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The Availability Of Essential Parkinson's Disease Medications In The Public And Private Sectors And The Suitability Of Storage Conditions For Medications In Nafusa Mountain, Libya

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مدى توافر الأدوية الأساسية لعلاج شلل الرعاش في القطاعين العام والخاص ومدى ملاءمة ظروف تخزين الأدوية في جبل نفوسة ـليبيا

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Abstract

In the recent years, parkinson's disease has been distributed widely over the world specifically among elderly people. The major aim of this research is find out the availability rates for the essential parkinson's disease medications (PDMs) as well as studying the suitability of storage conditions of medications in the major cities of Nafusa Mountain, Libya. A survey was completed after a field visit to the major hospitals and to the biggest private pharmacies in the area of study. The results showed that the essential PDMs were not available in the public sector. In the private sector, the highest availability rate were 66.66% in Gharyan pharmacy. The availability rates of biperiden and levodopa/carbidopa were 10% and 20% respectively in the private sector. Regarding the suitability of storage conditions of medicines in the dispensing area, the storage conditions were 100% compliance in Al-Awainiya hospital (public sector), Jadu hospital (public sector), Jadu pharmacy (private sector) and Al-Zintan pharmacy (private sector). It is recommended to address the root causes of the low availability of essential PDMs in both sectors. In additions, try to improve the storage conditions for medicines in the dispensing areas.

Key words: Parkinson's disease, essential medications, biperiden, levodopa/carbidopa

الملخص

في السنوات الأخيرة، انتشر مرض باركنسون على نطاق واسع في جميع أنحاء العالم، وخاصة بين كبار السن. يهدف هذا البحث بشكل رئيسي إلى معرفة معدلات توفر الأدوية الأساسية لمرض شلل الرعاش، بالإضافة إلى دراسة مدى ملاءمة ظروف تخزين الادوية في المدن الرئيسية بجبل نفوسة، ليبيا. أُجري مسح ميداني بعد زيارة ميدانية للمستشفيات الرئيسية وأكبر الصيدليات الخاصة في منطقة الدراسة. أظهرت النتائج عدم توفر الأدوية الأساسية في القطاع العام. أما في القطاع الخاص، فقد سُجِّل أعلى معدل توافر بنسبة 66.66% في صيدلية غريان. وبلغت معدلات توافر دواء biperden وlevodopa/carbidopa نسبة 10% و20% على التوالي في القطاع الخاص. وفيما يتعلق بملاءمة ظروف تخزين الأدوية في منطقة التوزيع، فقد كانت ظروف التخزين مطابقة تمامًا لشروط التخزين في مستشفى العوينية (القطاع العام)، ومستشفى جادو (القطاع العام)، وصيدلية جادو (القطاع الخاص)، وصيدلية الزنتان (القطاع الخاص). ينصح بمعالجة الأسباب الجذرية لانخفاض توافر الأدوية الأساسية في كلا القطاعين. بالإضافة إلى ذلك، يُنصح بتحسين ظروف تخزين الأدوية في أماكن صرفها.

الكلمات المفتاحية: مرض باركنسون، الأدوية الأساسية، ، biperden، levodopa/carbidopa

Introduction

During the last years, the incidence of parkinson’ s disease was growing very fast. This disease affects mainly elderly people. Therefore, essential Parkinson’s disease medications should be available all time in the public and private sectors. Moreover, unsuitable storage of medicines might have serious health effects, so the storage conditions of medicines in the dispensing area should be compliance in both sectors.

Research Questions

1-What is the percentage of availability of essential PDMs in the public and in the private health sectors?

2-Is there a difference between the availability of essential PDMs in the public health sector compared to the private health sector?

3-Are there expired essential PDMs on the shelves?

4-Are medications stored in pharmacies under appropriate storage conditions?

Aim (importance) of the study

The importance of this research lies in the following:

1- Determine whether there is a shortage of essential PDMs in the public and private health sectors.

2-Raise awareness among public and private healthcare institutions about the need and importance of providing essential PDMs.

Objectives of the study

1-To determine the availability of essential PDMs in the public hospitals and private pharmacies.

2-To study the difference between the availability of essential PDMs in the public hospitals and private pharmacies.

3- To determine whether expired essential PDMs are on the shelves.

4- To study the suitability of medication storage conditions in the public hospitals and private pharmacies.

Research methodology

In this study, an observational approach was adopted, through completing questionnaires regarding the availability of essential PDMs and the suitability of medication storage conditions in the public hospitals and private pharmacies, and then analyzing the results. The sampling technique used in this research was purposive or selective sampling because the researchers intentionally chose specific hospitals and specific pharmacies(not randomly).

The selection of the cities included in this study within the Nafusa Mountain region was based on several methodological criteria to ensure appropriate geographical and demographic representation. The chosen cities (Yefren, Al-Qalaa, Umm Al-Jarsan, Al-Awainiya, Kikla, Al-Rayayna, Al-Asabaa, Al-Zintan, Gharyan, and Jadu) cover the entire geographical extent of the Nafusa Mountain area from north to south, including both urban centers and smaller rural communities. This distribution allowed for a realistic comparison between densely populated cities and less populated areas.

