



(RESEARCH ARTICLE)



ROLES OF COMMUNITY PHARMACISTS IN IMPROVING THERAPEUTIC ADHERENCE AMONG ADULTS WITH DIABETES: A CROSS-SECTIONAL STUDY IN THE KHÉNIFRA REGION, MOROCCO

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ABSTRACT

Diabetes Federation, diabetes affects hundreds of millions of adults worldwide with a substantial proportion remaining undiagnosed. With the advancement of diabetes management strategies, therapeutic adherence has emerged as a pivotal component of care, and diabetic patients increasingly turn to community pharmacists as their first point of contact for health-related questions. This study aimed to investigate the specific roles played by community pharmacists in the Khénifra region in fostering improved therapeutic adherence among adult Moroccan patients with diabetes. This cross-sectional, one-day survey targeted community pharmacists practicing in the urban municipality of Khénifra and the rural commune of Moha ou Hammou-Zayani. Data were collected using a structured, self-administered questionnaire and analyzed with JAMOVI software, including an Exploratory Factor Analysis (EFA) used to delineate the pharmacists' roles in diabetes management. Of 48 pharmacists solicited, 43 agreed to participate (response rate 89.5%). Female pharmacists represented 53.5% of participants, with a mean age of 43.1 ± 9.5 years. Ninety-three percent reported having a glucometer and performing screening tests in their pharmacy, 93% emphasized lifestyle counseling as central to diabetes management, 88% actively educated patients about diabetes complications, and 97.7% advised patients to consult a physician when diabetes was suspected. The exploratory factor analysis identified 14 distinct roles for community pharmacists, grouped into three domains of activity: screening and awareness-raising among diabetic patients, therapeutic follow-up of diabetic patients, and lifestyle and dietary counseling. These findings underscore the pivotal role of community pharmacists in diabetes management and point to the need for a reorganization of their operational framework to better meet the treatment and counseling needs of diabetic patients.

Keywords: Diabetes; Community Pharmacist; Therapeutic Adherence; Factor Analysis; Morocco

1 INTRODUCTION

1.1 Diabetes: a growing multifactorial public health challenge

Diabetes is a complex, multifactorial clinical and public health challenge with growing social and economic repercussions worldwide. Global diabetes prevalence has doubled over the past two decades, making it a substantial contributor to the burden of non-communicable disease confronting health systems everywhere [1].

Diabetes management today is no longer understood as a simple clinical outcome but as an ongoing process shaped by social, behavioral, emotional, and cognitive factors, requiring a multidisciplinary approach and marking a shift away from the traditional paternalistic model — in which the patient simply complies — toward a genuine alliance between patient and healthcare professionals, in which the patient becomes the principal actor in their own care [2].

Despite improved access to medication and technological advances, maintaining rigorous adherence remains a significant challenge in the follow-up of diabetic patients. In this context, community pharmacists occupy an important place in diabetes care, owing to the ease of access to the pharmacy and the opportunities it affords for communication with patients, helping them better understand their condition, adhere to appropriate dietary regimens, and adopt a healthier lifestyle [3]. Therapeutic adherence therefore constitutes a major public health challenge, and community pharmacists, through their day-to-day activities, can play an essential role in supporting adherence to treatment recommendations among diabetic patients.

This study aims to explore the roles played by community pharmacists in the Khénifra region in improving therapeutic adherence among adult Moroccan patients with diabetes.

1.2 Diabetes: definitions and classification

Diabetes is a metabolic disorder characterized by chronic hyperglycemia resulting from a defect in insulin secretion, insulin action, or both [4]. Three main types are recognized. Type 1 diabetes, or insulin-dependent diabetes, accounts for roughly 10% of cases and mainly affects children and young people; it results from autoimmune destruction of insulin-producing beta cells in genetically predisposed individuals, likely triggered by an as-yet-unidentified environmental factor [5]. Insulin itself was discovered in 1921 by Banting, Best, and Macleod, a milestone in the understanding and treatment of the disease [6]. Management of type 1 diabetes continues to evolve, with closed-loop insulin delivery systems increasingly explored as a means of improving glycemic control [7]. Type 2 diabetes, or non-insulin-dependent diabetes, is far more common, accounting for approximately 90% of cases, and is characterized by chronic hyperglycemia arising from progressive insulin resistance and relative insulin deficiency [8]. Gestational diabetes, as defined by the World Health Organization, refers to glucose intolerance of variable severity first recognized during pregnancy, regardless of the treatment required or its postpartum course [9]; it typically resolves after delivery but reflects insulin resistance induced by placental hormones [10].

1.3 Epidemiology and risk factors

According to the International Diabetes Federation, diabetes affects hundreds of millions of adults worldwide, with a substantial proportion remaining undiagnosed [11]. In Morocco, the World Health Organization's regional office has highlighted diabetes as a growing national health priority [12], with national estimates suggesting that around 2.7 million Moroccans live with diabetes and a further 2.2 million with prediabetes [13]. Risk factors for type 2 diabetes combine non-modifiable elements, such as age, family history, and ethnicity, with modifiable behavioral factors including excess weight, physical inactivity, and unhealthy diet, all of which are amenable to preventive counseling [14].

