Research Article **Phytopharmacology Research Journal (PRJ) Open Access**

Received: 3 Dec, 2025 | Revised: 28 January 2026 | Accepted: 29, January 2026 | Published online : 31 January, 2026 | ISSN : 2959-9687

Evaluation of Regulatory Compliance in the Dispensing of Narcotics and Controlled Drugs in Community and Hospital Pharmacies: A Simulated Client Approach

Sarina Ali[1], Maryam Shoukat[1], Sumra Barkat[1], Javeria Mehmood Khan[1], Kashif Sohail[1], Rehman Zafar[1,2*]

[1]Akson College of Pharmacy, Mirpur University of Science and Technology, Mirpur, AJ&K
[2]Faculty of Pharmaceutical Sciences, Riphah International University, Islamabad, Pakistan

***Corresponding Author:**
Dr. Rehman Zafar, Principal, Akson College of Pharmacy, Mirpur University of Science and Technology, Mirpur, AJ&K, Email ID: Principal.akson@must.edu.pk

Funding Information
Not Applicable

Abstract

In Pakistan the standards of community pharmacy and knowledge of dispensers are not much high. Non-availability of pharmacist, poor handling and validation of prescription are leading factors for increasing incidence of drug abuse and misuse. The main objective of the study intended to access the dispensing practice of narcotics and controlled drugs in community pharmacies through implementation of simulated client approach. The aim of the study was to investigate the extent to which narcotics and controlled drugs are dispensed and compliance of dispensing practices with established guidelines and regulations related to narcotics and controlled substances.

A descriptive cross-sectional study was conducted at 130 pharmacies including community/retail and hospital pharmacies using simulated client approach. A self-structured questionnaire was used which remain confidential from the relevant personals. Data was analyzed using statistical package for social sciences (SPSS version20). A descriptive cross-sectional study was conducted to evaluate community and hospital pharmacy practices regarding dispensing of narcotics and controlled drugs from April 2023 to March 2024. In this study, 103 (79.2%) were community/ retail pharmacies and 27 (20.8%) was hospital pharmacies where study include 51 (39.2%) were dispensers, 20 (15.4%) were pharmacists, 53 (40.8%) were technicians and only 6 (4.6%) were salesman. 115 (88.5%) did not provide the demanded medication to simulated client whereas only 15 (11.5%) dispensed the medication which include only alprazolam 10(7.69%) and bromazepam 5 (3.8%) out of all the narcotics and controlled drugs demanded at community pharmacy. Such drugs were predominantly dispensed upon insisting. And only 1 and 2 tablets of alprazolam and bromazepam were dispensed. 117 (90%) respondents inquired about prescription and fewer 13 (10%) didn't inquired about prescription or purpose of taking medication. Despite regulatory framework, a small percentage of providers dispensed the medication without adherence to proper protocols. This lax approach is compounded by a lack of knowledge about drug information and minimal patient inquiry. Although in most pharmacies pharmacists were not available. Urgent interventions are necessary to improve narcotics and controlled substances stewardship and promote responsible dispensing practices, ultimately safeguarding public health against the risks of narcotics and controlled substances misuse.

KEYWORDS:
Narcotics; Controlled Drugs; Drug Regulatory; Dispensing Practice, Patient Safety

1.0.INTRODUCTION

Drug abuse can lead to many health problems as well as serious side effects. Illegal use of opioids, amphetamines, and benzodiazepines can have powerful stimulant effects, and increase the risk of dependency and addiction to drug. Furthermore, the abuse of some expensive and scarce drugs imposes costs on the health system and insurance institutions as well. Drug abuse is the consumption of some drugs in a quantity that may be self-damaging or cause addiction. Therefore, these drugs lie under-controlled drug legislation and listed under programs in drug abuse regulations in many countries. Therefore, dispensing those drugs needs to be monitored closely and controlled [1]. Narcotics drugs used widely in western medical practices during the latter part of nineteenth century. They had present in crude form, commonly known for their so called beneficial effects for centuries and had been used extensively either therapeutically or non-therapeutically for their calming, intoxication and presumed curative purposes. The use of such drugs, lead to abuse and it soon became necessary to limit their availability. Therefore, control mechanisms were established in most western countries whose primary objective was the prevention of individual access to these abusive drugs except prescription medication. These are drugs or medications that have the potential for being misused, are considered to be substances that have a substantially high risk of substance use disorder. Drug Enforcement Administration (DEA, USA) used the term "narcotic" for such drugs that are opioid analgesics. Controlled substances have a high risk of drug addiction and substance use disorder [2].

All the narcotics and other drugs that have significant potential of abuse are classified in Pakistan into Schedule G of Punjab Drug Rules 2017. In Pakistan the standards of community pharmacies and knowledge of dispensers are not much high. Non availability of pharmacists, poor handling and validation of prescription are leading factors for increased incidence of drug abuse and misuse. All drugs whether prescription or OTC are dispensed in same way. Even most of the time patients are entertained without prescription. Although laws are present for the sale of drugs but implementation and accountability is not up to the mark [3]. Addiction, Dependence, and Tolerance are major risk associated to narcotics and controlled substances. While each of these terms are similar to each other. Addiction - the constant need for a drug despite harmful consequences. Pseudo addiction - constant fear of being in pain, hypervigilance; usually, there is a resolution with pain resolution. Dependence - physical adaptation to a medication where it is necessary for normal function and withdrawal occurs with lack of the medication. Tolerance - lack of expected response to a medication increasing dose to achieve the same pain relief resulting from CNS adaptation to the medication over time [2]. The most common side-effects associated with antipsychotics are tremors, weight gain, sedation, impaired sexual function, dizziness and tardive dyskinesia. Although antipsychotics are not considered to be addictive, studies have shown their tendencies to be abused and misused due to their sedating and tranquilizing effects. Inappropriate use of antipsychotics carries the potential for fatal adverse effects, withdrawal symptoms and sudden death due to drug-induced ventricular arrhythmia [4]. Drugs like alcohol, heroin, barbiturates, benzodiazepines, anesthetics, solvents, and gamma-hydroxybutyrate (GHB) cause sedation. The initial effect may be liberating and disinhibiting, but as the blood level rises, the user becomes more impaired and exhibits signs of muscle incoordination, difficult speech, unsteady gait, and a general unawareness of the surroundings. In a toxic overdose the person may succumb to the potentially fatal effects of respiratory depression and cardiovascular collapse. These agents produce addiction with concurrent physical dependence [5].