The selection was also justified by the presence of active public hospitals and private pharmacies that provide pharmaceutical services to the local population, making these locations representative of the overall healthcare situation in the region. Furthermore, the proximity of these cities to the Medical Technical College in Yefren facilitated field visits and data collection within the specified time frame, while maintaining the quality and accuracy of observations. Therefore, this selection ensures that the study sample adequately represents the different population patterns and healthcare service levels across the Nafusa Mountain region, supporting the reliability and generalizability of the study findings.

Research limitations

Time limits of research

The survey collected during the period from (20/1/2025) to (8/3/2025).

Location limits of research

The study was conducted in 10 cities in Nafusa Mountain (Yefren, AlQalaa, Umm Al-Jarsan, Al-Awainiya, Kikla, Al-Rayayna, Al-Asabaa, Al-Zintan, Gharyan and Jadu).

Sample size

The sample size was 20 questionnaires collected from public hospitals and private pharmacies. An average of 10 questionnaires were collected from public hospitals and another questionnaires from private pharmacies.

Parkinson’s disease definition

Parkinson’s disease (PD) is a chronic, progressive condition that affects dopamine-producing cells, primarily in the midbrain. The resulting dopamine deficiency leads to a gradual decline in motor coordination (Guillermo *et. al*, 2018). This leads to a gradual loss of control of voluntary movements with time (Patel & Chang, 2014).

Role of dopamine in Parkinson’s disease

Parkinson's disease is a progressive neurodegenerative disorder that impacts movement. It results from a deficiency of dopamine in the brain's movement control region. Without enough dopamine, the brain struggles to send the proper signals to coordinate movement. Dopamine acts as a chemical messenger, transmitting signals between the substantia nigra and the corpus striatum. Both of these areas are part of the basal ganglia, a brain structure group responsible for facilitating movement. Research indicates that by the time symptoms of Parkinson's disease appear, most individuals have lost 60–80% or more of the dopamine-producing cells in the substantia nigra (Morales, 2023).

Essential Parkinson’s disease medications

There are three essential Parkinson’s disease medications (PDMs) that should be available in all public and private healthcare facilities. These medications are:

-Biperiden tablet

-Biperiden injection

-Levodopa/Carbidopa combination tablet (WHO, 2017).

Mechanism of action of biperiden

Biperiden is a centrally acting competitive antagonist of muscarinic acetylcholine receptors, with a particularly strong affinity for the muscarinic-1 (M1) subtype. By blocking these receptors in the basal ganglia, it helps restore the balance between dopaminergic and cholinergic neurotransmission that is disrupted in Parkinson’s disease This effect helps reduce symptoms like tremors and rigidity (Kostelnik *et. l*, 2017).

Mechanism of action of (Levodopa/Carbidopa)

In individuals with Parkinson's disease, the brain lacks enough dopamine, a chemical that helps control movement, making it difficult to move as desired. Carbidopa and levodopa are medications that work together to assist people with Parkinson's. Levodopa is converted into dopamine in the brain, but when taken alone, it breaks down too quickly before reaching the brain. Carbidopa prevents this breakdown, allowing more levodopa to reach the brain and helping people with Parkinson’s move more freely (Cho, 2024).

Previous studies

A study conducted by Mokaya and his colleges in 2016 to assess the availability and cost of PDMs in Kenya. In this study, the availability of levodopa in 48 pharmacies was 50% of them. Also, Only five pharmacies offered levodopa at an affordable price (Mokaya *et. al,* 2016).

In a statistical study conducted by Sakdisornchai and his colleagues on the availability of a group of drugs used to treat PD in Thailand in 2017, the results indicated that the availability of levodopa was 69.3%. The Availability of levodopa was higher in private, and central region hospitals (*Sakdisornchai et. al, 2018)*

In another study conducted in Municipality Riobamba in 2112 on the availability of PDMs, it was found that the availability rate of PDMs in the public sector was %51 while in the private sector it was %01. The availability of biperiden and levodopa was only 5% in the private sector (Guillermo *et. al,* 2018).

In 2019, a study was conducted in Nigeria by Okubadejo and his colleagues on the availability and affordability of PDMs. It was found that the percentage of levodopa/carbidopa was 48%. Also, In this study, only two medications (trihexyphenydyl tablets and biperidine injections) were affordable (Okubadejo *et. al, 2019)*

A comprehensive continent-wide survey investigated the availability, affordability, usage frequency, and insurance coverage of PD therapies and services across Africa conducted by Hamid and his colleagues in 2021. The results indicated that the availability of levodopa-based oral preparations was only 46.4% (Hamid *et. al, 2021).*

In 2022, a study was conducted by surveying International Parkinson and Movement Disorders Society members about availability of PD treatment by Goh and his colleagues. The study highlights significant disparities in the availability of PD treatments between countries with different income levels. It revealed that levodopa was available in almost all countries with a percentage of 99%. Also, In this study, the availability of other PDMs decreases as the national income level decreases (Goh *et. al, 2022).*

A study conducted by Fothergill-Misbah and his colleagues in 2024 in Kenya showed that the availability of levodopa/carbidopa in the public pharmacies is only 6.7%, compared to 73.7% in the private pharmacies, where the costs are much higher. Moreover, certain formulations, such as levodopa/carbidopa 100/25, are among the least available and most expensive. This limited availability, particularly in public health facilities, significantly impacts the ability of people with PD to manage their condition effectively (Fothergill-Misbah *et. al, 2024).*

Materials and methods

Study design

The study was conducted using the WHO Operational Package for Assessing, Monitoring and Evaluating country pharmaceutical situation as a guide with some modification of the data collection forms to include medicines selected on the basis of their importance in the treatment of Parkinson's disease. The methodology used was adapted from the WHO study system to facilitate comparisons with other countries (11). The first survey in public pharmacies and the second survey in private pharmacies, collected information on the current availability of essential medicines for the treatment of Parkinson's disease.

