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STUDY OF THE PREVALENCE AND RISK FACTORS OF ANTI TUBERCULOSIS DRUG INDUCED HEPATOTOXICITY AMONG PULMONARY TUBERCULOSIS PATIENTS ATTENDED AL-MADAEN GENERAL HOSPITAL IN BAGHDAD-IRAQ

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ABSTRACT

Background: The first-line anti-TB drugs are potentially hepatotoxic and many factors have been reported to increase the risk of developing hepatotoxicity in patients with anti-TB therapy. **Objectives:** To determine the prevalence of hepatotoxicity among patients on anti-TB drug and to find any associated factors. **Methods:** A cross- sectional study held on 178 TB patients those admitted to Al-Madaen General hospital during the period from October 2023 to April 2024. Data were collected using a structured questionnaire, composed of socio-demographic characteristics of the patients and medical history. Data were analyzed by using Statistical Package of Social Sciences Version 29. **Results:** More than half (61%) of the patients were new cases, 72% of patients had no TB family history, 57% of patients use HRZE regime, 99.4% of the patient were with history of concomitant hepatotoxic drugs, 9% had abnormal liver function test with significant associations with gender, occupation and type of TB case. **Conclusion:** The mechanism of hepatotoxicity in female TB patients is unclear. Low socio-economic status (non-employed), and poor health TB patient were more likely to develop hepatotoxicity.

KEYWORDS: Anti TB drug, Hepatotoxicity, Monitoring, Tuberculosis.

1. INTRODUCTION

Tuberculosis (TB) remains a serious global public health problem, particularly in developing countries such as Iraq, where pulmonary tuberculosis continues to represent a considerable disease burden.[1] Despite improvements in diagnosis and treatment, the success of tuberculosis control programs is frequently compromised by adverse drug reactions associated with anti-tuberculosis treatments.[2] Anti-tuberculosis drug-induced hepatotoxicity (ATDIH) is one of the most significant and potentially fatal side effects.[3-4]

First-line anti-tuberculosis medications, including isoniazid, rifampicin, and pyrazinamide, are well known to cause serious hepatotoxicity.[5] Hepatotoxicity can cause treatment cessation, therapeutic regimen modification, extended treatment duration, increased drug resistance risk, and poor clinical results.[6] ATDIH prevalence varies greatly in different populations, indicating differences in genetic predisposition, dietary state, concomitant diseases, alcohol usage, and healthcare environments.[7] Several risk factors for ATDIH have been identified in the literature, including advanced age, female gender, low body mass index, pre-existing liver disease, viral hepatitis, diabetes mellitus, alcohol consumption, and polypharmacy.[8-9] However, the relative contributions of these elements vary by demographic and geographic region.[10] In Iraq, published data on the prevalence and causes of anti-tuberculosis drug-induced hepatotoxicity are limited.

Understanding the magnitude of ATDIH and identifying associated risk factors among Iraqi tuberculosis patients is critical for enhancing patient monitoring, optimizing treatment regimens, and lowering morbidity from medication toxicity.

The aim of this study was to determine the prevalence of anti-tuberculosis drug-induced hepatotoxicity and the risk factors associated with it among pulmonary tuberculosis patients in Al-Madaen General Hospital in Baghdad, Iraq.

2. PATIENTS AND METHODS

This is a hospital-based cross-sectional study was carried out during the period from 1st of October 2023 till the 1st of April 2024 at Al-Madaen General hospital in which outpatients and inpatient are seen, (including TB and other respiratory diseases), by the referral system. This hospital receives referral cases from the institute of chest and respiratory diseases in Baghdad General Hospitals, TB units at PHC and private clinics. At the time of data collection, this hospital received roughly 486 patients, 178 patients included in the study with pulmonary TB, 190 patients were not TB cases, 102 patients were patients with extra pulmonary TB and 16 patients without sufficient data and records (all have been excluded from the study).

