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Prescription Patterns of Statins in Ibrahim Malik Teaching Hospital, Khartoum - Sudan

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Abstract

Background: The discovery of antihyperlipidemic drugs, particularly statins, has led to significant progress in both primary and secondary prevention of coronary artery disease. Optimal pharmaceutical usage is critical for achieving excellent healthcare outcomes for patients and mitigating the financial burden.
Aim: The main objective of this study is to assess the prescribing and utilization patterns of statins in the outpatient department of Ibrahim Malik Teaching Hospital in Khartoum, Sudan.
Methods: Three-month observational research was conducted to evaluate statin prescription practices at a university hospital in Sudan. We monitored three different types of statins that were accessible at the hospital. A total of 204 prescriptions from the hospital's outpatient department were included, and the prescribing patterns were subjected to statistical analysis.
Results: The study findings indicated that the majority of consumers were male (52.9%) and had reached the age of 60 (53.4%). Atorvastatin was the most often prescribed statin for hyperlipidemia, with a total of 153 patients receiving it. The initial dose of 20 mg was given to 113 patients, and 115 patients had their dosage adjusted. Statins are administered for disorders other than the ones mentioned.
Conclusion: Despite being aware of the medication's adverse effects, the prescribers at the Sudan teaching hospital were seen to follow the recommended guidelines while prescribing the prescription, demonstrating sound clinical judgement and adherence.

Keywords: Hyperlipidemia, statins, clinical judgment, prescribers

1. Introduction

Hyperlipidemia is a medical disorder characterized by abnormally high amounts of lipids in the body. It encompasses a range of inherited and acquired conditions. Hyperlipidemia is a highly prevalent condition, particularly in the Western Hemisphere but also globally. Hyperlipidaemia can be defined more objectively as having levels of low-density lipoprotein (LDL), total cholesterol, triglycerides, or lipoproteins that are higher than the 90th percentile compared to the general population. It can also be defined as having a high-density

lipoprotein (HDL) level that is lower than the 10th percentile compared to the general population. Lipids often encompass cholesterol levels, lipoproteins, chylomicrons, VLDL, LDL, apolipoproteins, and HDL [1]. Statins are a pharmacological class of medications that lower blood cholesterol levels by inhibiting the liver's cholesterol synthesis. Statins inhibit the liver enzyme 3-hydroxy-3-methylglutaryl-coenzyme A reductase, which is involved in cholesterol synthesis. Statins encompass widely recognized medications, including atorvastatin, simvastatin, lovastatin, pravastatin, rosuvastatin, Fluvastatin, and other others. In large-scale clinical trials, the effectiveness of statins in reducing cardiovascular disease in individuals without diabetes has been extensively documented. HMG-CoA reductase inhibitors' positive effects are typically attributed to their ability to decrease cholesterol production within the body by competitively blocking the primary enzyme responsible [2]. According to the most recent Progress Surveillance report by the World Health Organization (WHO) in 2017, non-communicable diseases (NCDs) are responsible for the highest number of deaths globally, accounting for 70% of all mortality. Non-communicable diseases primarily affect 40% of the adult population under the age of 70. These conditions, especially hyperlipidemia, obesity, and hypertension (cardio-metabolic disorders), are prevalent. Diseases are correlated with risk factors related to an unhealthy lifestyle in the population, such as alcohol intake, smoking, consumption of fatty foods, and insufficient physical activity [3]. Dyslipidemia has had a long-standing impact on numerous developed countries. In 2011, a study conducted by the Centers for Disease Control and Prevention found that over 33% of individuals in the United States had high levels of LDL-C. The incidence of dyslipidemia varied between 34% and 50% in Spain, 45.5% in Brazil, and 64.5% in Italy [4]. Multiple investigations and experiments have demonstrated that elevated levels of LDL cholesterol significantly raise the likelihood of developing atherosclerotic plaques and consequent vascular disease. On the other hand, high-density lipoprotein (HDL) plays a role in maintaining cholesterol levels to avoid an imbalance that could raise the likelihood of atherosclerosis in vascular disease. The LDL cholesterol target for each patient is determined by their overall cardiovascular risk. Medical treatment should be customized to suit the specific needs of each patient [1, 5, 6, 7]. The study results will enable Ibrahim Malik Teaching Hospital (IMTH) to assess their prescribing trends and make necessary adjustments to their prescribing guide and clinical practice. This, in turn, would enhance treatment outcomes. This study is noteworthy because there has been little research conducted in Sudan to evaluate statin prescribing trends.