1.4 Diagnosis, treatment, and the role of the pharmacist

Diagnosis rests on validated biological criteria, most commonly fasting plasma glucose and glycated hemoglobin (HbA1c) thresholds [15]. Management combines lifestyle modification with pharmacological treatment, ranging from oral antidiabetic agents to insulin therapy, the latter requiring careful patient education on injection technique and self-monitoring [16,17]. Across this care pathway, the community pharmacist is increasingly recognized as a key resource: pharmacist-led counseling has been associated with improved patient understanding of therapeutic education programs [18], and pharmacists are well placed to support patients living with chronic conditions more broadly, including in domains such as age-related macular degeneration, illustrating the breadth of the counseling role pharmacists can play beyond dispensing alone [19]. This broader counseling role has also been documented among hospital outpatients [21] and among patients managing chronic pain [20], further illustrating its reach beyond diabetes care specifically.

1.5 Therapeutic adherence: a central but complex concept

Therapeutic adherence, sometimes still framed in the older language of patient "compliance" or "obedience" to medical prescription, has evolved conceptually toward a negotiated, patient-centered understanding of treatment-taking behavior [22]. Poor adherence remains a complex, multidetermined problem, widely recognized as one of the central challenges of contemporary medicine [23], shaped simultaneously by patient-related, treatment-related, and health-system-related factors [24]. This conceptual background motivated the present study, which sought to characterize, empirically, the concrete roles that community pharmacists in the Khénifra region play in supporting adherence among their diabetic patients.

2 MATERIALS AND METHODS

2.1 Study site

This study was conducted among community pharmacists practicing in the Khénifra region. The city of Khénifra, known as the "Red City" for the reddish color of its building façades, is located in the central Middle Atlas of Morocco, with an estimated population of between 127,047 and 130,000 inhabitants in 2020 [25].

2.2 Study design and period

This was a cross-sectional, one-day survey of community pharmacists practicing in the urban municipality of Khénifra and the rural commune of Moha ou Hammou-Zayani. Data collection took place over three months, from January to April 2023.

2.3 Target population

All community pharmacies operating in the Khénifra province were eligible for inclusion, regardless of their location (urban or rural) or years in operation. The complete list of community pharmacists was obtained through the Southern Regional Council of Community Pharmacists.

2.4 Data collection methods

A preliminary literature review was conducted to identify and select the main activities relevant to diabetes management, informing the design of a 34-item questionnaire organized into four sections: (1) the socio-professional status of participating pharmacists; (2) the quality of treatment counseling and dispensing; (3) the pharmacist's role in diabetes screening; and (4) the pharmacist's role in the therapeutic follow-up of diabetic patients. The anonymous, standardized, self-administered questionnaire was then distributed to participating pharmacists. The primary outcome measure was the set of roles played by community pharmacists in the therapeutic adherence of diabetic patients, assessed across these four domains.

2.5 Statistical analysis

Data were entered using Excel 2020. Statistical analysis proceeded in two stages. Descriptive statistics were first computed, with qualitative variables presented as frequencies and percentages and quantitative variables as means and standard deviations. Second, an Exploratory Factor Analysis (EFA) was performed to examine the relationships between the different roles and types of intervention undertaken by community pharmacists in diabetes management, with the goal of identifying the variables that best explained pharmacists' roles in supporting therapeutic adherence and grouping them into coherent activity domains. Two underlying assumptions were verified before extraction: sphericity, assessed with Bartlett's test of sphericity, and sampling adequacy, assessed with the Kaiser-Meyer-Olkin (KMO) index, for which values between 0.5 and 0.7 are considered adequate, between 0.7 and 0.9 good, and between 0.9 and 1.0 excellent. Parallel analysis was used to determine the number of factors to retain, and Varimax rotation was applied to facilitate interpretation of each factor. All analyses were performed using Jamovi (version 2.3.28), with statistical significance set at $p < 0.05$.

3 RESULTS

During the study period, from January to April 2023, the survey targeted 48 community pharmacists practicing in the Khénifra region. Of these, 43 agreed to participate, corresponding to a response rate of 89.5% (43/48).

3.1 Sociodemographic characteristics

Female pharmacists represented 53.5% of participants, corresponding to a female-to-male sex ratio of 1.2 (Fig. 1). The mean age of participating pharmacists was 43.1 ± 9.5 years, with more than 80% of participants aged between 30 and

50 years. The vast majority of pharmacists (98%) practiced in an urban setting, with only a single pharmacist established in a rural area (Fig. 2).