The study included patients with active Pulmonary TB who had positive culture for Mycobacterium Tuberculosis or negative culture with clinical and radiological features of pulmonary TB associated with response to anti TB medications. As well as, the study included patients received INH, rifampicin and/ or pyrazinamide in standard doses at least 5 days before the development of hepatotoxicity with normal liver function prior to treatment. On the other hand, the study excluded patients with extra pulmonary TB, abnormal liver function prior to treatment, patient with serological evidence of viral hepatitis B or C, patient who received higher doses of anti TB drugs than recommended based on body weight and patient who received other potential hepatotoxic drug at the same time of receiving anti TB treatment.

A structured questionnaire has been done to collect data from the study patients. The questionnaire composed of socio-demographic characteristics (age, gender, residence, occupation status, educational level). Meanwhile, other part of questionnaire composed of body weight, family history of TB, type of TB case, history of regular use of medication and treatment regimen. Risk factors composed of history of co-morbid diseases, history of concomitant hepatotoxic drugs, history of alcohol consumption and history of smoking cigarette.

Data was collected from all the eligible patients who had given consent to participate in this study after filling questionnaire form which prepared to collect information. For all patients involved in the study a complete history and physical examination have been taken as well as, the laboratory tests that have been done before initiation of anti-TB drugs which included; complete and differential blood counts, renal function tests (serum creatinine and blood urea) as well as the serological tests for hepatitis B surface antigen (HBsAg) and anti-hepatitis C antibody (anti-HCV) and HIV antibody by ELLISA. Liver function tests also have been done which include alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALK.P) and serum total bilirubin that performed before initiation of anti-TB drugs. During TB treatment course, patients were followed clinically for any noxious or unintended response to a drug which occurs at doses which are used in human normally for prophylaxis, diagnosis or treatment of disease or for modification of physiological functions were considered as Adverse Drug Reaction (ADR). An increase in serum ALT or AST greater than three or five times of the upper limit of normal (UNL), (UNL is < 40 IU/L and for total bilirubin <1.5 mg/dl), with or without symptoms of hepatitis, respectively defined as drug related hepatotoxicity according to WHO Criteria.[11]

Based on this definition severity of hepatotoxicity was considered as follow: mild (ALT or AST < 2.5 times of the ULN), moderate (ALT or AST 2.5–5 times of the ULN), severe (ALT or AST 5-10 times of the ULN) and very severe (ALT or AST >10 times of the ULN).[12] In this case, all the anti-TB drugs were discontinued and patients have been under both clinical and biochemical monitoring for signs and symptoms of drug induced hepatotoxicity. When all signs and symptoms of drug induced hepatotoxicity dissolved and the liver function tests decreased to near of the normal range, treatment was attempted sequentially based on the following hospital protocol.

Ethambutol was started with full dose (15 mg/kg) plus rifampin 150 mg at the first day, 300 mg at the second day, 450 mg at the third day and then 600 mg/daily. If Rifampin was tolerable, at the fourth day isoniazid was started as follows; isoniazid 50 mg at the first day, 100 mg at the second day, 150 mg at third day and then 300 mg/daily. If patient tolerated, then pyrazinamide started as 500 mg at the first day, 1000 mg at the second day and then continued at doses which was on the basis of patient's body weight.

The information gathered was processed, categorized, and evaluated using relevant statistical significance tests. Statistical analysis was carried out using SPSS version 29. Categorical variables were presented as frequencies and percentages. Continuous variables were presented as (Means ± standard deviation). Pearson's chi square test (X^2) and fisher exact test were used to find the association between the categorical variables. Independent sample t-test was used to compare means. P

value of less than 0.05 was considered as a cut off value for significance.

3. RESULTS

The study includes 178 patients. The mean age ± standard deviation of the study participants is 49.53 ± 9.83 years. Of them 110 patients were males and 68 patients were females with Male: Female ratio was 1.61:1. As shown in figure 1.

