

ASSESSMENT OF POLYPHARMACY AMONG PATIENTS WITH TYPE 2 DIABETES MELLITUS AT THE KOMFO ANOKYE TEACHING HOSPITAL DIABETES CENTER OF EXCELLENCE: PATTERNS AND ASSOCIATED FACTORS

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ABSTRACT

Background: Polypharmacy, the use of five or more medications, is often associated with the management of chronic conditions, particularly Type 2 diabetes mellitus (T2DM).

Objectives: To evaluate the prevalence and factors associated with polypharmacy in T2DM patients.

Method: A cross-sectional retrospective study was conducted at the Diabetes Centre of Excellence, Komfo Anokye Teaching Hospital, Ghana, one of West Africa's largest tertiary hospitals and referral centres, to assess polypharmacy among individuals with T2DM. The study included 346 patients aged 40 years or older, following ethical approval. Data analysis involved descriptive statistics and chi-square tests ($p < 0.05$) using SPSS.

Results: The study revealed a high prevalence of polypharmacy (72.25%) among participants, influenced by gender, age (especially over 70), and employment status. Significant ($p < 0.05$) comorbidities linked to polypharmacy included hyperlipidemia (86.67%), infectious diseases (79.07%), macrovascular complications (76.98%), and neuropathy (90.48%). The study also found significant associations ($p < 0.05$) between polypharmacy and the use of analgesics (87.50%), anti-neuropathy medications (58.82%), antiplatelet/coagulant medications (93.83%), antibiotics (28.57%), antihypertensive medications (74.15%), lipid-lowering medications (79.17%), and other non-diabetes medications (88.89%).

Conclusion: The 72.5% prevalence of polypharmacy among the participants provides valuable insights into the complex relationship between comorbidities and polypharmacy in T2DM. The study recommends a multidisciplinary approach, including establishing a comprehensive diabetes registry and implementing medication therapy management (MTM) programs to optimise patient treatment.

Keywords: Polypharmacy, T2DM, Medication Therapy Management, comorbidities, global health.

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INTRODUCTION

Type 2 diabetes (T2DM) is a condition associated with high morbidity and mortality, making it a major contributor to the global burden of disease (Nanda *et al.*, 2022; Khan *et al.*, 2019). The International Diabetes Federation (IDF) estimates that 11% of the global adult population (aged 20-79 years), or 1 in 9 people, has diabetes (IDF, 2025). Similarly, Li and colleagues indicated that 114 million (11%) adults worldwide currently have T2DM, and that number is expected to reach 120 million by 2045 (Li *et al.*, 2019). The trends in Ghana and the African sub-region do not vary significantly, with several studies estimating a disease burden of 18.6 million by 2030 (Armocida *et al.*, 2023; Asamoah-Boaheng *et al.*, 2019; Sarfo-Kantank *et al.*, 2014). We aimed to explore their epidemiology among 10–24 year-olds. Methods: Estimates were retrieved from the Global Burden of Diseases Study (GBD). The recent prevalence of type 2 diabetes mellitus (T2DM) in Ghana varies from 6.2% to 13.9%, including many undiagnosed cases (Asamoah-Boaheng *et al.*, 2019; Sarfo-Kantank *et al.*, 2014).

Many T2DM patients also suffer from comorbid conditions such as chronic kidney disease, depression, coronary artery disease, dyslipidemia, and hypertension (Akın and Bölük, 2020; Novak *et al.*, 2016). Thus, several patients not only take medications to control their glycemic levels but also consume additional drugs to prevent or manage complications related to diabetes or other comorbidities (Alwhaibi *et al.*, 2018).

As a result, polypharmacy, the use of five or more drugs, occurs frequently among T2DM patients. In developed nations, polypharmacy rates can range from 57% to 84% (Fraser *et al.*, 2022; Pahuja *et al.*, 2020). Chronic kidney disease is a major public health problem. Arteriovenous fistulas (AV fistulas. Indeed, as indicated by Bauer and Nauck (2014), middle-aged and older adults with diabetes tend to take approximately nine (9) medications daily, amounting to about twelve (12) daily doses. This figure rises to more than twenty (20) tablets per day among geriatric populations, who are typically prescribed over twelve (12) different medication classes (Bauer and Nauck, 2014).