2.Motheds

Study design

The study was a descriptive, cross-sectional, hospital-based study done at the IMTH in Khartoum, Sudan, Outpatient Department for three months. During this period, prescription screening took place.

Sampling Size

The study was carried out in the Internal Medicine outpatient department of Ibrahim Malik Teaching Hospital, situated in the Khartoum locality, where it offers healthcare services to individuals of all age groups. The study included individuals from Khartoum, Sudan, who had hyperlipidemia and were treated with several types of statins.

Sampling technique and Sample size calculation

The data was acquired using a rigorous random sampling procedure. Following verbal consent from patients who visited the outpatient department, the prescriptions were recorded. Currently, there are no prevalence statistics for the prescription of statins in Sudan. Statin utilization is determined by analyzing diverse prevalence data from Asian populations, revealing an approximate rate of 5% among patients with any medical issues. The sample size is determined using a formula that takes into account a 5% prevalence rate, a 95% confidence interval, and a 5% margin of error.

$n = Z^2 P (1 - P)/d^2$

where n = sample size

Z = Z statistic for a level of confidence = 1.96 (CI = 95%)

P = expected prevalence or proportion = 5% = 0.05 d = precision = 0.05 (margin of error = 5%).

A total of 1400 prescriptions were evaluated, and the sample size was determined to be 204 using the formula mentioned above. Hence, the total sample size collected for analysis amounted to 204. Determine the appropriate sample size to assess the prevalence of statin usage in the IMTH. The calculations were made using the Raosoft sample calculator. According to the provided formula, the sample size is 73. Nevertheless, the sample size is duplicated for data collection, resulting in a 30% improvement in the study's precision. 40% of the sample was gathered in surplus to mitigate the risk of missing data. Hence, the total sample size collected for analysis amounted to 204. According to IMTH's Statistics Department, the outpatient department is expected to have a maximum estimated patient population of 10,000 per month.

Data Collection

A total of 1400 prescriptions underwent screening for various medications, such as statins, antidiabetic medications, antihypertensive drugs, and others. We assessed all categories of prescribed statins while excluding other types of lipid-lowering drugs (such as fibrates) due to their unavailability and lack of relevance to our objectives. We specifically examined the specific type of statin, the process of up-titration or equivalent dose, and the daily dosage in milligrams per day. As per the 2017 ACC/AHA guideline, statins were categorized into three levels of dose intensity according to their effectiveness in reducing LDL (low-intensity, moderate-intensity, and high-intensity statins). (1) Low-intensity statins include atorvastatin at a dosage of less than 10 mg per day, rosuvastatin at a dosage of less than 5 mg per day, simvastatin at a dosage of less than 20 mg per day, and lovastatin at a dosage of less than 40 mg per day. (2)

