years old. The majority (66.3%) had two or more coexisting chronic health conditions, of which hypertension and dyslipidemia were the most common (65.8% each). About a third of the patients (38.6%) had controlled DM, as defined by glycosylated hemoglobin values of <7% **(Table 1)**. Overall, the polypharmacy rate was 83.1% (defined as the concurrent use of ≥5 medications), while the hyperpolypharmacy rate was 17.4% (defined as the concurrent use of ≥10 medications).

Table 1. Characteristics of patients with type 2 diabetes mellitus attending a primary care clinic in Muscat, Oman (N = 202)

	Characteristic	Total n (%)	Polypharmacy group (n = 167) n (%)	*P* value
Age in years	<50	42 (20.8)	27 (16.2)	0.011
	50–59	68 (33.7)	56 (33.5)	
	≥60	92 (45.5)	84 (50.3)	
	Mean ± SD	58.6 ± 10.4	59.7 ± 9.6	
Gender	Male	87 (43.1)	68 (40.7)	0.076
	Female	115 (56.9)	99 (59.3)	
Marital status	Single	3 (1.5)	3(1.7)	0.430
	Married	182 (90.1)	151 (90.4)	
	Divorced	5 (2.5)	3(1.7)	
	Widow	12 (5.9)	10 (6.0	
Education level	Illiterate	74(36.6)	63 (37.7)	0.133

	School	65 (32.2)	49 (29.3)	
	Higher education	63 (31.2)	55 (32.9)	
BMI category	Normal	31 (15.3)	26(15.6)	0.250
	Overweight	78 (38.6)	62 (37.1)	
	Obese	66 (32.7)	57 (34.1)	
	Extremely obese	27 (13.4)	22 (13.2	
Comorbidities	Hypertension	133 (65.8)	117 (70.1)	0.004
	Dyslipidaemia	133 (65.8)	119 (71.3)	0.001
Biochemical parameters	Mean SBP in mmHg	136.69	137.11	-
	Mean DBP in mmHg	72.33	71.83	-
	Mean HbA1c in %	7.76	7.70	-
DM variables	Controlled DM*	78 (38.6)	65 (38.9)	0.714
	Mean DM duration in years	11.41	11.97	0.016
Type of DM treatment	Oral drugs only	141 (69.8)	114 (68.3)	
	Oral drugs plus one type of insulin	53 (26.2)	47 (28.1)	0.032
	Two or more types of insulin	8 (4.0)	6 (3.6)	
	Mean number of medications ± SD	7.30 ± 3.15	8.28 ± 3.10	-

SD = standard deviation; BMI = body mass index; SBP = systolic blood pressure; DBP = diastolic blood pressure; HbA1c = glycated haemoglobin; DM = diabetes mellitus.
*Defined as HbA1c levels of <7%.

Apart from antidiabetic medications, the most prescribed drug category was antidyslipidaemia medications (75.7%), followed by antihypertensives (69.3%) and antiplatelets (52%). Within the antihypertensives category, angiotensin-converting enzyme inhibitors (ACEIs)/angiotensin II receptor blockers (ARBs) were the most common (78.2%). However, 6.9% of patients who received ACEI/ARB drugs were not hypertensive, with these medications instead prescribed due to their renal protective effects. Atorvastatin (58.7%) was the most frequently prescribed antidyslipidaemia medication, followed by rosuvastatin (39.4%) and simvastatin (1.9%). Of the 155 patients who were prescribed antidyslipidaemia medications, 22 patients (14.2%) were prescribed these drugs for secondary prevention purposes.