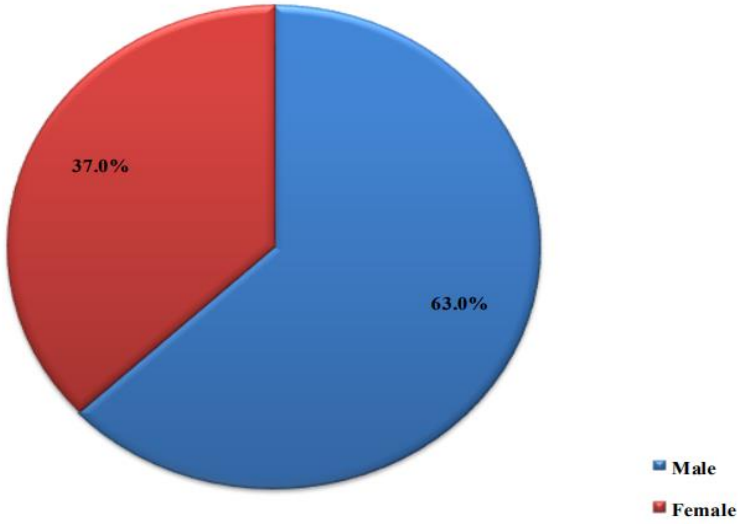

Figure 1: Distribution of the study participants according to their gender.

The majority of pulmonary TB patients (59.6%) were younger than 50 years old. As shown in figure 2.

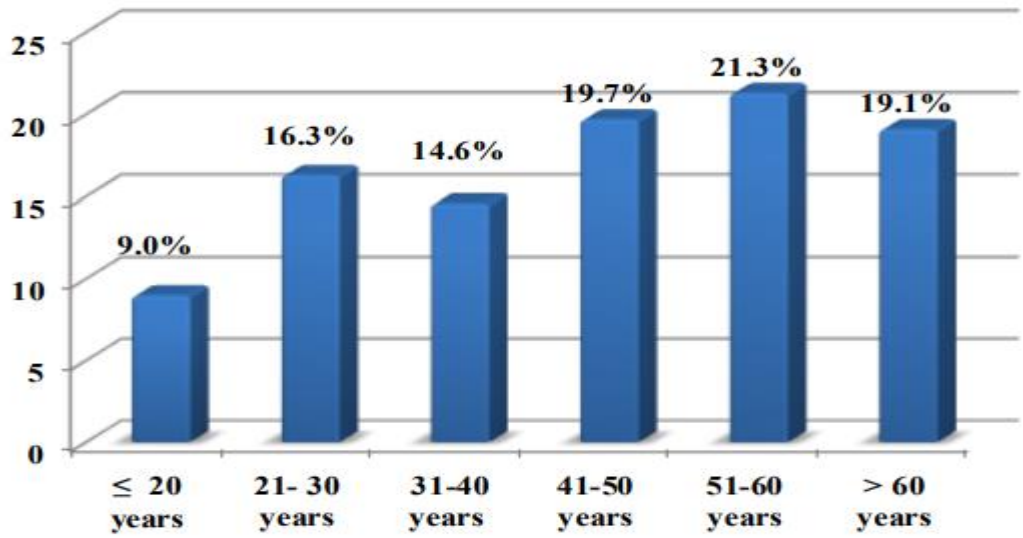

Figure 2: Distribution of the study participants according to their age group.

Figure 3 shows the distribution of pulmonary TB patients by occupational status. The majority (52.2%) of pulmonary TB patients were non employed.