Study population and Sampling

Area of study

This study was conducted in Nafusa Mountain (Western Mountain) region in the western part of Libya.

Areas selection

Considering the location of the Medical Technical College-Yefren, the city of Yefren was chosen and the 9 closest cities to the city of Yefren

were chosen: Al-Qalaa, Umm Al-Jarsan, Al-Awainiya, Kikla, AlRayayna, Al-Asabaa, Al-Zintan, Gharyan and Jadu. A total of 10 cities were chosen from Nafusa Mountain.

Pharmacies selection

Pharmacies were selected to include both public and private sectors, with one public pharmacy (one public hospital) and one private pharmacy selected from each city for the study. A total of 10 public hospitals and 10 private pharmacies were studied.

Public sector (Public Hospitals)

Public hospitals were selected taking into account that they had outpatient and drug distribution area and so that the largest public hospital was selected from each city included in the study.

Private sector (Private Pharmacies)

Private pharmacies were selected to be somewhat the best private pharmacy from each city included in the study.

List of surveyed medicines

The selected drugs should be:

- Present in the national essential medicines list

- Parkinson's disease drugs that are expected to be available in all public hospitals and private pharmacies at all times (WHO, 2017).
- In the study, 3 medicines from the WHO Essential Medicines list were tested on the basis of their importance in the treatment of Parkinson's disease.

Table (1) The list of essential PDMs that were included in the study.

Essential medicines for Parkinson's	
1.	Biperiden injection
2.	Biperiden tablet
3.	Levodopa+Carbidopa tablet

Data collection

The survey forms were prepared and then filled out after conducting a field visit to all public hospitals and private pharmacies included in this study during the period from (20/1/2025) to (8/3/2025).

How to fill out the survey forms

Table (2): Survey form no.1 related to the availability of essential PDMs

Survey form no. 1			
Availability of essential Parkinson's disease medications			
Facility:…… Date: / / 5			
Region:…… Investigator:……			
Column (A)		Column (B)	Column (C)
Essential PDMs	Dosage form	In stock Yes=1, No=0	Expired medicines on shelves Yes=1, No=0
Biperiden	Injection		
Biperiden	Tablet		
Levodopa+Carbidopa	Tablet		
		B1 = Sum of B	C1 = Sum of C

	B2 = % in stock = B1 ÷3 x 100 =	C2 = % expired = C1÷ B1 x 100 =

-For Column (B), Mark " " if any quantity of any dosage form of the medicines is in stock in the facility on the day of the visit**.** Mark " " if the medicine is not available in stock**.**

- For Column (C), If any amount of a medicine has an expiry problem, mark " " for "Yes" and mark " " for "No" (WHO, 2007).

Table (3): Survey form no. 2 related to Adequate conservation conditions

Survey form no	
Adequate conservation conditions and handling of medicines in the dispensing area	
Facility:…… Date: / /	
Region:…… Investigator:……	
Check list [A]	Dispensing Area True=1, False=0 [B]
1. There is a method in place to control temperature(e.g. roof and ceiling with space between them in hot climates, air conditioners, fans, etc.).	
2. There are windows that can be opened or there are air vents.	
3. Direct sunlight cannot enter the area (e.g. window panes are painted or there are curtains/blinds to protect against the sun).	
4. Area is free from moisture (e.g. leaking ceiling, roof, drains, taps, etc.)	
5. There is a cold storage in the facility.	
6. There is a regularly filled temperature chart for the cold storage	
7. Medicines are not stored directly on the floor	

8. Medicines are stored in a systematic way (e.g. alphabetical, pharmacological).	
9. Medicines are stored first-expiry-first out (FEFO).	
10. There is no evidence of pests in the area.	
11. Tablets/capsules are not manipulated by naked hand	
B1 = Sum of B	
B2= Score = B1 ÷ 11 x 100 =	

–for column (B), indicates "1" if all parts of the statement are true for the dispensing area and "0" if any part of it false (WHO, 2007).

How to calculate the availability rate of each essential PDM alone:

The availability rate of each essential PDM alone (public sector) :

$$= \frac{\text{number of hospitals that had the essential PDM in their shelves}}{\text{total number of hospitals}}$$

The availability rate of each essential PDM alone (private sector) :

$$= \frac{\text{number of pharmacies that had the essential PDM in their shelves}}{\text{total number of pharmacies}}$$

Data analysis

After collecting the data, the percentages of medicine availability and the percentages of the suitability of storage conditions were calculated for each pharmacy in each sector. The percentages were placed in explanatory tables, and the data for the public sector were compared with the data for the private sector.