Statins with moderate intensity include atorvastatin at a daily dose between 10 mg and less than 40 mg, rosuvastatin at a daily dose between 5 mg and less than 20 mg, simvastatin at a daily dose between 20 mg and less than 80 mg, and lovastatin at a daily dose of 40 mg or more. (3) High-intensity statins include atorvastatin at a daily dose of 40 mg or higher, rosuvastatin at a daily dose of 20 mg or higher, and simvastatin at a daily dose of 80 mg or higher [30]. The prescriptions were looked at to see things like disease patterns, the specific hypolipidemic drugs prescribed for those diseases, the daily dosage at which the drugs were prescribed (PDD), and the ratio of the drugs' PDD to their defined daily dosage (DDD). The World Health Organization has established the Anatomical Therapeutic Chemical (ATC) classification and the daily defined dosage (DDD) for hypolipidemic medicines. In adults, the daily defined dose (DDD) refers to the average dose of a medication that is typically used for its main purpose. On the other hand, the prescribing daily dose (PDD) represents the average dose given based on the number of prescriptions filled, indicating the quantity of medication supplied. The prescription included many doses of hypolipidemic medications, and the PDD (Prescribed Daily Dose) was calculated as the average of the daily doses for these medications. The PDD/DDD ratio was calculated to assess the appropriateness of the dosage [8].

The PDD/DDD ratio is used to assess the disparities between the recommended dose and the defined daily dose. This ratio directly reflects the difference between these two doses, as well as the magnitude of the ratio.

Ethical Considerations

The project has received approval from the medical director of Ibrahim Malik Teaching Hospital (IMTH) in Khartoum, Sudan. The study obtained approval from the ethical committee of the Ministry of Health, Sudan (approval code: 02-02-2021) before being conducted at IMTH.

Statistical analysis

The data analysis was conducted using the Statistical Package for Social Sciences (SPSS) version 25.0. An analysis was conducted that involved describing and examining one variable at a time. All statistical tests were conducted at a significance level of 5%. We used discrete data sets that have no relationship or dependence on each other. The T-test was employed to compare the average values among different groups, while Pearson's chi-squared test was utilized to examine the proportions between groups. In cases where any of the cells had an anticipated frequency of five or below, Fisher's exact test was used. Variable categories with low frequencies were merged accordingly. To analyze the association between the study variables and the prescription of statins, logistic regression was employed. The criteria for inclusion

In the logistic regression model, a significance level of $p<0.20$, or established clinical importance, was used.

3. Results

A total of 210 cleaning workers from health facilities in Dhamar Governorate were enrolled in this study. The majority were male (77.1%), aged 19-29 years (56.7%), and married or divorced (60.5%). Most participants had some formal education (78.6%). Work experience was varied, with 42.4% having worked for one year and 27.6% for seven years or more. The detailed demographic and occupational characteristics are presented in Table 1.

Table 1: The general characteristics of cleaning workers at health facilities in Dhamar governorate (no= 210)

Variable	n (%)
Age/Year	
≤ 18	25 (11.90)
(19-29)	119 (56.67)
(30-40)	43 (20.48)
> 40	23 (10.95)
Sex	
Male	162 (77.14)
Female	48 (22.86)
Social Status	
Single	83 (39.52)
Married & Divorce	127 (60.48)
Education Level	
Uneducated	45 (21.43)
Educated	165(78.57)
Working duration/years	
1	89 (42.38)
2	24 (11.43)
3-6	39 (18.57)
≥ 7	58 (27.62)

The present study showed that the overall prevalence of at least one parasite species among cleaners working at public and private health facilities in Dhamar governorate was 79.0 % (166/210) (Figure 1). It was the same rate of the infected cases with intestinal parasitic infections (IPIs). However, four cases of the 210 participants (1.91%) had urinary parasitic infections as co-infection with IPIs. On other hand, no parasite in blood samples was detected. As shown in the figure 2, prevalence rates of single infections, double infections and multiple infections were 40.48% (85/210), 34.76% (73/210) and 3.81% (8/210), respectively.