There was a significantly higher rate of polypharmacy according to T2DM duration, with patients diagnosed 10 years previously or more having a greater frequency of polypharmacy compared to those diagnosed 5–9 and <5 years previously (62% versus 23.3% and 14.7%, respectively; P = 0.005). Additionally, there was a significantly higher polypharmacy rate among patients aged ≥60 years compared to those aged 50–59 and <50 years (90.1% versus 82.4% and 69%, respectively; P <0.001). Age was also significantly related to the number of comorbidities, with 41.3% of patients aged ≥60 years old having three or more comorbidities compared to 19.1% of patients aged <60 years (P = 0.001). Although women had a higher polypharmacy rate compared to men, this difference was not statistically significant (86.8% versus 78.2%; P = 0.104). However, women did have a significantly higher rate of hyperpolypharmacy (59.3% versus 40.7%; P = 0.011). The likelihood of polypharmacy increased with the coexistence of both hypertension and dyslipidemia (odds ratio = 2.964, 95% confidence interval = 1.395–6.298).

In terms of their self-rated health, 92% of patients perceived themselves to be in good-to-excellent health, with only 8% believing themselves to be in fair-to-poor health. The relationship between polypharmacy and self-related health was not statistically significant (P = 0.233). However, the relationship between self-rated health and the number of co-existing comorbidities was significant, with a higher number of comorbidities associated with poorer health perceptions (P = 0.036). High, medium, and low levels of treatment adherence were reported by 65%, 29.9%, and 5.1% of patients, respectively. Overall, 64.2% of the patients in the polypharmacy group reported high adherence to treatment compared to 67.6% of patients taking fewer medications, with no significant relationship between polypharmacy and adherence to treatment (P = 0.088).

Essentially, pharmacological interventions aim to treat medical conditions using the most appropriate drug. However, polypharmacy can increase the risk of hospitalization, adverse drug events, drug-drug interactions, medication errors, and duplication of therapy, as well as negatively affect the quality of life and healthcare costs [1, 3, 13, 17]. Previous research has revealed that a unit increase in the number of drugs prescribed increases the incidence of drug-related problems by 8.6% [18]. In particular, polypharmacy can endanger the elderly due to impaired renal and hepatic function [2]. Despite these risks, patients still require treatment for coexisting health conditions; moreover, the use of multiple drugs in some cases can be more beneficial than monotherapy [11]. As such, there is some debate over

what constitutes appropriate pharmacotherapy for quality assurance monitoring purposes [3].

In the current study, the rate of polypharmacy was high (83.1%) among a sample of T2DM patients attending a family medicine clinic at SQUH. Reported polypharmacy rates in diabetic adults range widely from 54–84%, which may be potentially due in part to the use of different criteria to define polypharmacy [1, 8, 19-21]. Furthermore, various sociodemographic and clinical factors have been associated with polypharmacy, including age, number of comorbidities, and socioeconomic status [3-5, 22]. In particular, older adults (i.e. those aged 60 years or more) have been reported to have higher rates of polypharmacy compared to younger individuals [8, 13-15]. In the present study, polypharmacy was similarly found to increase significantly with age.

Comorbidities play a major role in the number of medications prescribed to diabetic patients [3, 13, 14]. As such, one possible explanation for the association between age and polypharmacy is the greater likelihood of comorbidities within older age groups. Indeed, approximately two-thirds of the T2DM patients in the present study had two or more coexisting chronic health conditions, while just under half were 60 years or older. Similar results have been reported elsewhere in the published literature [13, 23, 24]. For example, Iglay *et al.* noted that 97.5% of the adult T2DM population in the USA had at least one coexisting chronic disease, with 88.5% suffering from two diseases or more; moreover, up to 82.1% were hypertensive [21].

Another study observed that the prevalence of comorbidities increases with diabetes duration [25]. In contrast, the mean T2DM duration in the present study was very similar in the polypharmacy group compared to the total population. However, this is understandable given the high rate of polypharmacy affecting the vast majority of the total population. Moreover, as health services and drug prescriptions for local citizens are usually free or heavily subsidized in Oman, this may have affected the rate of polypharmacy, with several studies showing that individuals receiving free or inexpensive medical aid are at greater risk of polypharmacy [7, 14].