Despite the perceived benefits of polypharmacy, the practice actually exemplifies irrational drug use. It increases the risk of negative clinical outcomes such as hospitalisations, drug interactions, prescription cascades, adverse drug reactions, dosing errors by healthcare providers, and poor medication adherence (Zelko *et al.*, 2016; Nguyen *et al.*, 2006). It is also associated with higher mortality and morbidity (Masnoon *et al.*, 2017; Montiel-Luque *et al.*, 2017) is common in the older population. Despite this, there is no consensus definition for polypharmacy. A systematic review was conducted to identify and summarise polypharmacy definitions in existing literature. Methods: The reporting of this systematic review conforms to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA).

While extensive research on polypharmacy has been conducted in advanced nations, there are few studies focusing on underdeveloped and developing countries, where the T2DM burden is rising (Kwakyie *et al.*, 2024; Rieckert *et al.*, 2018; Hovstadius and Petersson, 2012). Hence, investigating the prevalence, patterns, and factors influencing polypharmacy in Ghanaian patients with type 2 diabetes is essential. The results and suggestions from this

study aim to enhance treatment management and medication adherence for T2DM patients by simplifying their treatment strategies.

MATERIALS AND METHODS (METHODOLOGY)

Study design

An observational, retrospective, cross-sectional study was conducted from January to December 2021, utilising outpatient data from the Electronic Medical Records (EMRs) within the Lightwave Health Information Management System (LHIMS).

Study Site

The study was conducted at the Diabetes Centre of Excellence at Komfo Anokye Teaching Hospital (KATH), a major tertiary teaching hospital and referral centre in Ghana and West Africa.

Sampling and Sample Size Calculation

The study recruited participants using a multistage sampling technique. Briefly, the clinic registry was used to create an initial sampling frame of patients with confirmed T2DM. The SurveyMonkey sample size calculator was used to determine the sample size (Eqn 1). Simple random sampling was subsequently used to select the final participants. Each individual was assigned a unique ID, and a random number generator (random.org) was used to select the required number of participants.

Sample	$\frac{(Z_{\alpha/2})^2 \times p \times (1-p)}{MOE^2}$	eqn 1
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$Z_{\alpha/2}$ is the critical value of the normal distribution at $\alpha/2$ (the critical value is 1.96 at a 95% confidence level with $\alpha=0.05$), MOE is the margin of error (5%), and p is the sample proportion. The estimated total number of patients with T2DM was 346.

Inclusion and Exclusion Criteria

All T2DM patients aged 40 years or older were included in the study. This demographic was selected due to their increased risk, as well as the higher rate of multimorbidity and polypharmacy (Asamoah-Boaheng *et al.*, 2019). Patients suffering from active infections, those without complete information on the LHIMS software, or those who were pregnant were excluded from the study. Moreover, medications for managing acute illness, herbal medicines, and over-the-counter supplements were also excluded from the study. Kretchy and colleagues reported that hospitals inconsistently document supplement and herbal medicine use, and that some patients refuse to disclose it altogether, justifying their exclusion from the study (Kretchy *et al.*, 2014). Inpatient and outpatient prescriptions issued outside the study window were also excluded from the study.

Data Collection

The primary data were obtained using a structured, validated questionnaire after pretesting with 38 patients from the initial sampling frame who were not part of the final sample selected for the study. The results of the pretest were evaluated by a research expert for appropriateness in addressing the aim of the study, after which minor adjustments were made before finalising the data collection tool. Data analysis of the pretest yielded a high reliability score of 0.890 (Cronbach's alpha). Polypharmacy was defined as the prescription of five or more distinct medications. The final data collection tool included sociodemographic characteristics, comorbidities, and prescription details documented on the LHIMS platform.