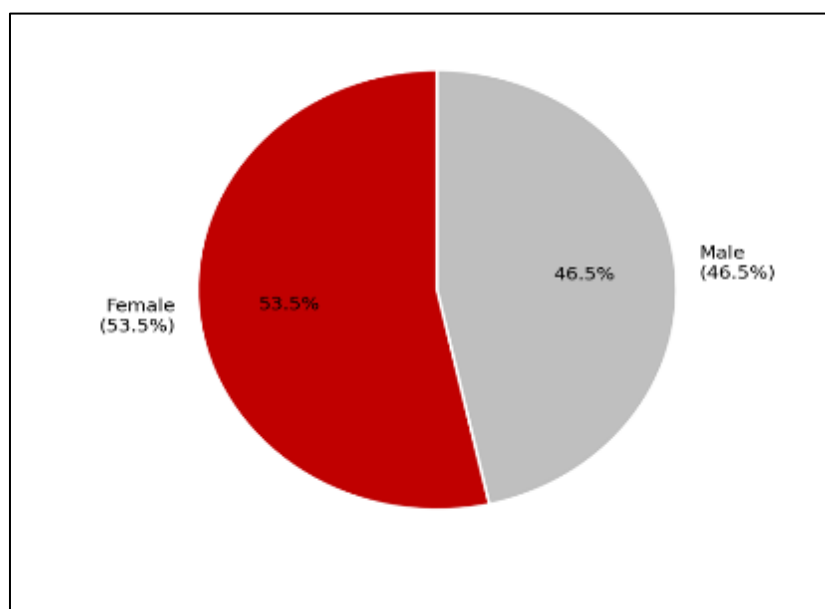


Figure 1: Distribution of participating pharmacists by sex (n = 43).

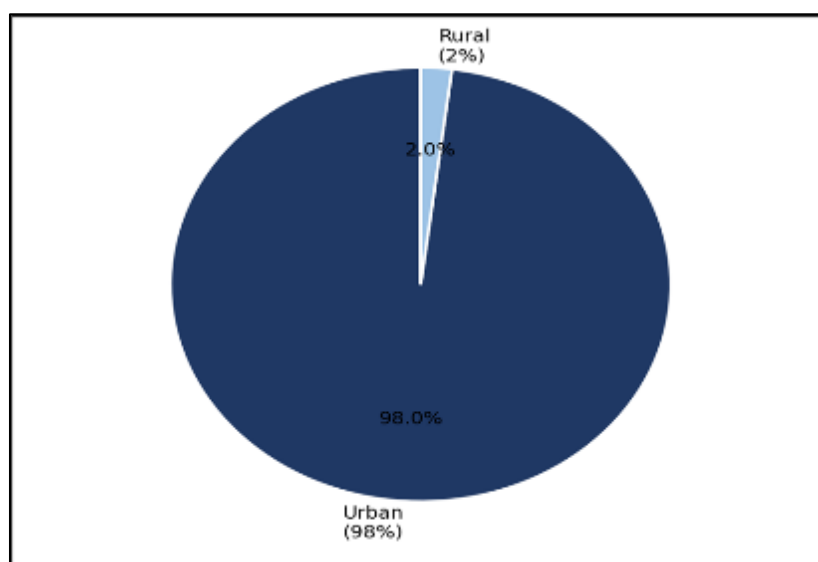


Figure 2: Distribution of pharmacists by practice area (n = 43).

3.2 Diabetes screening in community pharmacies

Ninety-three percent of pharmacists (40/43) reported having a glucometer available in their pharmacy (Fig. 3). Among these, 86% (37/43) reported frequently receiving prescriptions for oral antidiabetic agents (often to always), compared with 9.3% (4/43) who reported doing so rarely or never. Additionally, 65.1% (28/43) reported often to always dispensing insulin to their diabetic patients.

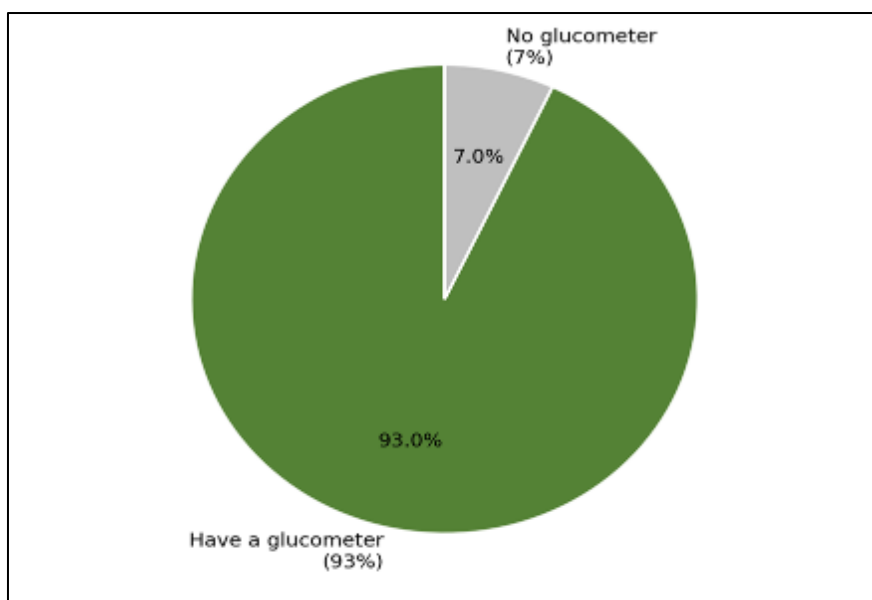


Figure 3: Glucometer availability in surveyed pharmacies (n = 43).