In the current study, BMI was not found to be significantly related to polypharmacy. While weight increases are associated with polypharmacy, obesity *per se* is an intermediate confounder and thus cannot be directly related to polypharmacy due to its potential link with other chronic diseases [26]. Moreover, while diabetic women in the present study had a higher rate of polypharmacy compared to men, this association lacked statistical significance. Conflicting results have been published in the literature regarding the effect of gender on polypharmacy [6, 7, 13, 26, 27]. These inconsistent findings may be due to the influence of other factors, such as age, comorbidities, and education level.

In the present study, the most frequent categories of medication administered to T2DM patients were lipid-regulating drugs, antihypertensive and antiplatelet medications. Previous studies have confirmed that these medications are commonly prescribed to diabetic individuals, alongside others like proton-pump inhibitors and nonsteroidal anti-inflammatory drugs [13, 26]. Polypharmacy can result in suboptimal therapeutic effectiveness and poor disease control due to high levels of medication non-adherence [28]. In contrast, the current study observed a relatively high rate of medication adherence (65%) according to the Morisky-Green-Levine score. Using the same tool, Cárdenas-Valladolid *et al*. observed that 65.7% of homebound elderly patients with polypharmacy were highly adherent to treatment [29]. Other studies evaluating compliance and polypharmacy have used a myriad of tools to assess medication adherence, such as telephone interviews, the Haynes-Sackett test, pill counts, and value judgments [28].

In the present study, the vast majority of T2DM patients (92%) perceived themselves to be in good-to-excellent health. However, a review of the existing literature revealed a dearth of comparable studies evaluating self-rated health in adult diabetic patients with polypharmacy. According to Badawi *et al*., 78% of diabetic adults in a Canadian community sample rated their health as either good, very good, or excellent, while the remaining 22% perceived themselves to be in poor-to-fair health; however, the polypharmacy status of the population was not assessed.[27] In turn, Bazargan *et al*. studied associations between polypharmacy and self-rated health in a non-diabetes-specific sample of older adults and found that polypharmacy was associated with poor self-rated health and depression [30]. However, it is worth noting that various confounders may play a role in self-perceived health ratings [30, 31].

This study had several strengths, such as the mixed methodology which involved several means of data collection, including a review of patient electronic records as well as face-to-face interviews. This allowed for the inclusion of other medications that the patients may have been taking, including those prescribed by other health institutes or over-the-counter purchases which might not otherwise have been noted in the patients' medical records. Moreover, assessment of the level of medication compliance and the patients' self-rated health provided a more holistic picture regarding the effect of polypharmacy on this population.

However, there were certain limitations. Firstly, the study did not include herbal treatments within the criteria for polypharmacy, despite such remedies being widely used in this region [32]. Secondly, the exact clinical indication for each medication was beyond the scope of the study. This would have helped to determine whether polypharmacy was appropriate on a case-by-case basis. Thirdly, the prevalence of medication-related side-effects and drug-drug interactions was not assessed; further studies are recommended to determine how and whether such adverse consequences of

polypharmacy affect this population. Fourthly, polypharmacy was considered only if the patient had been taking the drug for over six months; as such, short-term drug use was not evaluated. This may have affected the number of medications used by patients and the overall prevalence of polypharmacy. Finally, actual drug consumption was difficult to measure as the methods used to assess polypharmacy were subjective.

Conclusion

Polypharmacy was very common among a sample of T2DM patients at a family medicine clinic in Oman, with both age and diabetes duration found to be significantly associated with this phenomenon. Furthermore, hypertension and dyslipidemia were the most common coexisting chronic conditions and significant predictors of polypharmacy risk. Further research is needed to explore the causal relationship between these variables and polypharmacy. Moreover, additional research assessing the prevalence of drug-drug interactions and adverse drug reactions among T2DM patients is recommended. These findings may be of help to healthcare providers when making prescribing decisions.

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