Statistical Analysis

The responses obtained from the study were entered into Microsoft Excel (Office LTSC) and evaluated for completeness and consistency. Coding of the text responses into numerical variables was done and imported into SPSS

version 20. Descriptive data were presented as frequency tables, while inferential statistics were carried out using chi-square tests. Statistical significance was evaluated at a p-value threshold of 0.05.

Ethical Consideration

The study strictly adhered to the KATH Institutional Review Board (IRB) guidelines (approval number: KATH IRB/AP/118/24), as well as national ethical principles and the standards of the Declaration of Helsinki (1975, revised 2008). Before the study, the administrator, Medical Director, Head of Records, and Head of Pharmacy at the Diabetes Centre of Excellence at KATH granted permission. All primary data were pseudonymised to protect participant confidentiality.

RESULTS AND DISCUSSION

Sociodemographic Characteristics

Polypharmacy varies among patient groups and is influenced by factors such as age, disease severity, insurance coverage, and socioeconomic status (Masnoon *et al.*, 2017; Iglay *et al.*, 2016). The results (Table 1) corroborate previous epidemiological data on T2DM obtained in sub-Saharan Africa (Tarekegne *et al.*, 2018; Gatimu *et al.*, 2016; Danquah *et al.*, 2012) aged 50 years and over, who self-reported having been diagnosed and treated for diabetes mellitus (DM).

Female participants dominated the distribution (71.68%), reflecting higher health-seeking behaviour among women, a greater burden of obesity-related T2DM risk in this demographic, and the gendered dynamics of access to formal healthcare in the Ghanaian context (Kwakye *et al.*, 2024; Danquah *et al.*, 2012). Sub-Saharan Africa faces a rapid spread of diabetes mellitus type 2 (DM2). However, sex was not a statistically significant determinant of polypharmacy in this cohort ($\chi^2 = 0.5604$, $p = 0.454$) (Table 4). This finding aligns with existing evidence indicating that,

when disease complexity and comorbidity burden are considered, sex-based differences in prescribing intensity generally lessen (Venditti *et al.*, 2023; Walckiers *et al.*, 2015). However, sex-specific differences in drug metabolism, cardiovascular risk development, and medication adherence remain important clinical considerations. Some studies indicate these differences significantly influence polypharmacy, with females showing a higher prevalence (Rochon *et al.*, 2025; Alwhaibi *et al.*, 2018).

The majority of participants were in the 60–69-year age bracket (35.26%), with an average age of 61.85 ± 11.08 years. This correlates with the known peak incidence of T2DM in older adults and has significant pharmacological implications (Pazan and Wehling, 2021; Khezrian *et al.*, 2020) in part, a consequence of the increasing proportion of multimorbidity in the ageing population worldwide. Our understanding of the potential harm of taking multiple medications in an older, multi-morbid population, who are likely to be on a polypharmacy regime, is limited. This is a narrative literature review that aims to appraise and summarise recent studies published about polypharmacy. We searched MEDLINE using the search terms polypharmacy (and its variations, e.g. multiple prescriptions, inappropriate drug use, etc.). Age-related physiological changes, such as reduced renal and liver function and altered body composition, affect drug pharmacokinetics and pharmacodynamics. Polypharmacy rates increased from 49.12% in the 40–49 age group to 85.37% in those aged 70 and older ($\chi^2 = 23.55$, $p < 0.001$).

Nketiah-Amponsah and colleagues reported on how insurance removes financial barriers to prescriptions, allowing prescribing records to reflect the full clinical picture of T2DM and its comorbidities (Nketiah-Amponsah *et al.*, 2025) commonly referred to as "lost-to-follow-up" (LTFU). Therefore, the high coverage of

NHIA cards among participants (96.82%) is essential for analysing polypharmacy trends. This is because the high rates not only reflect improved access to essential care but also act as a structural factor that adds to the polypharmacy burden. In regions with limited insurance coverage, reduced rates of polypharmacy might result from restricted access to healthcare rather than more appropriate prescribing habits (Kim *et al.*, 2024). This study offers comprehensive insights into medication management issues in T2DM and emphasises the need for clinical safeguards to enhance prescribing practices and prevent irrational polypharmacy.