Increasing issues of malpractice regarding dispensing of narcotics and controlled drugs which is exacerbated by inappropriate narcotic use. The simulated client approach provides a unique and ethical method to observe real-world dispensing behaviors, allowing for a comprehensive analysis of factors influencing such practices. These factors enhance regulatory measures, standardize protocols for dispensing, promote responsible narcotics and controlled substances dispensing, and ultimately mitigate the growing threat of misuse and abuse of narcotics and controlled substances safeguarding both individual and public health. The present study on assessment of dispensing practices of narcotics and controlled substances, a simulated client approach addresses a critical issue in public health by evaluating the dispensing

practice of narcotics and controlled substances in community pharmacies [6]. Narcotics and controlled substances misuse contributes to abuse, a global health threat. Through simulated client approaches, this study aims to provide valuable insights into the factors influencing dispensing decisions, facilitating the development of targeted interventions to improve dispensing practices [7]. The findings have the potential to shape policies, enhance healthcare education and ultimately contribute to the global effort in combating inappropriate dispensing regarding narcotics and controlled substances in community pharmacies. The main objective of this study was to assess the dispensing practices of narcotics and controlled substances in community and hospital pharmacies through the implementation of a simulated client approach [8]. The aim of study was to investigate the extent to which narcotics and controlled substances were dispensed and the compliance of dispensing practices with established guidelines and regulations related to narcotics and controlled substances dispensing.

Inappropriate use of narcotic drugs is growing worldwide health challenge. It is also the problem of Sub-Saharan Africa where organized supply chain regulations on dispensing and stock management are poor for controlling these global challenges. The misuse of opioids by health professionals as well as other clients in the United States of America (U.S.A), Canada and Europe have also drawn the most attention. However, recent trends in Africa and Asia suggest opioid use epidemic may be rapidly expanding [9]. The use of narcotics and controlled drugs and their drug addiction are growing problems in Pakistan. Despite harsh anti-narcotics laws, the country has witnessed an increased growth in the number of drug addicts in the last three decades, and today Pakistan stands as one of the most drug affected countries in the world. A reported incident in Sindh on March 2016, more than 50 people died after consuming spurious liquor. Methamphetamine or "ice" use has become very popular in the last few years, which results in risky, violent and hostile behavior among users. The last decade witnessed an increasing trend in the spread of hepatitis B, C and HIV/AIDS amongst addicts all over the country because of used syringes and needles. Such an egregious situation of the problem demands a holistic intervention on part of the government and thus needs to study critically [10].

2.0. METHODOLOGY

2.1. STUDY DESIGN

This was a descriptive cross-sectional study design.

2.2. STUDY SETTING

The study was conducted at all the registered community and hospital pharmacies of district Mirpur, AJK.

2.3. INCLUSION AND EXCLUSION CRITERIA

All community and hospital pharmacies were included but medical stores were excluded.

2.4. STUDY DURATION

Study duration was April 2023 to March 2024.

2.5. STUDY POPULATION

The study was conducted on pharmacists, dispensers, technician and salesman who were involved in dispensing medicine at community and hospital pharmacies of targeted area.

2.6. SAMPLING METHOD

A simulated client approach with self-structured questionnaire was used to collect data which remain confidential from the relevant personals.

2.7. SAMPLE SIZE

Study size was calculated using Raosoft calculator at 95% of confidence interval with 5% margin of error, N=130.

2.8. DATA COLLECTION TOOL

Self-structured questionnaire containing questions regarding knowledge and dispensing practice of personnels was used to collect data

2.9. STATISTICAL ANALYSIS

Responses from each pharmacy about drug dispensing were recorded and descriptive statistics was used to calculate frequency and percentage by using statistical package for social sciences (SPSS version 20).

2.10. ETHICAL CONSIDERATION

This study was conducted by the permission of respective institute Akson College in joint venture with Mirpur University of Science and Technology (MUST), Mirpur AJK. All procedure was performed in this study and conducted with ethical standards.

3.0. RESULTS

3.1. DEMOGRAPHIC CHARACTERISTICS

The study was comprised of total 130 pharmacies, out of which 103 (79.2%) were community/retail pharmacies and 27 (20.8%) were hospital pharmacies. Out of 130 person who deal, 51 (39.2%) were dispensers, 20 (15.4%) were

pharmacists, 53 (40.85%) were pharmacy technicians and 6 (4.65%) were salesman. A detailed description given in the table 3.1 below;

Table 3.1: Demographic characteristics

Demographic Characteristics	Type of pharmacy	Frequency (n)	Percentage (%)
Study setting	Community/ Retail pharmacy	103	79.2
	Hospital Pharmacy	27	20.8
Person who deals	Dispenser	51	39.2
	Pharmacist	20	15.4
	Technician	53	40.8
	Salesman	6	4.6