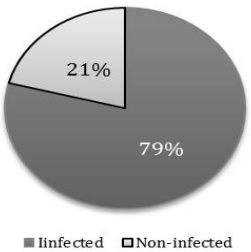

Figure 1: The overall prevalence of parasitic infections among cleaning workers at health facilities (no=210)

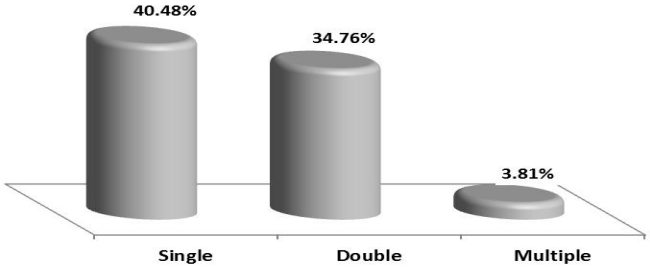

Figure 2: Prevalence rates of single, double and multiple parasitic infections among the study participates (no=210)

Figure 3 shows prevalence of parasitic infections among the participates according to separately parasite species, where the sum of the infection shows greater than the total number of participates, because the double and multiple infections were included.

E. histolytica/dispar (57.14 %, n= 120) and *G. lamblia* (41.90 %, n= 88) were found to be the highest prevalence of protozoan infections. While, prevalence rate of *T. vaginalis* was only 0.48 % (n= 1). *A. lumbricoides* 8.10 % (n=17) was found to be the highest prevalence of helminthic infections. While, prevalence rates of *E. vermicularis, S. mansoni, H. nana, S. haematobium,* and *Hookworms* were 7.14 %, n= 15; 2.86 %, n= 6; 1.90 %, n= 4; 1.43 %, n=3; and 0.95 %, n= 2, respectively. On the other hand, the prevalence of urinary parasitic infections (*S. haematobium*, n=3; and *T. vaginalis,* n=1) was 1.91 % (4/210). These were co-infection with IPIs as double or multiple infections.

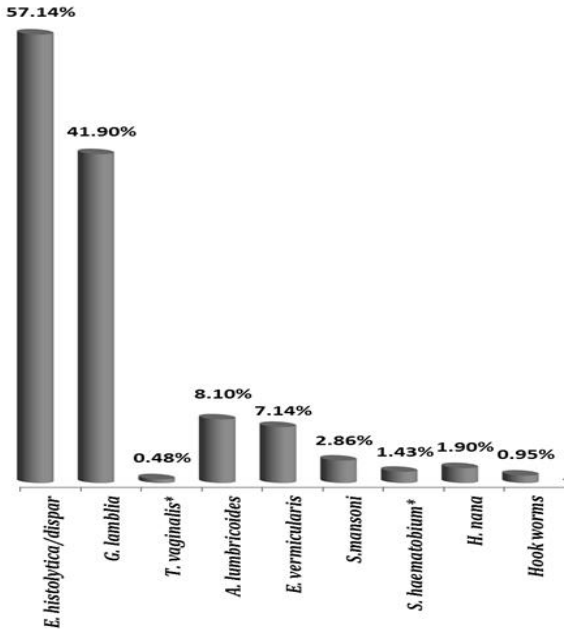

Figure 3: Prevalence of parasitic infections among the study participates (n=210) according to parasite species
* The detected parasite in urine specimens

Table 2 shows levels of infections among the 166 infected cases according to parasite species. The commonest protozoan detected as single infection was *E. histolytica/dispar* (26.51%). While, the commonest helminthes detected was *A. lumbricoides* (3.01%).

Regarding double infections among the 166 infected cases, the commonest protozoan detected with other protozoa were *E. histolytica /dispar* with *G. lamblia* (28.31%). The commonest protozoan detected with helminthes were *E. histolytica/dispar* with *E. vermicularis* (6.63 %). While, the commonest helminthes detected with other helminthes were *E. vermicularis* with *A. lumbricoides* (1.20%).

Regarding multiple infections, the commonest parasites as multiple infections represented 1.81% (3/166) of combination *E. histolytica/dispar*, *G. lamblia* and *H. nana or A. lumbricoides*. On other hand, overall single protozoan infections were found to be 90.6% (77/85) more common than the single helminthic infections 9.4 % (8/85).