The comprehensive management of T2DM, such as dietary management and medication adherence, is significantly affected by the employment status of patients (Downing *et al.*, 2022). Danquah and colleagues identified an association between stressful living

conditions resulting from unemployment and an increased risk of T2DM. They posited that stress may, at least in part, contribute to overeating and reduced exercise while also increasing the risk of comorbid conditions, such as hypertension and dyslipidemia. Since these conditions require therapy, they may further exacerbate the risk of polypharmacy (Danquah *et al.*, 2012) Ghana, we aimed at characterizing clinical, anthropometric, socio-economic, nutritional and behavioural parameters of DM2 patients and at identifying associated factors. Methods. Between August 2007 and June 2008, 1466 individuals were recruited from diabetes and hypertension clinics, outpatients, community, and hospital staff. Fasting plasma glucose (FPG). The study confirmed this association, with employed patients having the lowest rate of polypharmacy (50.00%, $\chi^2 = 15.87$, $p = 0.003$).

Table 1. Sociodemographic Characteristics of Participants

Variable	Frequency (n=346)	Percentage (%)
Age (years)		
40-49	57	16.47
50-59	85	24.57
60-69	122	35.26
≥70	82	23.7
Sex		
Female	248	71.68
Male	98	28.32
NHIA Status		
No	11	3.18
Yes	335	96.82
Employment Status		
Unemployed	21	6.07
Employed	26	7.51
Retired	8	2.31
Self-employed	49	14.16

Not Specified	242	69.94
Comorbidities		
0	120	34.68
1-2	217	62.72
≥3	9	2.6

Prevalence of Polypharmacy in T2DM

The comprehensive management of T2DM requires the management of comorbidities, disease complications and risk factors, particularly cardiovascular risk factors, even beyond the primary glycaemic control. The concomitant effect is polypharmacy, characterised by an increased number of prescriptions (typically more than five) (Gurwitz *et al.*, 2018; Scott *et al.*, 2015) especially in older people, imposes a substantial burden of adverse drug events, ill health, disability, hospitalization, and even death. The single most important predictor of inappropriate prescribing and risk of adverse drug events in older patients is the number of prescribed drugs. Deprescribing is the process of tapering or stopping drugs, aimed at minimizing polypharmacy and improving patient outcomes. Evidence of efficacy for deprescribing is emerging from randomized trials and observational studies. A deprescribing protocol is proposed comprising 5 steps: (1. The study population exhibited a high prevalence of polypharmacy at 72.25%, with 58.09% of participants receiving six prescriptions (refer to Tables 2 and 3). Indeed, Bauer and Nauck (2014) reported that T2DM patients are prescribed 8.4 ± 3.0 different drug substances and can consume up to 22 different tablets daily. Dobrică *et al.* (2019) and especially in type 2 diabetes mellitus, as patients require treatment both for this condition and its related or unrelated comorbidities. Thus, we aimed to evaluate the use of polypharmacy in type 2 diabetes mellitus vs. non-diabetes patients. Materials and Methods: A cross-

sectional retrospective observational study was conducted. We collected the medical records of patients hospitalized in the Internal Medicine Clinic of the Clinical Emergency Hospital of Bucharest, Romania, for a period of two months (01/01/2018–28/02/2018 also reported that patients with T2DM consumed 7.81 ± 2.23 drugs daily. A polypharmacy prevalence of 78% was reported by Alwhaibi *et al.*, who observed an increased incidence in women compared to men, the elderly, and those with comorbid conditions (Alwhaibi *et al.*, 2018). As shown in Table 4, the cross-tabulation of polypharmacy prevalence with sociodemographic characteristics revealed significant associations ($p < 0.05$), except for sex distribution. The factors associated with polypharmacy are vastly complex and multifaceted. Research has shown a strong link between age and the prevalence of polypharmacy. Furthermore, the number of people aged 60 and older using multiple medications is expected to double by 2050 (Khezrian *et al.*, 2020; Gurwitz *et al.*, 2018; Duerden *et al.*, 2013) in part, a consequence of the increasing proportion of multimorbidity in the ageing population worldwide. Our understanding of the potential harm of taking multiple medications in an older, multi-morbid population, who are likely to be on a polypharmacy regime, is limited. This is a narrative literature review that aims to appraise and summarise recent studies published about polypharmacy. We searched MEDLINE using the search terms polypharmacy (and its variations, e.g. multiple prescriptions, inappropriate drug use, etc..