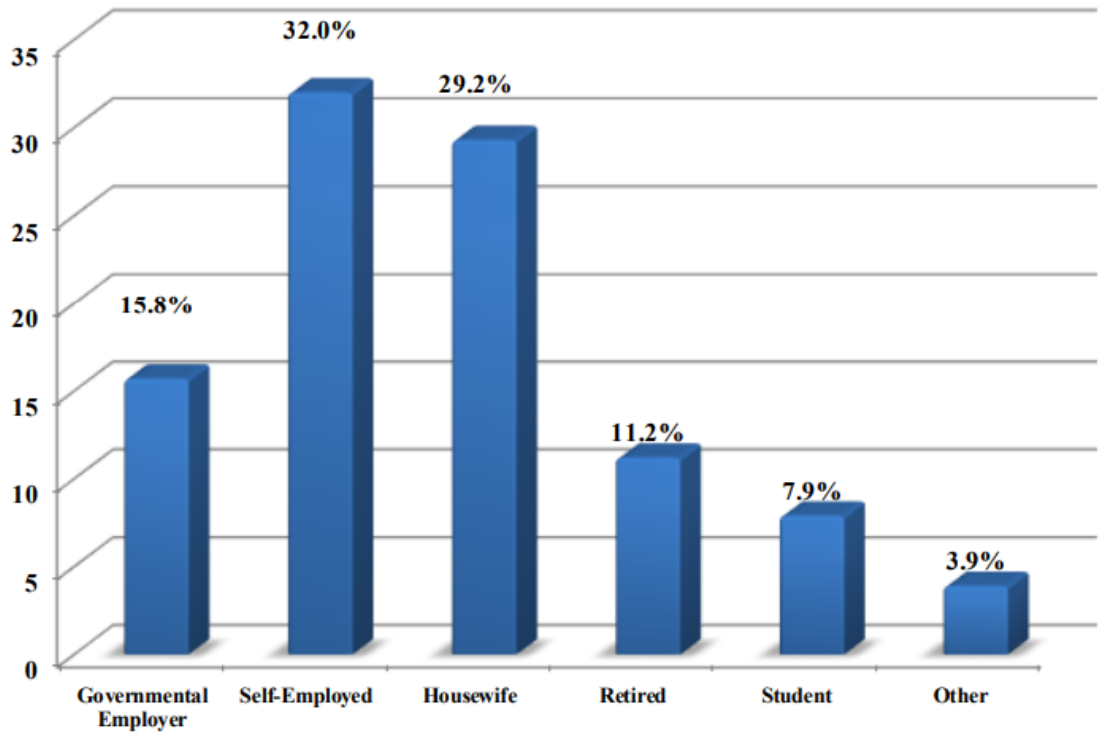

Figure 3: Distribution of the study participants according to their occupational status.

Figure 4 shows the distribution of pulmonary TB patients by educational level. More than one third of patients with pulmonary TB had a secondary school education.

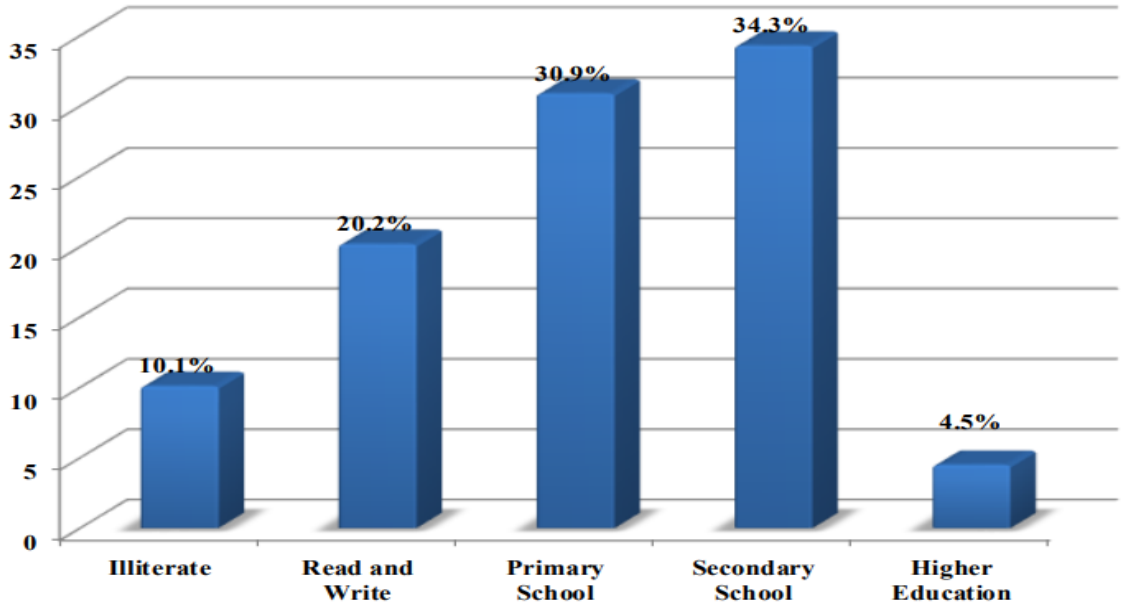

Figure 4: Distribution of the study participants according to their educational level.