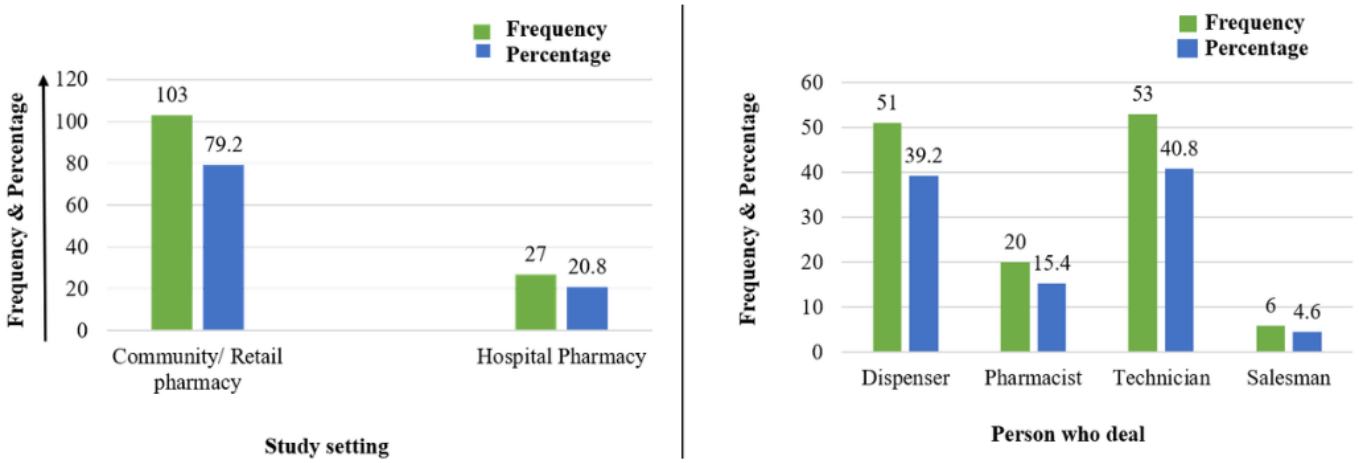


Figure 1 : Indicating the demographic characteristics of investigated area

3.2. DRUGS DEMANDED TO CHECK PRACTICE

Six classes of narcotics and controlled drugs were asked without prescription which include opioids, antidepressants, barbiturates, benzodiazepines, antipsychotics and CNS stimulant. Among opioids 3 (3.3%) asked were morphine, 12 (9.2%) asked were methadone, 6 (4.6%) asked were fentanyl and 3 (2.3%) asked were tramadol. From antidepressant class, 3 (2.3%) were bupropion, 3 (2.3%) were fluoxetine, 1 (0.8%) were citalopram. From barbiturates, 4 (3.2%) were phenobarbital, 3 (2.3%) were thiobarbital. From benzodiazepines, 31 (23.8%) were bromazepam, 39 (30%) were alprazolam and 8 (6.2%) were alprazolam and 8 (6.2%) were diazepam. From antipsychotics, 3 (2.3%) were haloperidol, 1 (0.8%) was loxapine and 2 (1.5%) were olanzapine. From CNS stimulant, only amphetamine 9 (6.9%) were asked from pharmacies. A detailed description is given in the table 3.2 below.

Table 3.2: Drugs that were asked to check practice

Drugs		Frequency	Percentage (%)
Opioids	Morphine	3	2.3
	Methadone	12	9.2

	Fentanyl	6	4.6
	Tramadol	3	2.3
Antidepressants	Bupropion	3	2.3
	Fluoxetine	3	2.3
	Citalopram	1	0.8
Barbiturates	Phenobarbital	4	3.1
	Thiobarbital	3	2.3
Benzodiazepines	Bromazepam	31	23.8
	Alprazolam	39	30
	Diazepam	8	6.2
Antipsychotics	Haloperidol	3	2.3
	Loxapine	1	0.8
	Olanzapine	2	1.5
CNS stimulant	Amphetamine	9	6.9