Results

The results of availability of essential PDMs

Table (4): Availability percentage of essential PDMs in the public sector

Public hospital	Yefren	Al-Qalaa	Umm Al-Jarsan	Al-Awainiya	Kikla	Al-Rayayna	Al-Asabaa	Al-Zintan	Gharyan	Jadu
Availability %	0	0	0	0	0	0	0	0	0	0

The analysis results revealed that essential Parkinson's disease medications (PDMs) were not available at all in all public hospitals across the Nafusa Mountain region.

Table (5): Availability percentage of essential PDMs in the private sector

Private pharmacy	Yefren	Al-Qalaa	Umm Al-Jarsan	Al-Awainiya	Kikla	Al-Rayayna	Al-Asabaa	Al-Zintan	Gharyan	Jadu
Availability %	0	33.33 %	0	0	0	0	0	0	66.66 %	0

In the private sector, Gharyan pharmacy recorded the highest availability rate of essential PDMs at 66.66% followed by 33.33% in Al-Qalaa pharmacy, while these medications were unavailable in all other pharmacies

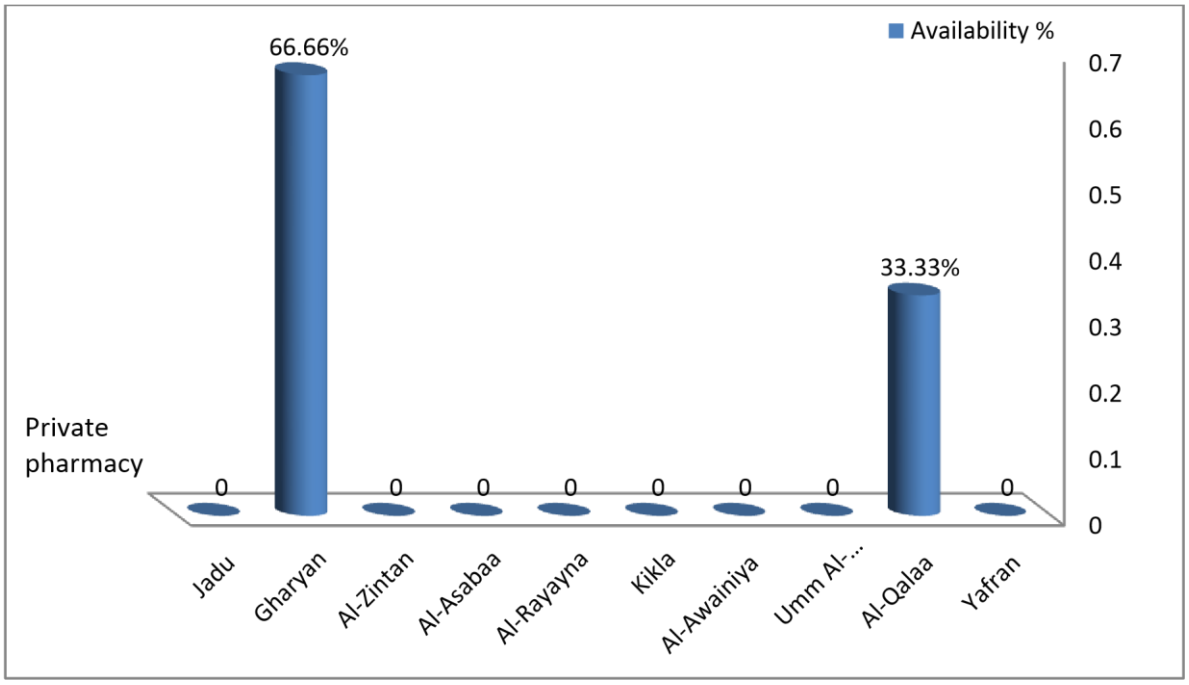

Figure 1: Availability percentage of essential PDMs in the private sector

Table 6: Availability percentage of each essential PDMs alone in the public sector

Essential PDM	Biperiden Injection	Biperiden Tablet	Levodopa+Carbidopa Tablet
Availability % in public sector	0	0	0

When comparing the availability of essential PDMs individually in the public hospitals, it was found that the essential PDMs availability rate was nil for each of them**.**

Table 7: Availability percentage of each essential PDMs alone in the private sector

Essential PDM	Biperiden injection	Biperiden tablet	Levodopa+Carbidopa Tablet
Availability % in Private sector	0	10%	20%

By comparing the availability rates of each essential PDM in the private pharmacies, it was found that the highest availability was for levodopa/carbidopa combination tablets at 20%, followed by biperiden tablets at 10%, while biperiden injections were completely unavailable.