Table 2: Single, double and multiple infections among the infected specimens (n=166) according to parasite species

Parasite species	n (%)[1]	%[2]
Single infection(n=**85)**		
E.histolytica/dispar	44 (51.76)	26.51
G.lamblia	33 (38.82)	19.88
S.mansoni	2 (2.35)	1.20
E.vermicularis	1 (1.18)	0.60
A.lumbericoids	5 (5.88)	3.01
Double infection(n=73)		
E.histolytica/dispar and *G.lamblia*	47 (64.38)	28.31
E.histolytica/dispar and *T.vaginalis*[3]	1 (1.37)	0.60
E.histolytica/dispar and *S.mansoni*	2 (2.74)	1.20
E.histolytica/dispar and *H.nana*	2 (2.74)	1.20
E.histolytica/dispar and *E.vermicularis*	11(15.07)	6.63
E.histolytica/dispar and *A.lumbericoids*	4 (5.48)	2.41
E.histolytica/dispar and *Hook worms*	1 (1.37)	0.60
G.lamblia and *S. haematobium*[3]	1 (1.37)	0.60
G.lamblia and *A.lumbericoids*	1 (1.37)	0.60
S.mansoni and *Hookworm*	1 (1.37)	0.60
E.vermicularis and *A.lumbericoids*	2 (2.74)	1.20
Multiple infection(n=8)		
E.histolytica/dispar, G.lamblia and S. haematobium[3]	2 (25.00)	1.20
E.histolytica/dispar, G.lamblia and H.nana or A.lumbericoids	3 (37.50)	1.81
E.histolytica/dispar, A.lumbericoids and E. vermicularis or S.mansoni	2 (25.00)	1.20
E.histolytica/dispar, G.lamblia, E.vermicularis, H.nana and A.lumbericoids	1(12.50)	0.60

1:Percentage of total single, double or, multiple infection; 2: Percentage of total infected specimens (n=166), and 3: in urine specimens.

Table 3: Prevalence of parasitic infections according to the general characteristics of participates

Variable	Infected n (%)	Non-infected n (%)	X^2	*P*
Age/Year				
≤ 18	21(84.00)	4(16.00)	1.17	0.761
(19-29)	91 (76.47)	28(23.53)		
(30-40)	35 (81.40)	8(18.60)		
> 40	19 (82.61)	4(17.39)		
Sex				
Male	134 (82.70)	28(17.30)	5.76	0.025
Female	32 (66.67)	16(33.33)		
Social status				
Single	63 (75.90)	20(24.10)	0.82	0.389
Married & Divorce	103 (81.10)	24(18.90)		
Education				
Uneducated	38 (84.44)	7 (15.66)	1.01	0.410
Educated	128 (77.58)	37 (22.42)		
Working duration/Year				
1	63 (70.79)	26 (29.21)	11.78	0.008
2	17 (70.83)	7(29.17)		
3-6	32 (82.05)	7 (17.95)		
≥ 7	54 (93.10)	4 (6.90)		

Table 3 shows that the prevalence of parasitic infection was higher among males than females (82.7% and 66.7%, respectively). The prevalence rate increased with working duration /years of cleaning workers in health facility from who had a history of one year, two

years and 3-6 years to ≥7 years of working duration (70.79 %, 70.83 % and 82.05 % to 93.10 %, respectively). Distribution of prevalence infections significantly associated with gender and working duration variables (*P*=0.008 and *P*=0.025, respectively).

Table 4 shows that the overall single, double and multiple IPIs among cleaning workers were 41.43%, 34.76% and 2.86%, respectively. The double IPIs (27.43% and 43.6% to 43%, respectively) and multiple IPIs (0.9% and 5.13% to 5.17 %, respectively) increased with working duration of cleaning workers from who had a history of 1-2 years, and 3-6 years to ≥7 years of working duration. Relation between Levels of IPIs and working duration appeared a significant difference (*P*=0.019).