A substantial proportion of pharmacists (65.1%) reported frequently being able to suspect diabetes in their patients. Three suspicion criteria were reported by more than 80% of pharmacists: overweight/obesity (83.7%), family history (81.3%), and glycemic control results (76%), while age (43.8%) and lifestyle factors (32.5%) were less frequently cited (Fig. 4).

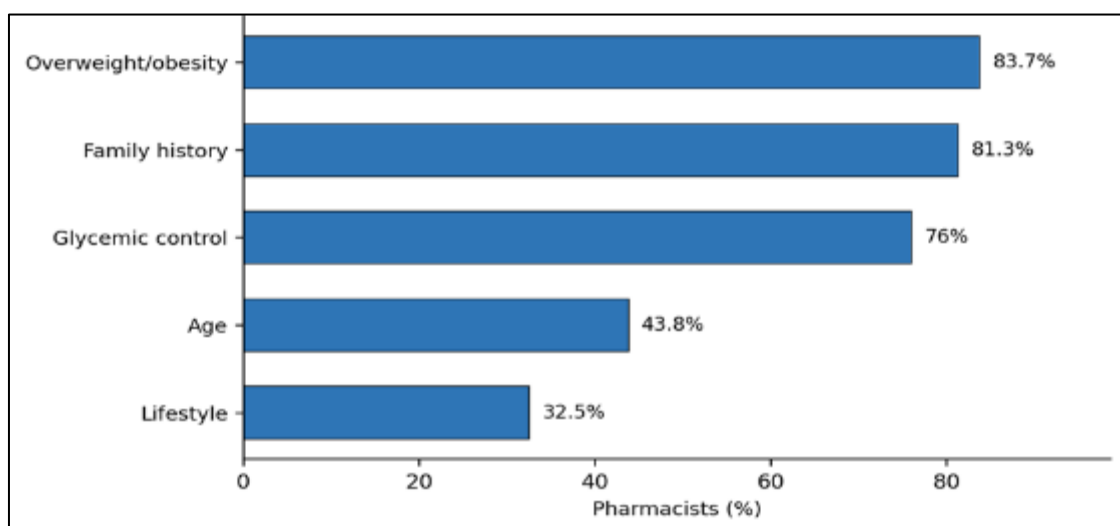


Figure 4: Criteria used by pharmacists to suspect diabetes (n = 43).

3.3 Awareness-raising and patient education

A large majority of pharmacists (88%, 38/43) reported actively raising patient awareness of diabetes complications, most commonly diabetic foot (81%), cardiovascular disease (76%), and diabetic retinopathy (76%), with diabetic angiopathy (51%) and atherosclerosis (30%) mentioned less frequently (Fig. 5).

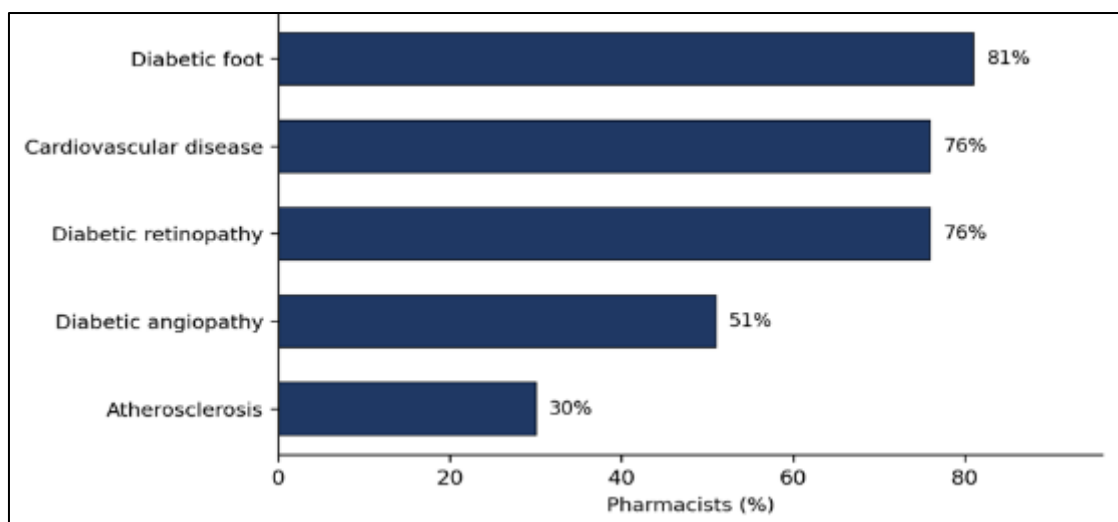


Figure 5: Diabetes complications discussed with patients (n = 43).