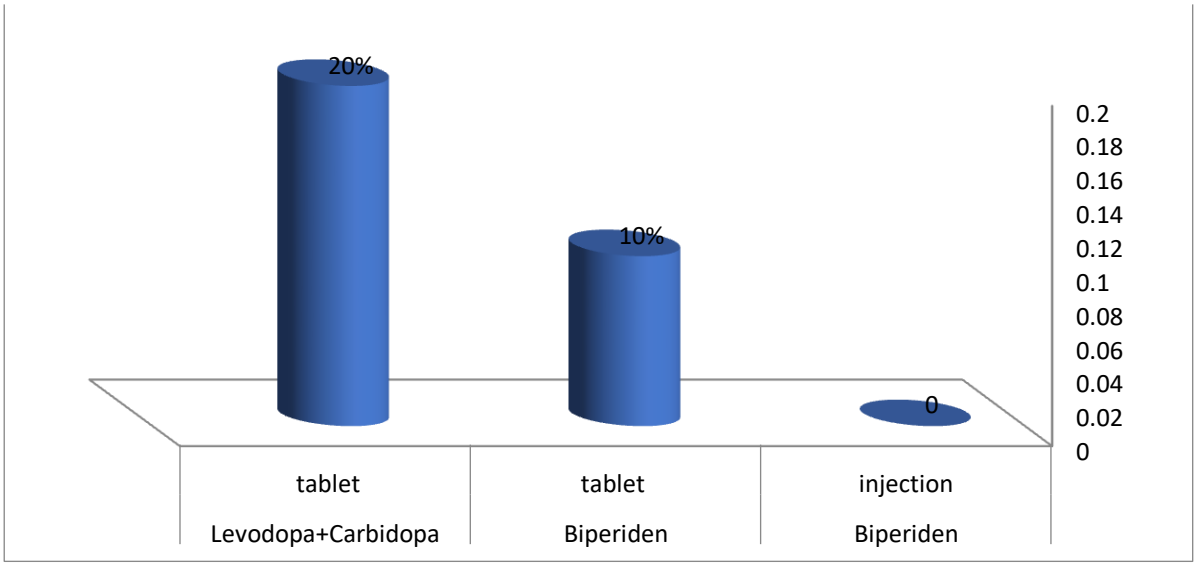

Figure 2: Availability percentage of each essential PDMs alone in the private sector

The results of percentage of expiry date for essential PDMs

The results showed that none of the essential PDMs were expired in the day of visit to the private sector.

The results of adequate conservation conditions and handling of medicines in the dispensing area.

Table 8: Adequate conservation conditions in the public sector

Public hospital	Yefren	Al-Qalaa	Umm AlJarsan	Al-Awainiya	Kikla	Al-Rayayna	Al-Asabaa	Al-Zintan	Gharyan	Jadu
Conservation conditions %	72.72 %	90.90 %	81.81 %	100%	90.90 %	90.90%	90.90 %	90.90 %	72.72%	100 %

When comparing the storage conditions of medications in public hospitals across different regions, it was observed that the storage conditions were ranged from 72.72% to 100% compliance. In Jadu and Al-Awainiya, each achieving a full compliance rate of 100%. These were followed by Al- Al-Rayayna, Kikla, Al-Zintan, Al-Asaba, and AlQalaa, with a compliance rate of 90.90%, indicating good adherence to proper storage standards. In contrast, Umm Al-Jarsan recorded a rate of 81.81%, while Gharyan and Yafran showed the lowest compliance at 72.72% , reflecting a need for improvements in storage facilities in these areas.