Figure 5 shows the distribution of the patients with TB by residence. Majority (86.0%) of patients lived in urban areas.

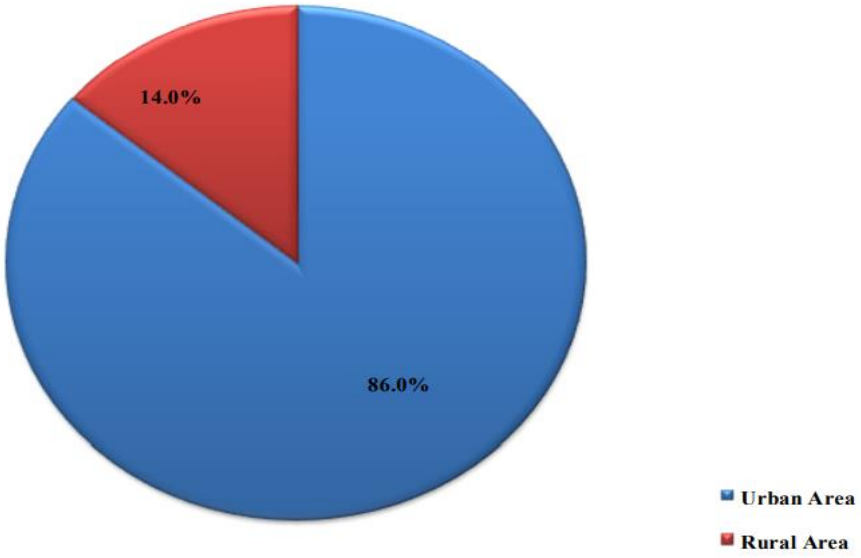

Figure 5: Distribution of the study participants according to their residence.

Table 1 shows the distribution of TB patients by medical history which includes type of TB case, (61.0%) of the patients were new cases. Family history of TB, (72.0%) of patients had no family history. Regimen of treatment, (57.0%) of patients use HRZE regime. Use same regimen during the last year, (84.0%) of patients did not use same regime.

Table 1: Distribution of TB Patients by medical history.

Variables	Frequency (%)	
Types of TB case	New case	109 (61.0%)
	Relapse case	46 (26.0%)
	Interruption case	17 (10.0%)
	Resistant case	6 (3.0%)
Family history of TB	Present	50 (28.0%)
	Absent	128 (72.0%)
Regimen of treatment	HRZE	102 (57.0%)
	HRZES	73 (41.0%)
	Other	3 (2.0%)
Use same regimen during last year	Present	29 (16.0%)
	Absent	149 (84.0%)

Table 2 shows the distribution of TB patients by risk factors which include comorbidity, (53.0%) of patients had chronic diseases. History of use concomitant hepatotoxic drugs, (99.4%) did not have. Medication history, (50.0%) had medication history. Alcohol consumption, (95.0%) were not alcoholic. (50.0%) were smokers.

Table 2: Distribution of TB Patients by risk factors.

Variable	Frequency (%)	
Co-Morbidity	Present	95 (53.0%)
	Absent	83 (47.0%)
History of concomitant hepatotoxic drugs	Present	1 (0.6%)
	Absent	177 (99.4%)
Medication history	Present	89 (50.0%)
	Absent	89 (50.0%)
Alcohol consumption	Present	9 (5.0%)
	Absent	169 (95.0%)
Smoking cigarette	Smoker	89 (50.0%)

Table 3 shows the distribution of the patients with pulmonary TB by clinical and laboratory evidence of hepatotoxicity. Jaundice was prevalent in 14 (8.0%) of patients, hepatomegaly in 1 (0.5%) patient and abnormal liver enzymes in 16 (9%) patients.