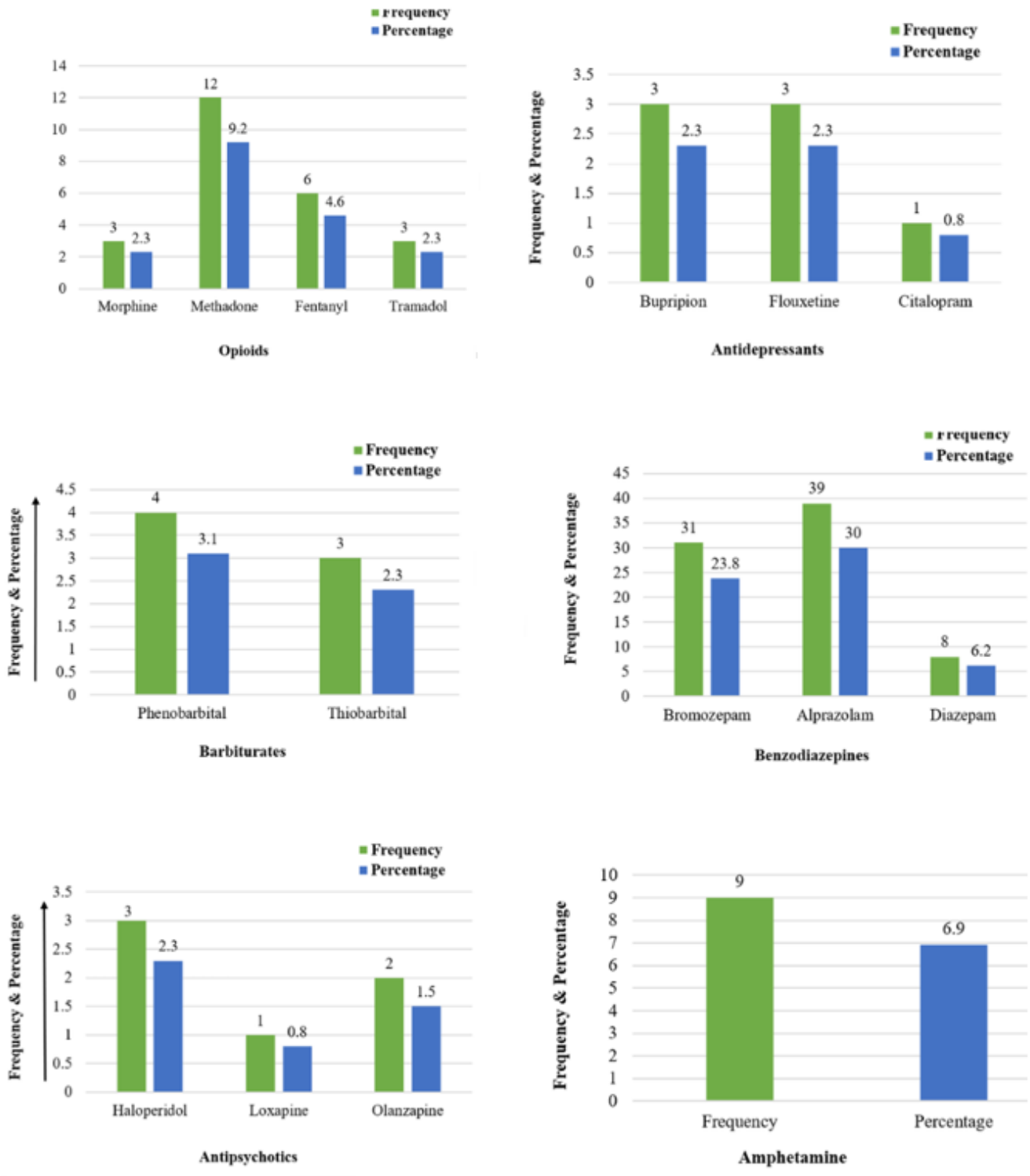


Figure 2: Frequency and Percentage of Controlled drugs that were Sold repeadly

3.3. DISPENSING CHARACTERISTICS

In total of 130 pharmacies 117 (90%) pharmacies asked for prescription of the demanded drugs and only 10% Pharmacies didn't ask any question about prescription related and only 15 (11.5%) pharmacies provide required medication and 115 (88.5%) pharmacies didn't provide the medication. Out of all the narcotics asked, only Alprazolam 10 (7.69%) and bromazepam 5 (3.8%) were dispensed in total of 15 pharmacies having quantity of 1 tablet was 6 (4.6%) and 2 tablets were dispensed 9 (6.9%) only and in these pharmacies only 1 (0.8%) were dispensed without insisting and 14 (10.8%) were dispensed after insisting. In total of 130 pharmacies, 91 (70%) pharmacies were inquired about medical history of taking such medicines and 39 (30%) didn't inquire about it. Only 3 (2.3%)

pharmacies provide alternative of antihistamine and 126 (96.9%) didn't provide any other alternative. Out of 130 pharmacies 55 (42.3%) pharmacies provide side effects of using these drugs and 75 (57.7%) didn't provide any side effects of these drugs. Awareness of pharmacies regarding dispensing of narcotics and controlled substances were include 39 (30%) average, 30 (23.1%) moderate and 61 (46.9%) were excellent. A detailed description is given in the table 3.3 below.

Table 3.3. Dispensing characteristics

Dispensing variables		**Frequency (n)**	**Percentage (%)**
Were we asked for prescription	Yes	117	90
	No	13	10
Did they provide required medication	Yes	15	11.57
	No	115	88.5
Narcotics dispensed	Alprazolam	10	7.69
	Bromazepam	5	3.8
Quantity dispensed	1 tab	6	4.6
	2 tabs	9	6.9
Did they dispense without insisting	Yes	1	0.8
	No	14	10.8
Did they inquire about medical history or purpose of taking medicines	Yes	91	70
	No	39	30
Were we offered any alternative non- prescription option or advice of changing your medicines	Yes	4	3.1
	No	126	96.9
Provide alternative	Antihistamine	3	2.3
Did they provide any side effects or usage instructions	Yes	55	42.3
	No	75	57.7
Overall awareness of dispensing of narcotics and controlled substances	Average	39	30
	Moderate	30	23.1
	Excellent	61	46.9