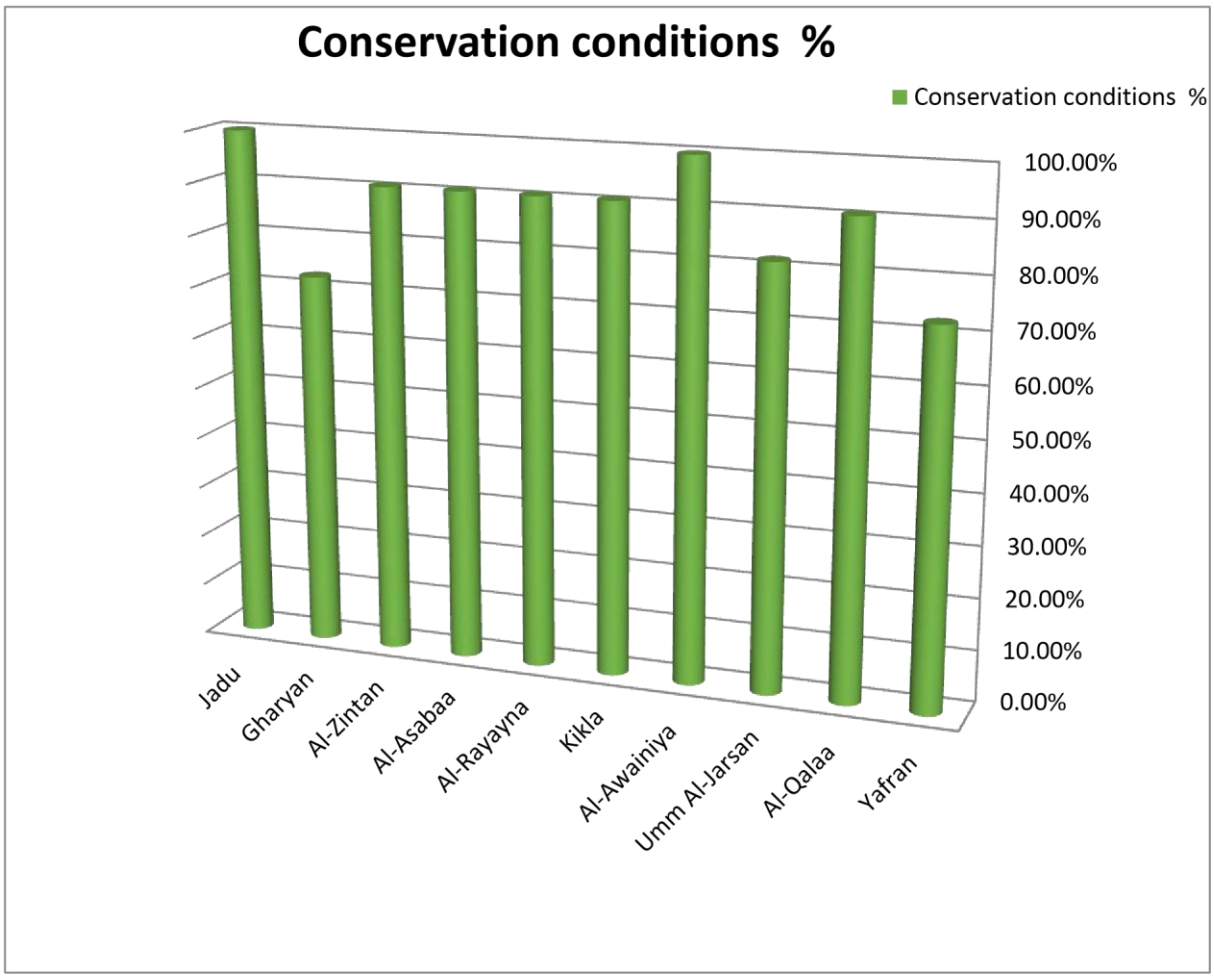

Figure 3: Adequate conservation conditions in the public sector

Table 9: Adequate conservation conditions in the private sector

Private pharmacy	Yefren	Al-Qalaa	Umm AlJarsan	Al-Awainiya	Kikla	Al-Rayayna	Al-Asabaa	Al-Zintan	Gharyan	Jadu
Conservation conditions %	90.90 %	72.72 %	90.90 %	81.81%	90.90 %	72.72%	90.90 %	100%	81.81%	100 %

When comparing the storage conditions of medications in the private pharmacies across various regions, the highest compliance with storage standards was observed in Jadu and Al-Zintan pharmacy, each achieving 100%. They were followed by Umm Al-Jarsan, Kikla, AlAsaba, and Yafran pharmacy, each with 90.90%, indicating good storage conditions. Al-Awainiya and Gharyan pharmacy recorded 81.81%. The lowest compliance rates were found in Al-Qalaa and AlRayayna pharmacy, each at 72.72%, highlighting the need for improvement in storage practices in these areas.