Table 3: Distribution of patients by clinical and laboratory evidence of hepatotoxicity.

Variables	Frequency (%)	
Jaundice	Present	14 (8.0%)
	Absent	164 (92.0%)
Hepatomegaly (clinically)	Present	0 (0.0%)
	Absent	178 (100.0%)
Hepatomegaly (Ultrasound)	Present	1 (0.05%)
	Absent	177 (99.5%)
Liver enzymes level	Abnormal	16 (9.0%)
	Normal	162 (91.0%)

Table 4 shows the association of LFT results (abnormal or normal) with sociodemographic characteristics. There were significant associations between LFT results with female patients and unemployed patients.

Table 4: Association of LFT with socio-demographic characteristics.

Variable		LFT results		χ^2	df	P-value
		Abnormal	Normal			
Age groups	≤ 30 years	7 (44%)	38(24%)	3.645	2	0.162
	(31-50) years	3 (19%)	58(35%)			
	> 50 years	6 (37%)	66(41%)			
Gender	Male	5 (31%)	107(66%)	7.559	1	0.006 **
	Female	11 (69%)	55(34%)			
Residence	Urban	14 (88%)	139(86%)			1.000 [a]
	Rural	2 (12%)	23 (14%)			
Occupational status	Employee	3 (19%)	82 (51%)	5.927	1	0.015 *
	Non employed	13 (81%)	80 (49%)			
Educational level	Illiterate	7 (44%)	47 (29%)			0.674 [a]
	Primary	4 (25%)	51 (31%)			
	Secondary	5 (31%)	56 (35%)			
	More than secondary	0 (0%)	8 (5%)			

Table 5 shows the association of LFT results (abnormal or normal) with medical history. There was significant association between LFT results and new cases of TB.

Table 5: Association of LFT results with medical history.

Variable		LFT results		χ2	P-value
		Abnormal (%)	Normal (%)		
Type of TB case	New case	14 (87.7)	95 (59.0)		0.004*[a]
	Relapse case	0 (0.0)	46 (28.0)		
	Interruption case	0 (0.0)	17 (10.0)		
	Resistant case	2 (13.0)	4 (3.0)		
Family history of TB	Present	3 (19.0)	47 (29.0)		0.562[a]
	Absent	13 (81.0)	115 (71.0)		
Regimen of treatment	HRZE	11 (69.0)	91 (56.0)		0.575[a]
	HRZES	5 (31.0)	68 (42.0)		
	Others	0 (0.0)	3 (2.0)		
Use same regimen	Present	3 (19.0)	26 (16.0)		0.728[a]

a: Fisher exact test.

Table 6: shows the association of LFT results (abnormal or normal) with risk factors. There was significant association between LFT results with smoking cigarette.

Variable		LFT results		χ2	P-value
		Abnormal (%)	Normal (%)		
Co-Morbidity	Present	9 (56.0)	86 (53.0)	0.059	0.809
	Absent	7 (44.0)	76 (47.0)		
History of concomitant hepatotoxic drugs	Present	0 (0.0)	1 (0.6)		1.000[a]
	Absent	16 (100.0)	161 (99.4)		
Medication history	Present	8 (50.0)	81 (50.0)	0.0	1.000
	Absent	8 (50.0)	81 (50.0)		
Alcohol consumption	Present	0 (0.0)	9 (6.0)		1.000[a]
	Absent	16 (100.0)	153 (94.0)		
Cigarette smoking	Smoker	3 (19.0)	89 (55.0)	7.637	0.006*
	Non Smoker	13 (81.0)	73 (45.0)		

a: Fisher exact test.