Similar links were found for employment and comorbid conditions, highlighting the importance of a holistic approach in

medication management for T2DM patients (Qato *et al.*, 2016; Duerden *et al.*, 2013).

Table 2. Prevalence of Polypharmacy

Type of prescription	Frequency (n)	Percentage (%)
Not Polypharmacy	96	27.75
Polypharmacy	250	72.25
Total	346	100

Table 3. Number of Medications Prescribed

Number of Medications Prescribed	Frequency	Percentage (%)
One	7	2.02
Two	20	5.78
Three	25	7.23
Four	44	12.72
Five	49	14.16
Six	201	58.09
Total	346	100

Table 4. Relationship between Polypharmacy and Sociodemographic characteristics of respondents

Variable	Polypharmacy	Not Polypharmacy	Total	Chi-square	p-value
Age (years)				23.5493, 3	0.000
40-49	28 (49.12)	29 (50.88)	57		
50-59	59 (69.41)	26 (30.59)	85		
60-69	93 (76.23)	29 (23.77)	122		
≥70	70 (85.37)	12 (14.63)	82		
Sex				0.5604, 1	0.454
Female	182 (73.39)	66 (26.61)	248		
Male	68 (69.39)	30 (30.61)	98		
Employment				15.8748, 4	0.003
Unemployed	13 (61.90)	8 (38.10)	21		
Employed	13 (50.00)	13 (50)	26		
Retired	6 (75.00)	2 (25)	8		

Self-employed	29 (59.18)	20 (40.82)	49
Not Specified	189 (78.10)	53 (21.90)	242
Comorbidities			14.2412, 2 0.001
0	72 (60.00)	48 (40.00)	120
1-2	170 (78.34)	47 (21.66)	217
≥3	8 (88.89)	1 (11.11)	9
Total	250 (72.25)	(96 (27.75)	346

Comorbid Conditions and Non-hypoglycaemic Medications Contributing to Polypharmacy

T2DM may be associated with comorbid conditions that are classified as clinically dominant (e.g., Heart failure), concordant and discordant (e.g., hypertension and arthritis), and chronic (which can be symptomatic and asymptomatic) (Young *et al.*, 2016). Oxidative stress, endothelial damage, and formation of advanced glycation products are implicated in the high incidence of comorbid conditions in T2DM, with more than 40% of adults reporting at least three conditions (Young *et al.*, 2016). This was supported by Li *et al* (2019), who observed that diabetic patients had 10.35 ± 3.09 comorbid conditions compared to non-diabetic patients. The study revealed that hypertension and macrovascular complications were the most frequently reported conditions, as shown in Table 5. Antihypertensive medications, antiplatelets/ anticoagulants, and lipid-lowering drugs were the most frequently prescribed classes of non-diabetic agents (Table 6). The prevalence of polypharmacy in the conditions ranged from 60% (non-specific conditions) to 90.48% (Neuropathy) (Table 7). Moreover, significant associations ($p < 0.05$) were observed between comorbid conditions and the prevalence of polypharmacy. This association corroborated the findings of Al-Musawe and colleagues, who reported that polypharmacy is related to increased all-cause mortality and macrovascular outcomes. Li *et al.* (2019) indicate that patients with comorbidities, such as nutritional and metabolic disorders like hyperlipidemia, circulatory conditions