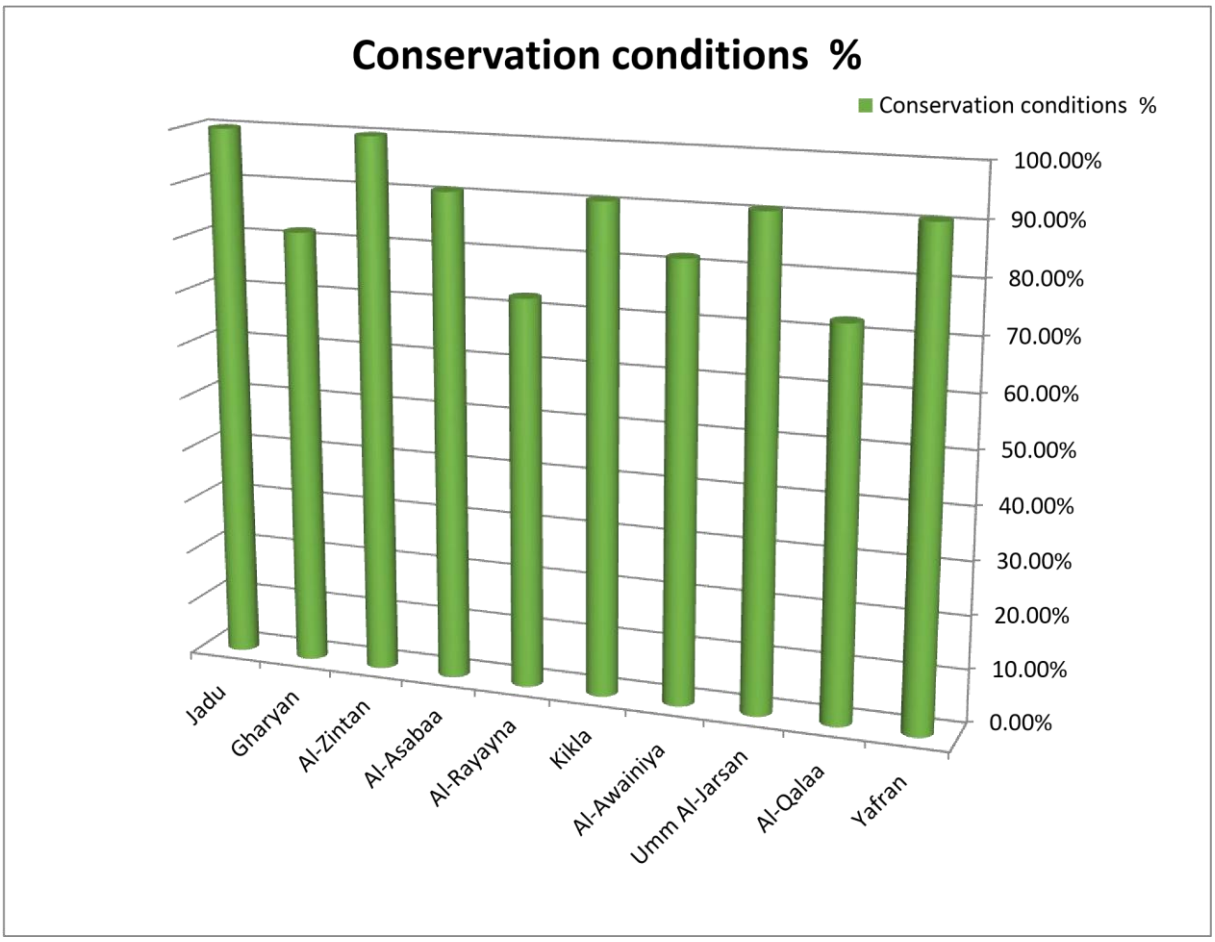

Figure 4: Adequate conservation conditions in the private sector

Discussion

This study revealed that the availability of essential PDMs was 0% in the public sector, indicating a critical shortage in public sector, with a wide variations when compared to findings from other studies in different countries.

While the availability of essential PDMs in the private sector ranged from 0% in 8 private pharmacies to 33.33% in Al-Qalaa pharmacy to 66.66% in Gharyan pharmacy.

When compared to previous studies conducted in different countries, the following observations can be made:

In a study conducted by Misbah and his colleges in Kenya in 2024, the availability of levodopa/carbidopa was 6.7% in public pharmacies and 73.7% in private pharmacies. These findings show significantly higher availability in the private sector compared to our study and slightly better availability in the public sector (Misbah et. al, 2024).

Okubadejo and his colleges from Nigeria, in their study in 2019, found that the overall availability of levodopa/carbidopa was 48%, with only two medications (trihexyphenidyl and biperidine) being considered

affordable. These results reflect moderately low availability and affordability but are still substantially better than the findings of our study (Okubadejo et. 2019).

The study conducted by Guillermo and his colleages in 2018 in Riobamba showed that availability rates of PDMs were 50% in the public sector and 90% in the private sector, both significantly higher than in our study. However, the availability of specific drugs such as biperidine and levodopa was only 5% in the private sector, indicating selective shortages (Guillermo et. al, 2018).

According to study of Sakdisornchai and his colleages in 2017 in Thailand, the availability of levodopa was 69.3%, with higher rates in private and central region hospitals. These findings suggest a more balanced and accessible distribution system compared to our results (*Sakdisornchai et. al, 2018).*

Goh and his colleages conducted a global survey in 2022 showing that levodopa was available in 99% of countries, although the availability of other parkinson's medications decreased with lower national income levels. This supports our finding of poor availability in low-resource public healthcare systems, but also highlights that the availability of PDMs in the private sector in our study is extremely low even by global low-income standards (Goh et. al, 2022).

The continent-wide African study by Hamid and his colleages in 2021 found that 46.4% of levodopa-based oral preparations were available, indicating that while availability across Africa remains suboptimal, it is not as critically low as in both sectors reported in our study (Hamid *et. al*, 2021).

Finally, in a study of Mokaya and his colleages in 2016 from Kenya, levodopa was available in 50% of pharmacies, but only five offered it at an affordable price, highlighting issues not only with availability but also affordability barriers. Once again, these findings are considerably better than ours (Mokaya *et. al*, 2016).

The study revealed a significant disparity in the availability of essential Parkinson's disease medications between the public and private sectors in the Nafusa Mountain region. While the public sector reported a 0% availability rate, the private sector showed only limited access.This wide gap can be explained by several interrelated factors:

1. Weakness in the national drug supply system in the public sector, due to inefficient central planning and delays in procurement procedures.
2. Logistical barriers, especially the difficulty of transportation and distribution to mountainous areas, leading to delayed delivery of time-sensitive drugs such as anti-Parkinson medications.

3. Financial constraints, as the public sector suffers from insufficient budget allocations for chronic disease medications, while private pharmacies rely on direct import and commercial profit.
4. Lack of continuous monitoring systems for medicine availability, resulting in unequal distribution among cities.

Conclusion

Based on the project's findings, none of the sessential Parkinson's disease medications (PDMs) were available in the public sector across all ten cities examined in the study. On the other side, in the private sector, the availability rates were 66.66% and 33.33% in Gharyan pharmacy and Al-Qalaa pharmacy respectively. Moreover, essential PDMs were unavailable (0%) in all other private pharmacies. By comparing the availability rates of each essential PDMs alone in the public and private sector, all three essential PDMs were unavailable in the public sector, while it was 20% and 10% for levodopa/carbidopa tablet and biperiden tablet respectively in the private sector. Regarding the suitability of storage conditions and handling medicines in the dispensing area, the storage conditions were 100% compliance in AlAwainiya hospital and Jadu hospital. Whereas it was 72.72% in Yefren hospital and Gharyan hospital in the public sector. On the other hand, storage conditions was 100% compliance in Jadu pharmacy and AlZintan pharmacy and 72.72% in Al-Qalaa pharmacy and Al-Rayayna pharmacy in the private sector.