3.4 Management of positive screening results

More than 60% of pharmacists reported following at least one of three main approaches when a screening test returned positive: referral to a physician (79%, 34/43), direct communication of results to the patient (72%, 31/43), and personal, in-person contact at the pharmacist's office (67%). Remote follow-up was less common, reported by 27.9% (12/43) (Fig. 6).

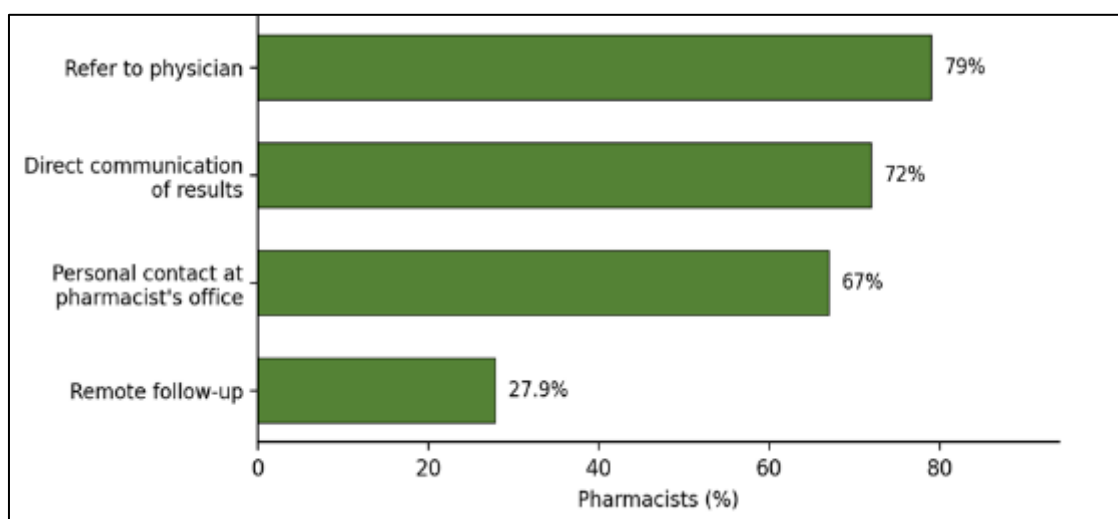


Figure 6: Pharmacists' management of positive screening results (n = 43).

3.5 Pharmaceutical care and counseling practices

Ninety-three percent of pharmacists (40/43) emphasized lifestyle counseling as a central component of diabetes care, while 51.2% (22/43) prioritized therapeutic patient education, and side-effect management and therapeutic alternatives were mentioned by 48.8% and 41.3%, respectively. When advising patients, pharmacists most frequently recommended a healthy diet (76.7%), glycemic self-monitoring (74.7%), and regular physical activity (69.7%) (Fig. 7).

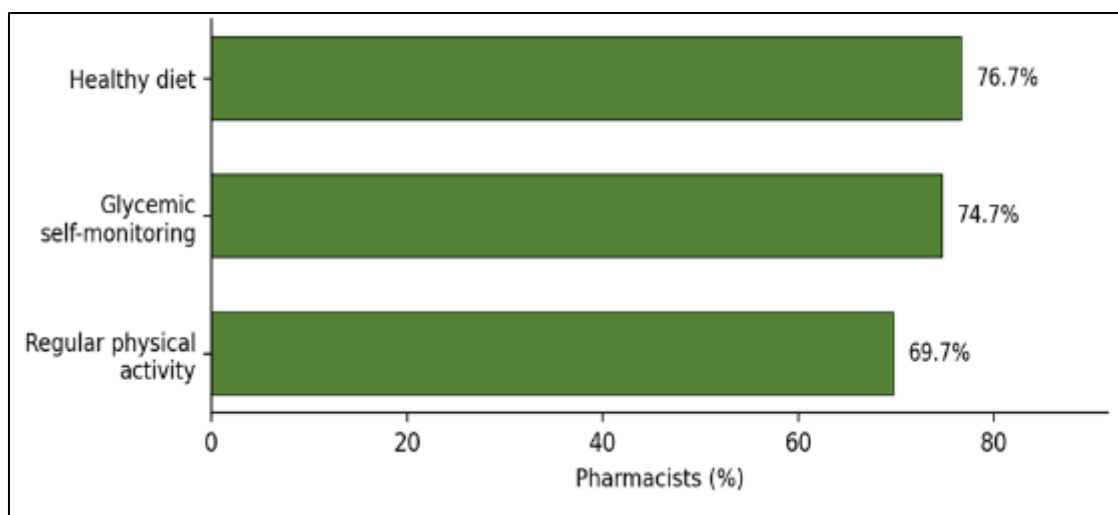


Figure 7: Lifestyle advice most recommended by pharmacists (n = 43).