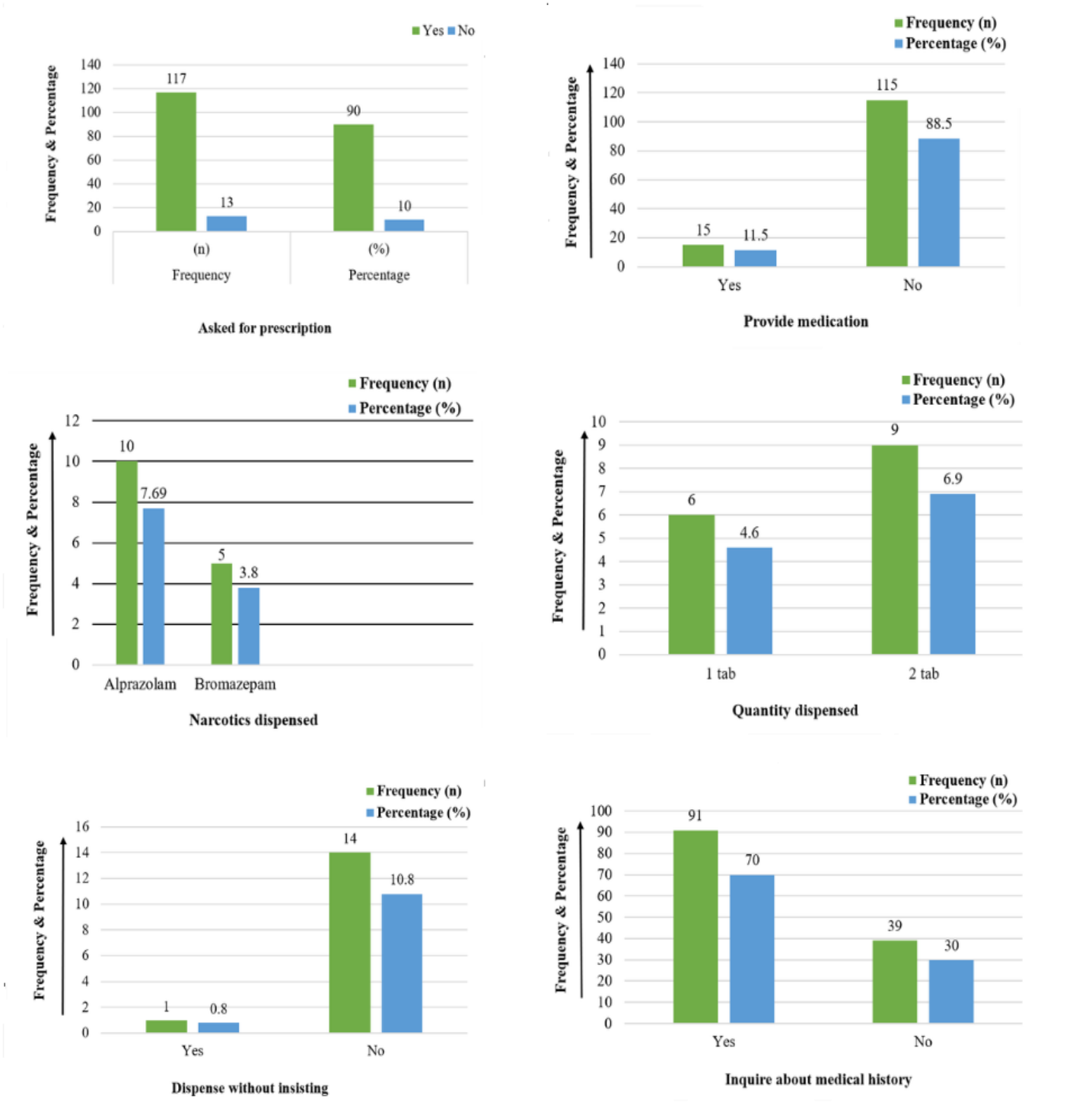


Figure 3: Characteristics of the patients asking for medicine in pharmacies

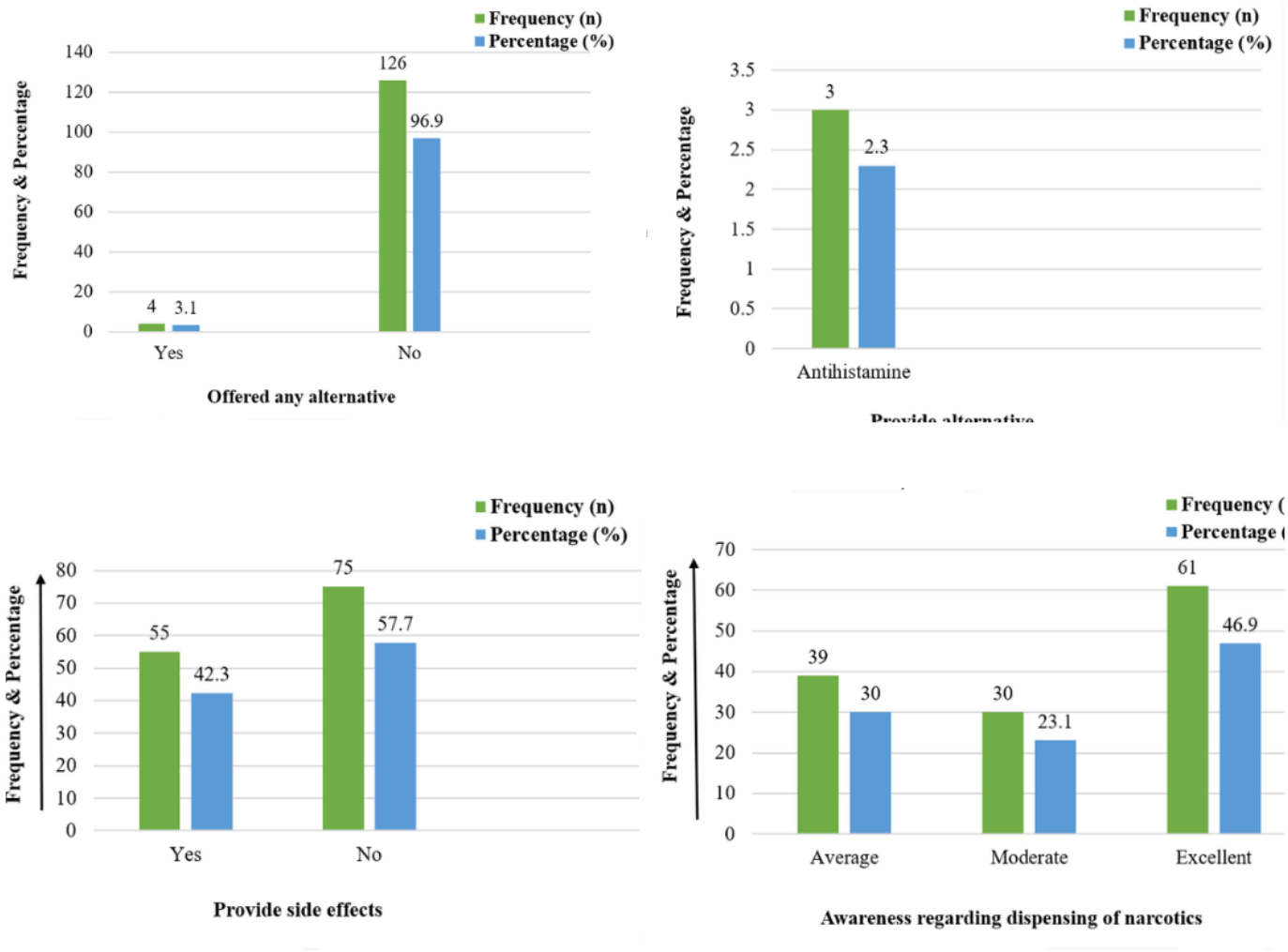


Figure 4: Replies of Pharmacies and Awareness regarding dispensing of narcotics

3.4. CROSS TABULATION

3.4.1. Study Setting verses Type of pharmacy

The comparison between dispensing variables and type of pharmacies gives detailed insight. In community pharmacies/retail pharmacies majority i.e. 93 asked for prescription whereas in hospital pharmacies this number was significantly lower at 24. Conversely, instance where we were not asked for prescription were comparatively infrequent in both settings. Concerning with the provision of required medication, a notably disparities exist, where only 14 instances recorded in community/ retail pharmacies compared to only 1 in hospital pharmacies. Regarding the dispensing of narcotics alprazolam and bromazepam is dispensed frequently in community/retail pharmacies i.e. 8 alprazolam, 5-bromazepam were dispensed while none of the narcotics were dispensed by hospital pharmacies and the quantity dispensed were only 1 or 2 tablets which they dispense us upon insisting from most of the pharmacies while only one retail/ community pharmacy dispensed us without insisting. Additionally, inquiries about medical history or purpose of taking medicine were also prevalent in community/retail pharmacies i.e. 32 were inquire about medical history and purpose while in case of hospital pharmacies, this number was 7. Concerning about provision of any side effects or usage instruction, mostly i.e. 58 did not provide us any side effect or usage instruction, only 45 community/retail pharmacies provided us with side effect while this number was fewer in case of hospital pharmacies i.e. 10 and 24 hospital pharmacies did not provide us the information. Regarding the policy for dispensing of narcotics and controlled substances, majority i.e. 102 community/retail pharmacies had policy while 24 hospital pharmacies had the policy regarding dispensing of controlled substances and narcotics. A detailed description is given in the table 3.4 below.

Table 3.4. Study setting and type of pharmacy

Dispensing variables		Type of pharmacy	
		Community/Retail pharmacy	Hospital pharmacy
Were we asked for prescription	Yes	93	24
	No	10	3
Did they provide required medication	Yes	14	1