Recommendations

1-Addressing the root causes of the low availability of essential parkinson's medications in both public and private sectors could lead to significant improvements.

2 -interventions to improve and prioritize essential PDM access, are urgently warranted.

3-Improving access to essential medications for parkinson's patients at affordable prices.

4-Periodic testing of drug validity, especially in the public sector.

5-Efforts to improve the storage conditions for medicines in the dispensing areas and store rooms as well.

Based on the findings of this project, The following practical and policy-oriented recommendations are proposed to the Ministry of Health and the national pharmaceutical supply authority:

-Establish a national digital monitoring system to track the availability of essential medicines in public hospitals and pharmacies.
- Enhance transportation and supply logistics in mountainous regions through decentralized pharmaceutical supply units.
- Increase financial allocations for chronic disease medications, ensuring a dedicated quota for neurological disorders.

- Promote public–private partnerships to ensure affordable and continuous access to essential medicines.
- Implement regular inspection programs for storage and distribution practices in both public and private sectors.

Implementing these measures would reduce disparities between sectors and improve the sustainability and equity of medicine availability across the Nafusa Mountain region, ultimately benefiting patients with Parkinson's disease.

References

- Cho. H.J, "Carbidopa/Levodopa - Uses, Side Effects, and More", WebMD, 2024.

- Fothergill-Misbah, N., Hooker, J., Kwasa. J., Walker, R. (2024). Access to Medicines for Parkinson's Disease in Kenya: A Qualitative Exploration. *Movement Disorders Clinical Practice*, 11 (11), 1373-1378. doi: 10.1002/mdc3.14192.

- Goh, ZHK., Cheong, JLY., Marras, C., Tanne,. CM., Kaste,. M., Korczyn, AD., Chahine, L., Lo, R., Noycem AJ. (2022). Surveying Global Availability of Parkinson's Disease Treatment. *Journal of Parkinson's Disease*, 12 (3), 1023-1034. https://doi.org/10.3233/JPD-213006

- Guillermo, GJ., Urbano, SC., Angélica, BM., and Johana, SCB. (2018). Availability of Drugs for the Treatment of Parkinson's Disease, Pharmacy Network in the Municipality Riobamba. *Journal of Rheumatology and Arthritic Diseases*, *3*(2), 1–4. https://doi.org/10.15226/2475-4676/3/2/00139.

- Hamid, E., Ayele, BA., Massi, DG., Ben Sassi, S., Tibar, H., Djonga, EE., El-Sadig, SM., Amer. El Khedoud, W., Razafimahefa, J., Kouame-Assouan, AE., Ben-Adji, D., Lengané, YTM., Musubire, AK., Mohamed.. MH., Phiri, TE., Nestor, N., Alwahchi, WA., Neshuku, SN., Ocampo, C., Sakadi, F., Maidal, MA., Ngwende, GW., Hooker, J., Okeng',. K., Charway-Felli, A., Atadzhanov, M., Carr. J., Okubadejo, NU., Shalas,. A. (2021). Availability of Therapies and Services for Parkinson's Disease in Africa: A Continent-Wide Survey. *Movement Disorders*, 26 (10), 2393-2407.

- Kostelnik A, Cegan A, Pohanka M. Anti-Parkinson Drug Biperiden Inhibits Enzyme Acetylcholinesterase. *Biomed Research International*., 2017

- Mokaya, J., Dotchin, CL., Gray, WK., Hooker, J., Walker, RW. (2016). The Accessibility of Parkinson's Disease Medication in Kenya: Results of a National Survey. *Movement Disorders*, 3 (4), 376-381. https://doi.org/10.1002/mdc3.12294

- Morales, L. (2023). What is the connection between dopamine and Parkinson's disease?. *MedicalNewsToday*,

- Okubadejo, NU., Ojo, OO., Wahab, KW., Abubakar, SA., Obiabo, OY., Salawu, FK., Nwazor, EO., Agabi, OP., Oshinaike, OO. (2019). A Nationwide Survey of Parkinson's Disease Medicines Availability and Affordability in Nigeria. *Movement Disorders Clinical Practice*, 6 (1), 27-33.

- Patel, T., Chang,. F. (2014). Parkinson's disease guidelines for pharmacist. *Canadian Pharmacists Journal*, 147 (3), 161–170. https://doi.org/10.1177/1715163514529740

- Sakdisornchai, K., Sringean, . J., Jitkritsadakul, O., panyakaew, P., Bhidayasiri, R. (2018). Availability of anti-Parkinsonian drugs in Thailand. *International Parkinson and movement disorder society*, 32 (2).

- WHO. (March 2017). WHO Model List of Essential Medicine 20th List.

- WHO. (2007). WHO Operational package for assessing, Monitoring and evaluating country pharmaceutical situations. Guide for coordinators and data collectors.