Regarding self-medication among diabetic patients, two main contributing factors were each cited by more than 60% of pharmacists: the cost of medical consultation (76%) and trust in the pharmacist's advice (67%), while inadequate patient practices (41%) and lack of time (27%) were cited less often (Fig. 8).

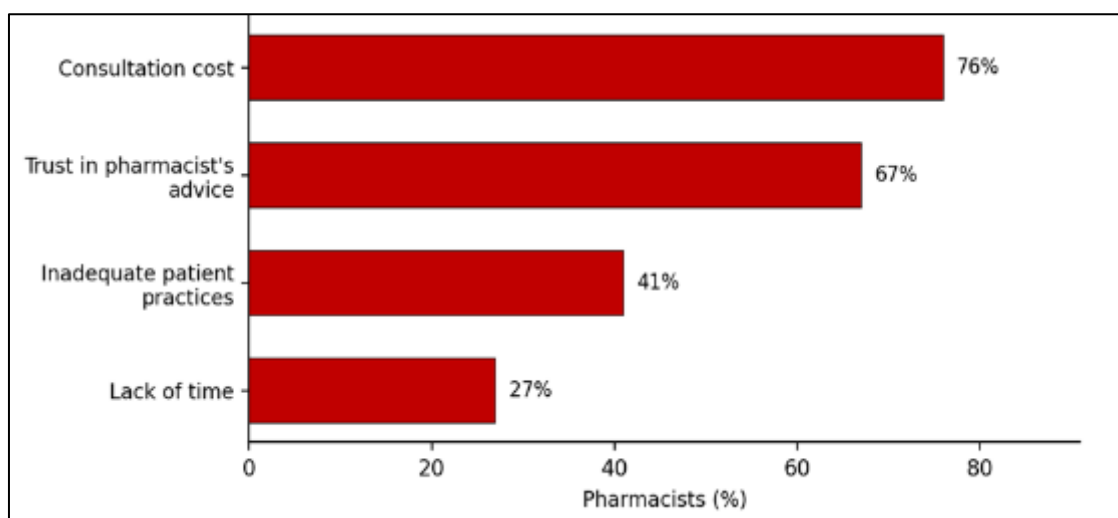


Figure 8: Reasons for self-medication reported by pharmacists (n = 43).

The most frequently dispensed oral antidiabetic agents were metformin (90%), the metformin-glibenclamide combination (83%), and glimepiride and gliclazide (81% each) (Fig. 9), underscoring the central place of these agents in the pharmacological management of the patients followed by the pharmacies in this study.

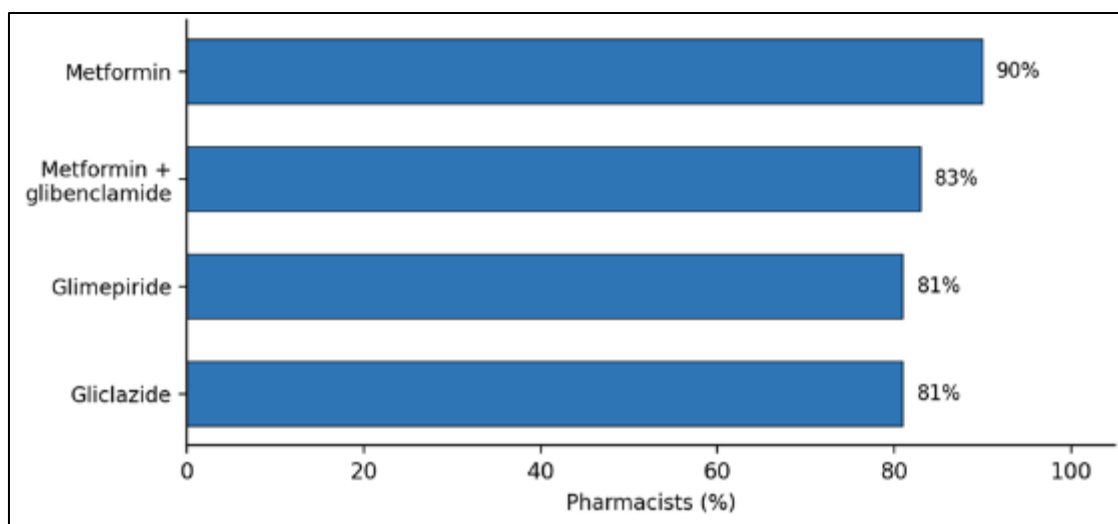


Figure 9: Most frequently dispensed oral antidiabetics (n = 43).