	No	89	26
Narcotics dispensed	Alprazolam	8	0
	Bromazepam	5	0
Quantity dispensed	1 tab	6	0
	2 tabs	8	1
Did they dispense without insisting	Yes	1	0
	No	13	1
Did they inquire about medical history or purpose of taking medicines	Yes	71	20
	No	32	7
Were we offered any alternative nonprescription medication option or advice of changing your medicine	Yes	2	2
	No	101	25
Provide alternative	Antihistamine	2	1
Did they provide any side effects or usage instruction	Yes	45	10
	No	58	17
Overall awareness of dispensing of narcotics and controlled drugs	Average	32	7
	Moderate	25	5
	Excellent	46	15

3.4.2 Provider verses Dispensing Characteristics

The request for narcotics and controlled drugs was directed to 51 dispensers, 20 pharmacists, 53 technicians and 6 salesmen while comparing dispensing variables with who dispense, 45 dispensers had inquired about prescription while this number is 19 in case of pharmacist, in case of dispenser 45, 48 technicians and 5 salesmen. Predominately narcotics were provided which include alprazolam, bromazepam i.e. 4 times alprazolam was dispensed by pharmacy technicians while salesman didn't dispense any of the required medications. Bromazepam was dispensed once by dispenser, pharmacist and pharmacy technicians while the quantity of medicines dispensed is 1 which was dispensed 7 times and twice was dispensed 9 times. Whiles such medications were dispensed upon insisting only once dispensed without insisting. Majority of personnel's who dispensed the medication asked us about the medical history/ purpose of taking medication i.e. 34 dispensers, 17 pharmacists, 36 technicians and 4 salesmen inquired while 17

dispensers and technicians, 3 pharmacists and 2 salesmen did not inquire about medical history or purpose of taking medication. Regarding to offering any non-prescription option or alternative, only twice times pharmacist and one time dispenser and technician offered i.e. they suggested the use of anti-allergic medication. 24 dispensers, 11 pharmacists, 18 technicians and only 2 salesman warned simulated clients about the side effects. Overall awareness regarding dispensing of narcotic and controlled drugs was excellent with 61 instances, technicians in 25 instances, pharmacist in 11 instances and 24 in case of dispensers. A detailed description is given the in table 4.4.2 below;