including T2DM-related macrovascular complications, and musculoskeletal or connective tissue issues, are more prone to being prescribed multiple medicines. Although polypharmacy offers several benefits, in older adults, it raises the risk of adverse drug effects due to changes in pharmacologic responses. Indeed, it has been reported that 20% of medications commonly prescribed in the aged population are inappropriate, with observational studies reporting at least 15% of adverse drug reactions and sometimes death in these populations. The significant risk of iatrogenic harm necessitates action from prescribing clinicians, including deprescribing and implementing personalised strategies to meet individual patient needs. The primary limitation of this study is the inclusion of only patients aged 40 and older, which may limit the generalisability of the findings, especially to younger diabetic populations. Nevertheless, the chosen demographic has been reported to be at high risk of multimorbidity. Moreover, reliance on the hospital's electronic medical records limited the capture of polypharmacy related to herbal medicines and over-the-counter supplements. However, given the nondisclosure of these therapies to clinicians and the lack of standardisation, the results represent a conservative estimate of the total medication burden and are consistent with previous studies. The retrospective cross-sectional design also limited the assessment of long-term medication trends and the establishment of causality.

Table 5. Comorbidities Associated with T2DM

Comorbid Conditions	Frequency	Percentage (%)
Hyperlipidemia	15	4.34
Infectious disease	43	12.43
Hypertension	90	26.01
Macrovascular complication	49	14.16
Neuropathy	21	6.07
Not Specified	120	34.68
Others	8	2.31
Total	346	100

Percentages are calculated relative to the total number of comorbidity occurrences (n = 346)

Table 6. Non-diabetic Medications Frequently Prescribed

Non-diabetic Medications	Frequency	Percentage (%)
Analgesic	8	2.39
Neuropathic pain	17	5.10
Antiplatelet/coagulant	81	24.18
Antibiotics	7	2.09
Antihypertensive	147	43.88
Lipid lowering	48	14.33
Other medications	27	8.06
Total	335	100

Percentages are calculated relative to the total number of medication entries (n = 335)

Table 7. Relationship between Polypharmacy and Comorbidities of Respondents

	Not Polypharmacy n (%)	Polypharmacy n (%)	Total	Chi-square	p-value
Hyperlipidemia	2 (13.33)	13 (86.67)	15 (4.34)	16.945, 5	0.005
Infectious disease	9 (20.93)	34 (79.07)	43(12.43)		
Macrovascular complication	32 (23.02)	107 (76.98)	139 (40.17)		
Neuropathy	2 (9.52)	19 (90.48)	21 (6.07)		
Not Specified	48 (40.00)	72 (60.00)	12(34.68)		
Others	3 (37.50)	5 (62.50)	8 (2.31)		
Total	96 (27.75)	250 (72.25)	346 (100)		

CONCLUSION

A high prevalence (72.25%) of polypharmacy was observed among T2DM patients at the Diabetic Clinic of Komfo Anokye Teaching Hospital, and it was significantly influenced by age, sex, and employment status. Hypertension, hyperlipidemia, and neuropathy were some of the principal comorbidities often associated with T2DM, adding to the complexity of treatment plans. The study highlights the need to implement policies that rationalise prescribing, even in the complex management of T2DM. Additionally, a structured, multidisciplinary approach to medication review and management is essential to minimise the risks of polypharmacy, optimise drug therapy, and improve overall treatment outcomes for patients with Type 2 diabetes.

AUTHORS CONTRIBUTIONS

AMO: Development of the proposal concept, data collection, and manuscript review.

APGJ: Data analysis, interpretation, and drafting of manuscript.

AH: Data collection, study implementation, data entry, and manuscript review.

AJ: Development of the proposal concept, review of the draft manuscript.

SAAAN: Data analysis and interpretation, and review of the draft manuscript.

APR: Data collection, study implementation, data entry, and manuscript preparation review.

AB: Data collection, study implementation, data entry, and manuscript preparation review.

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CONFLICT OF INTEREST

The authors state that they have no conflicts of interest related to publishing this paper.

DATA SHARING STATEMENT

Data can be provided upon request.

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