3.6 Therapeutic follow-up

The large majority of pharmacists (86%, 37/43) reported regularly providing advice and information on the proper use of oral antidiabetic medications, and 95% (41/43) reported doing so without hesitation on a regular basis. Regarding drug interactions, 20.9% (9/43) reported systematically asking about potential interactions, 37.2% (16/43) did so sometimes, and 41.9% (18/43) rarely to never. A notable proportion of pharmacists (60.5%, 26/43) reported difficulty explaining the proper use of medications to patients, while 76.8% (33/43) reported closely following their patients' health status after treatment initiation, and all pharmacists (100%) reported consistently advising patients on hygieno-dietary restrictions.

Regarding continuing engagement with diabetes management, 58.2% (25/43) reported rarely to never having participated in therapeutic education programs, while 46.5% (20/43) reported keeping up to date with treatment developments often to always, and 51.2% did so only sometimes to rarely. A substantial majority of pharmacists (83.8%) considered current diabetes prevention efforts to be moderately to insufficiently developed.

3.7 Pharmacists' recommendations for improving adherence

When asked about strategies to improve therapeutic adherence, pharmacists most frequently emphasized patient sensitization to the importance of adherence (79%, 34/43) and the importance of continuing professional education (76.7%, 33/43), followed by collaboration with physicians (60.4%) and the provision of dietary and exercise advice (51%).

3.8 Exploratory factor analysis: the roles of the community pharmacist

Bartlett's test of sphericity was significant ($p < 0.001$), confirming that the correlation matrix was sufficiently distinct from an identity matrix to be suitable for exploratory factor analysis. Sampling adequacy, assessed by the KMO index, was 0.56, indicating that EFA was appropriate. Three factors with eigenvalues greater than 1 were retained, together accounting for 46.5% of cumulative variance (Table 1).

Table 1: Variance explained by the three factors of the exploratory factor analysis

Component	Percentage of variance	Cumulative percentage
Factor 1	17.8%	38.3%
Factor 2	14.3%	30.8%
Factor 3	14.3%	30.8%
Total variance explained	46.5%	100.0%

The exploratory analysis retained 14 of the 26 candidate roles initially proposed to participating pharmacists, grouped into three factors according to their contribution to overall variance (Table 2). Factor 1 comprised six activities and explained 17.8% of the variance, reflecting the pharmacist's role in screening and raising awareness among diabetic

patients — notably glycemic control, screening for diabetes complications, and counseling on antidiabetic medications and their complications. Factor 2 comprised four activities and explained 14.3% of the variance, corresponding to the therapeutic follow-up of diabetic patients. Factor 3 also comprised four activities and explained a further 14.3% of the variance, relating to lifestyle and dietary counseling for diabetes management, particularly in the context of hyperglycemia.

Table 2: Classification of community pharmacist roles in improving therapeutic adherence among adults with diabetes (exploratory factor analysis)

Domain	Role (variable)	Factor 1	Factor 2	Factor 3
Screening and awareness-raising	Glycemic control	0.917		
	Screening for diabetes complications	0.847		
	Foot examination awareness	0.517		
	Counseling on antidiabetic medications	0.458		
	Awareness of complication risks	0.443		
	Advice on medication use	0.424		
Therapeutic follow-up of patients with diabetes				
	Information on potential drug interactions		0.782	
	Information on medication side effects		0.764	
	Glycemic monitoring		0.594	0.421
	Follow-up of health status after treatment initiation		0.439	
Advice on diabetes management				
	Diet and exercise advice			0.902
	Offering simple screening tests			0.752
	Advising physical activity in hyperglycemia			0.433
	Advising healthy diet in hyperglycemia		0.395	0.409

4 DISCUSSION

This study aimed to characterize the roles of community pharmacists in the Khénifra region in improving therapeutic adherence among adult Moroccan patients with diabetes. The exploratory factor analysis identified 14 such roles, grouped into three domains of activity: screening and awareness-raising among diabetic patients, therapeutic follow-up, and lifestyle and dietary counseling.

Female pharmacists represented 53.5% of the sample, corresponding to a female-to-male sex ratio of 1.2 — a feminization trend also documented among health professions more broadly in both national and international settings [27,28]. The mean participant age of 43.1 ± 9.5 years, with over 80% of pharmacists aged 30 to 50 years, is comparable to figures reported for Moroccan physicians: the Ministry of Health's report on medical and paramedical workforce demographics projected to 2025 found a mean physician age of approximately 40.7 years, with 70% of medical staff under 45 [27].

Among the factors reported by pharmacists as influencing therapeutic adherence, patient educational level (79.1%) and socioeconomic status (76.7%) were most frequently cited, alongside treatment-related factors such as cost (62.8%) and duration (60.5%). A regional systematic review and meta-analysis on the prevalence of poor medication adherence among type 2 diabetics in North Africa similarly identified low educational attainment as a determinant of reduced adherence [29], a pattern echoed in national adherence studies conducted among type 2 diabetics in Tunisia, Algeria, and Egypt [30,31,32], and consistent more broadly with the literature linking limited health literacy to difficulty understanding and following professional recommendations, ultimately undermining patients' capacity for diabetes

self-management. Socioeconomic status, cost of medication, and treatment duration have likewise been identified as adherence determinants in prior work [33,34], reinforcing the case for insurance mechanisms specifically dedicated to chronic disease management.