Table 4: Prevalence single, double and multiple intestinal parasitic infections according to working duration

Working period /years	Single	Double	Multiple	Negative		
	n (%)	n (%)	n (%)	n (%)	X^2	*P*
1	36 (40.45)	27 (30.34)	0 (0.0)	26 (29.21)	19.810	0.019
2	12 (50.00)	4 (16.67)	1 (4.17)	7 (29.17)		
3-6	13 (33.33)	17 (43.59)	2 (5.13)	7 (17.5)		
≥7	26 (44.83)	25 (43.10)	3 (5.17)	4 (6.90)		
Total	87 (41.43)	73 (34.76)	6 (2.86)	44 (20.95)		

4. Discussion

The present study was the first that looking at parasitic infections among cleaning workers at health facilities in Dhamar governorate, where showed that the overall prevalence of parasitic infections among them was 79 %. This finding was high compared to findings of many studies were conducted on other various populations reported that, overall prevalence rates of intestinal parasitic infections ranged from 26.4% to 58.7% in other Yemeni areas [16-21] and from 7.7 % to 57.9 % in Arabic and regional countries [22-26].

Although, prevalence rates of parasitic infections in Yemeni and regional studies mentioned were lower than findings of this study. High prevalence rates have also reported among school children in Al-Mahweet, Yemen (90%) [27] and, among patients in Ethiopia country (83%) [28]. Generally, the high prevalence of parasitic infection in this study reflects the elevated poor of personal hygiene, and health education about parasitic infections among cleaning workers category which working in critical facilities.

Protozoan infections were more common than helminthic infections in this study. This was comparable to that have reported in study conducted on patients in Sana'a, Yemen [19] and, in studies conducted on various populations in Saudi Arabia [29,30], United Arab Emirates [22], Italy [31] and India [32,33]. While, Ethiopian study has indicated to the opposite findings [28]. Prevalence of parasitic infections among males was significantly higher than females in the present study (p=0.025). This was comparable to that have reported in previous Yemeni [34,20], Palestinian [35], United Arab Emirates [22], and Iranian [36] studies.

Findings the present study showed a significantly increasing of overall prevalence rate of parasitic infection with working duration/years of cleaning workers in health facilities (*P*=0.008). Levels (single, double and multiple) of IPIs rates and working duration also significantly related (*P*=0.019), where prevalence rates of the double and multiple IPIs increased with working duration, these may be attributed to the prolonged exposure to parasitic infection among the participants without cyclic screening and appropriate treatment. On the other hand, the study's findings showed that, parasitic infections rate among males was significantly higher compared to females (*P*= 0.025). This may be due to, the few number of females in the sample study and the difference in the tasks nature. The main limitations which faced this study were the limited resources and the unavailable facilities that led to the inability to: differentiate cysts of *E. histolytica* from *E. dispar* by molecular technique; detect specific *Entamoeba species* by ELISA; and detect *Cryptosporidium* and other intestinal coccidian by Modified acid-fast staining technique.

5. Conclusions

The present study shows that prevalence of parasitic infection among cleaning workers in health facilities in Dhamar is high. Protozoan infections are more common than helminthic infections. Gender and working duration of cleaning workers significantly influence the prevalence: Males have a higher prevalence rate than females whereas, prevalence rate increases with rise of working duration. This study discover on a big health problem represents a warning bell on a worrisome source of parasitic infections in health facilities can be reduced by more effort of health public ministry and population and other related sides to improve the public measures of prevention and control infection in health facilities generally and by increasing of personal hygiene and health education among cleaning workers category particularly. More and large surveys are required in medical, administrative staff to reflect the factual size behind the high prevalence and risk factors of parasitic infections.

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Data Availability
All data relevant to this study are presented in this manuscript. Additional datasets are available from the corresponding author upon reasonable requests.

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Conflicts of interest
The authors declare that there are no conflicts of interest.

Consent for publication
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