Table 3.5. Provider verses dispensing variables

Dispensing variables		**Who dispense**			
		Dispenser	**Pharmacist**	**Technician**	**Salesman**
Were we asked for prescription	Yes	45	19	48	5
	No	6	1	5	1
Did they provide required medication	Yes	6	4	3	2
	No	45	16	50	4
Narcotics dispensed	Alprazolam	4	0	4	0
	Bromazepam	1	3	1	0
Quantity dispensed	1 tab	4	1	1	0
	2 tab	2	3	2	2
Did they dispense without insisting	Yes	0	0	1	0
	No	6	4	2	2
Did they inquire about medical history	Yes	34	17	36	4
	No	17	3	17	2
Were we offered any alternative non-prescription option or advice of changing your medicines	Yes	1	2	1	0
	No	50	18	52	6
Provide alternative	Antihistamine	0	2	1	0
Did they provide any side effects or usage instruction	Yes	24	11	18	2
	No	27	9	35	4
Overall awareness of dispensing of narcotics	Average	20	3	16	0
	Moderate	7	6	12	5
	Excellent	24	11	25	1

4.0. DISCUSSION

A descriptive cross-sectional study using a simulated client approach was conducted to assess dispensing practices of narcotics and controlled substances in 130 registered pharmacies of District Mirpur, AJK. The results of this study showed that large proportion of providers have knowledge about their misuse and majority of them didn't dispense the required medication. While a similar cross-sectional was study performed in four big cities of Punjab reported that Punjab was the hub of addicts for addiction of these narcotic drugs [11-14]. Prevalence of dispensing without prescription varies across different regions, revealing a concerning global trend. The results of present study conducted in Mirpur, AJK showed that only 11% pharmacies dispensed the drugs without prescription. These result were aligned with a similar cross-sectional study that was conducted in Uganda, 20-40% pharmacies in Uganda dispensed the drugs without prescription or invalid prescription [6]. According to present study which involved 130 pharmacies, providers dispensed 11% benzodiazepines consisting of alprazolam and bromazepam only. Only 9% providers have done bachelors in pharmacy while 15.4% pharmacist were available at that time. The results of the study were aligned with a similar cross-sectional study performed in Karachi having 200 pharmacists showed that 89% providers dispensed medication without prescription to which most of were benzodiazepines [15-18].

In present study antipsychotics were not dispensed and further revealed that these drugs were not available at the pharmacies while 11% pharmacies dispensed only alprazolam and bromazepam. These results were aligned with a similar cross-sectional study which was performed in Nigeria including 151 community pharmacies for common antipsychotics (two each of typical and atypical) namely olanzapine, risperidone, haloperidol, chlorpromazine) for the simulated patients. Almost all, 109 (92.4%), the pharmacists dispensed generic/cheaper antipsychotics over-the-counter while the originator's brands or "expensive" generics such as risperidone, olanzapine was sold only with prescriptions [19]. The present study which was performed at 130 community and hospital pharmacies in Mirpur AJK, providers didn't dispense antipsychotics without prescription [20]. While in comparison to this study a similar-cross sectional study was conducted in Nigeria including 119 community pharmacies to which 85 pharmacist dispensed antipsychotics without prescription [4]. In the present study, results showed that 30% providers had average knowledge about dispensing of narcotics. While in comparison to this a similar cross- sectional study was conducted in Ethiopia including 144 pharmacist had mean knowledge score was 7.789 and 75 pharmacist had poor knowledge regarding dispensing of psychotropic substances [7].

5.0. CONCLUSION

The present study highlighted the concerning trends in the dispensing practices of narcotics and controlled substances without prescription, as revealed through a simulated client approach. Following the regulatory framework, large portion of providers, including pharmacy technicians, dispensers and salesmen, didn't dispense narcotics and controlled substances and provide side effects of these substances. Despite regulatory framework, a small percentage of providers dispensed the medication without adherence to proper protocols. This lax approach is compounded by a lack of knowledge about drug information and minimal patient inquiry. Urgent interventions are necessary to improve narcotics and controlled substances stewardship and promote responsible dispensing practices, ultimately safeguarding public health against the risks of narcotics and controlled substances misuse.

6.0. RECOMMENDATIONS

Sales of narcotics and controlled substances without prescription in Mirpur AJK drug retail outlets is not as such alarming. Strengthening existing laws, guidelines and national medicines regulatory capacity, continuous awareness-raising programs, training and education programs for providers and implementation of medicines scheduling are recommended to achieve more prudent use of narcotics and controlled substances. Besides, future regulatory interventions should consider the access and excess use of narcotics and controlled substances. Further qualitative study is also suggested to unveil reasons that motivate the sale of narcotics and controlled substances without prescription. By implementing these recommendations, dispensing of narcotics and controlled substances will be improved further.

ACKNOWLEDGEMENT

All authors are very thankful to Akson College of Pharmacy, Mirpur University and Science and

Technology, Mirpur, for providing the research opportunities.

CONFLICT OF INTEREST

All authors have NO CONFLICT OF INTEREST in this research work.

REFERENCES

[1] Abbasi, R., et al., Using pharmacy surveillance information systems to monitor the dispensing practice of under-controlled drugs: A qualitative study on necessities, requirements, and implementation challenges. Informatics in Medicine Unlocked, 2023. **38**: p. 101198.

[2] Preuss, C.V., A. Kalava, and K.C. King, Prescription of controlled substances: benefits and risks. 2019.

[3] Bashir, I., et al., Illicit sale of controlled drugs at community pharmacy/medical stores of Punjab, Pakistan: A road to demolition of public health. Heliyon, 2021. **7**(5).

[4] Olasupo, J., et al., Knowledge and dispensing practice of community pharmacists towards antipsychotic medicines in a Nigerian metropolitan city–a cross-sectional study. BMC Health Services Research, 2023. **23**(1): p. 1450.

[5] Tommasello, A.C., Substance abuse and pharmacy practice: what the community pharmacist needs to know about drug abuse and dependence. Harm reduction journal, 2004. **1**(1): p. 1-15.