The two leading reasons for self-medication identified in this study — the cost of medical consultation (76%) and trust in the pharmacist's advice (cited by more than 60% of participants) — echo findings from a Tunisian study by Belhabib and colleagues, which similarly linked elevated cost to poor adherence [35,36].

Regarding the first domain of activity — screening and awareness-raising — several prior studies have underscored the central role of glycemic control in diabetes prevention and detection [37]. In our survey, 93% of pharmacists reported having a glucometer available for screening. A comparable Moroccan study by Skalli and Oulkadi similarly demonstrated pharmacist involvement in diabetes screening, in which 64 pharmacists performed 1,177 tests over two days [37], underscoring the value of entrusting community pharmacists with concrete screening tasks in support of diabetic patients.

A large majority of pharmacists (88%) reported actively raising patient awareness of diabetes complications, with particular emphasis on diabetic foot, cardiovascular disease, and diabetic retinopathy — complications that are indeed well documented as highly prevalent among people with diabetes in the broader literature.

Regarding the second domain of activity — therapeutic follow-up — the exploratory analysis identified four roles, together accounting for 14.3% of the variance explained. This finding is consistent with prior work emphasizing the community pharmacist's contribution to identifying difficulties adhering to antidiabetic treatment and supporting patient persistence and compliance [33].

Regarding the third domain of activity — lifestyle and dietary counseling — 51.2% of pharmacists prioritized therapeutic patient education, in line with prior regional evidence linking poor adherence to gaps in therapeutic education across North African settings [29]. Therapeutic education and communication play a central role in diabetes self-management, encompassing lifestyle measures, medical follow-up, and treatment adherence, and thereby helping to reduce risk behaviors among patients [24]. The development and dissemination of standardized counseling protocols would likely be of particular benefit to patients who lack information or struggle to follow their treatment. A large majority of pharmacists (86%) reported regularly providing advice on medication use, with an emphasis on proper administration practices and dietary regimens, consistent with prior work describing structured hygieno-dietary counseling practices in community pharmacy [38], and echoing prior findings on the collaborative role pharmacists can play alongside physicians in patient follow-up, including through telephone-based counseling contacts [39].

Taken together, these findings position the community pharmacy as a privileged setting for diabetes prevention and screening, centered on the three domains of activity identified through our exploratory analysis and encompassing 14 distinct pharmacist roles. This underscores the value of formally integrating pharmacists into the care pathway, entrusting them with concrete tasks in diabetes management to ensure optimal follow-up and disease control.

Study limitations

Several limitations should be acknowledged. First, therapeutic adherence was assessed indirectly, through pharmacists' self-reported perceptions rather than direct patient-level data, which may introduce information bias. Second, the study population, while comprehensive for the Khénifra region, remained relatively small ($n = 43$), limiting statistical power for the exploratory factor analysis, as reflected in the relatively modest cumulative variance explained (46.5%). Third, several sources cited in earlier drafts of this work could not be fully verified against complete bibliographic records at the time of writing, owing to incomplete metadata in the original reference database; only fully verifiable sources are cited here, and readers seeking the remaining citations are encouraged to consult the authors directly.

5 CONCLUSION

Therapeutic adherence today extends beyond simply detecting undiagnosed cases of diabetes; it represents an opportunity for the pharmacist to provide patients with essential explanations and counseling, raising their awareness of potential diabetes risk. Demographic and economic pressures nonetheless underscore the need to adapt the role of community pharmacists within the health system, focusing on improved patient care at the pharmacy counter rather than on medication volume alone.

This study highlights the pivotal role that community pharmacists play in the comprehensive management of diabetes, contributing not only to early detection but also to the ongoing management of treatment needed to sustain adherence. Positioned to identify the challenges patients face in managing chronic disease, pharmacists are well placed to provide counseling, reinforce the importance of patient awareness, support regular medication-taking, and address concerns

about side effects — acting, too, as a bridge between patients and other healthcare professionals. Ultimately, responsibility for adherence cannot rest with the patient alone: it calls for engagement across the entire care system.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Disclosure of conflict of interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Statement of ethical approval

Authorization for data collection was obtained from the president of the Khénifra pharmacists' union council, and all participating pharmacists were informed of the study's objectives. Data were collected anonymously, with informed consent and confidentiality maintained throughout. The study protocol was submitted to the Ethics Committee of Mohammed VI University of Health Sciences and received a favorable opinion.

Statement of informed consent

Informed consent was obtained from all participants prior to their inclusion in the study. Participants were informed about the purpose and procedures of the study, and their participation was entirely voluntary.

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