[6] Kamba, P.F., et al., Compliance of private pharmacies in Uganda with controlled prescription drugs regulations: a mixed-methods study. Substance Abuse Treatment, Prevention, and Policy, 2020. **15**: p. 1-13.

[7] Mekonnen, G.B. and A.T. Beyna, Pharmacists' knowledge and practice of issues related to using psychotropic medication in elderly people in Ethiopia: a prospective cross-sectional study. BioMed Research International, 2020. **2020**.

[8] F. Hussain, A. Tahir, M.S. Jan, N. Fatima, A. Sadiq, U. Rashid, Exploitation of the multitarget role of new ferulic and gallic acid derivatives in oxidative stress-related Alzheimer's disease therapies: design, synthesis and bioevaluation, RSC advances, 14 (2024) 10304-10321.

[9] F. Mahmood, M.S. Jan, S. Ahmad, U. Rashid, M. Ayaz, F. Ullah, F. Hussain, A. Ahmad, A.-u. Khan, M. Aasim, Ethyl 3-oxo-2-(2, 5-dioxopyrrolidin-3-yl) butanoate derivatives: anthelmintic and cytotoxic potentials, antimicrobial, and docking studies, Frontiers in chemistry, 5 (2017) 119.

[10] O.M. Alshehri, M.H. Mahnashi, A. Sadiq, R. Zafar, M.S. Jan, F. Ullah, M.A. Alshehri, S. Alshamrani, E.E. Hassan, Succinimide Derivatives as Antioxidant Anticholinesterases, Anti-α-Amylase, and Anti-α-Glucosidase: In Vitro and In Silico Approaches, Evidence-Based Complementary and Alternative Medicine, 2022 (2022) 6726438.

[11] B. Waheed, S.M. Mukarram Shah, F. Hussain, M.I. Khan, A. Zeb, M.S. Jan, Synthesis, antioxidant, and antidiabetic activities of ketone derivatives of succinimide, Evidence-Based Complementary and Alternative Medicine, 2022 (2022) 1445604.

[12] K. Shahzadi, S.M. Bukhari, A. Zaidi, T.A. Wani, M.S. Jan, S. Zargar, U. Rashid, U. Farooq, A. Khushal, S. Khan, Novel coumarin derivatives as potential urease inhibitors for kidney stone prevention and antiulcer therapy: from synthesis to in vivo evaluation, Pharmaceuticals, 16 (2023) 1552.

[13] M.H. Mahnashi, Y.S. Alqahtani, B.A. Alyami, A.O. Alqarni, M. Ahmed Alshrahili, M.A. Abou-Salim, M.N. Alqahtani, S. Mushtaq, A. Sadiq, M.S. Jan, GC-MS Analysis and Various In Vitro and In Vivo Pharmacological Potential of Habenaria plantaginea Lindl, Evidence-Based Complementary and Alternative Medicine, 2022 (2022) 7921408.

[14] R. Zafar, H. Naureen, M. Zubair, K. Shahid, M. Saeed Jan, S. Akhtar, H. Ahmad, W. Waseem, A. Haider, S. Ali, Prospective application of two new pyridine-based Zinc (II) amide carboxylate in management of alzheimer's disease: Synthesis, characterization, computational and in vitro approaches, Drug Design, Development and Therapy, (2021) 2679-2694.

[15] K. Ullah, S. Ali, A. Haider, S. Naz, S. Yousuf, K.S. Munawar, M.S. Jan, R. Zafar, R. Kumar, Investigation of pivalic acid-derived organotin (IV) carboxylates: Synthesis, structural insights, interaction with biomolecules, and computational studies, Journal of Molecular Structure, 1322 (2025) 140444.

[16] A. Rauf, M. Ibrahim, T.S. Alomar, N. AlMasoud, A.A. Khalil, M. Khan, A. Khalid, M.S. Jan, D. Formanowicz, M.M. Quradha, Hypoglycemic, anti-inflammatory, and neuroprotective potentials of crude methanolic extract from Acacia nilotica L.–results of an in vitro study, Food Science & Nutrition, 12 (2024) 3483-3491.

[17] N. Masood, Q. Jamil, M.I. Aslam, M.I. Masood, J.H. Shirazi, Q.A. Jamil, M.S. Jan, B. Alsuwayt, A. Ahmad, S.M.A. Alnasser, Antioxidant, carbonic anhydrase inhibition and diuretic activity of Leptadenia pyrotechnica Forssk. Decne, Heliyon, 9 (2023).

[18] A. Pervaiz, M.S. Jan, S.M. Hassan Shah, A. Khan, R. Zafar, B. Ansari, M. Shahid, F. Hussain, M. Ijaz Khan, A. Zeb, Comparative in-vitro anti-inflammatory, anticholinesterase and antidiabetic evaluation: computational and kinetic assessment of succinimides cyano-acetate derivatives, Journal of Biomolecular Structure and Dynamics, (2022) 1-14.

[19] W. Alam, H. Khan, M.S. Jan, H. W. Darwish, M. Daglia, A. A. Elhenawy, In vitro 5-LOX inhibitory and antioxidant potential of isoxazole derivatives, Plos one, 19 (2024) e0297398.

[20] O.M. Alshehri, A. Zeb, S.M. Mukarram Shah, M.H. Mahnashi, S.A. Asiri, O. Alqahtani, A. Sadiq, M. Ibrar, S. Alshamrani, M.S. Jan, Investigation of anti-nociceptive, anti-inflammatory potential and ADMET studies of pure compounds isolated from Isodon rugosus Wall. ex Benth, Frontiers in pharmacology, 15 (2024) 1328128.