4. DISCUSSION

The presenting study has found that the prevalence of hepatotoxicity in TB patients with anti-TB drugs was (9.0%). This estimate is comparable with a global review that found a range of 2% to 28%, depending on diagnostic thresholds and regional variables.[13] However, in a retrospective study conducted in Morocco revealed a prevalence of 24.6% among TB patients getting conventional medication,[14] which is much higher than many reports but demonstrates the potential burden in particular circumstances. Another major cross-sectional study conducted in India discovered that 18.4% of treated patients experienced hepatotoxicity,[15] highlighting its frequent prevalence in clinical practice.

The present study illustrates that, (19.1%) of TB patients were older than 60 years and there was no significant association between hepatotoxicity and age groups. Comparably, Kumar et al[16] found that age was not significantly associated with hepatotoxicity in TB patients. However, in a large retrospective Pakistani cohort, Quddus et al[17] discovered that older patients had much greater prevalence of hepatotoxicity than younger groups. This disparity could be related to age-related changes in liver function and polypharmacy.

Female patients were more likely to develop hepatotoxicity in the study, which has been confirmed by large multicenter study in which female patients had higher probabilities of hepatotoxicity than males.[8] This could be due to sex differences in drugs metabolism, enzyme activity, and hormonal impacts, while the specific mechanisms are still being investigated.

In this study, majority of TB patients were from urban area and did not complete their primary education. However, there were no significant associations between hepatotoxicity among TB patients by their residence and educational levels. Meanwhile, hepatotoxicity was significantly associated with non-employed TB patients. However, non-employed patients belong to low socio-economic families with overcrowded and hypo-ventilated places. Nidoi et al[18] found that low socio-economic status is associated with poor TB treatment outcomes.

This study revealed that, there was significant association between hepatotoxicity among new cases of TB patients, Gupta et al[19] found in a prospective cohort of newly diagnosed tuberculosis patients, roughly 9.3% experienced anti-TB drug-induced hepatotoxicity during therapy, indicating the substantial risk of liver injury in this population. This outcome could be related to the absence of prior medication exposure and hepatic adaptation in newly diagnosed patients. Additionally, new cases frequently receive full intensive-phase regimens that include pyrazinamide, which is known as the most hepatotoxic first-line anti-TB medication. This finding emphasizes the significance of continuous liver function monitoring, especially during the early stages of treatment.

Smoking was found in the present study to be a significant risk factor for hepatotoxicity. Nyangwara et al (8) showed consistent results in his univariant study. Cigarette smoking is known to cause oxidative stress and change hepatic enzyme function, which may exacerbate the hepatotoxic effects of anti-TB medications. This link is established by numerous research and emphasizes the importance of smoking cessation counseling as part of comprehensive tuberculosis management.

Interestingly, there was no significant association observed between hepatotoxicity and alcohol intake, patients' comorbidities or concurrent hepatotoxic medication usage. The lack of association with alcohol use could be explained by the study population's low alcohol consumption rate, which likely reflects sociocultural variables. Similarly, the absence of association with comorbidities could be attributed to the exclusion of patients with established chronic liver disorders and viral hepatitis, which are significant confounders in hepatotoxicity study. Clinically, hepatotoxicity appeared mostly as abnormal liver enzyme increases, with jaundice and hepatomegaly being uncommon. Zhang et al[20] found in a large retrospective sample of 28,753 TB patients with ATDIH, nearly 68% were asymptomatic and detected exclusively through biochemical surveillance, with just 18% exhibiting jaundice. This data highlights the fact that hepatotoxicity is frequently asymptomatic, emphasizing the significance of routine laboratory monitoring rather than relying solely on clinical symptoms.

This study has many limitations that should be noted before evaluating its conclusions. First, the cross-sectional design makes it difficult to demonstrate a temporal or causative association between identified risk variables and the emergence of anti-tuberculosis drug-induced hepatotoxicity. Longitudinal or prospective cohort studies would provide more reliable evidence about the cause and timing of hepatotoxic episodes. Second, the study was carried out in a single hospital, which may limit the applicability of the findings to other healthcare settings or locations in Iraq. Patient characteristics, treatment strategies, and monitoring protocols may differ between institutions, influencing the observed prevalence of hepatotoxicity. Third, while baseline liver function tests were carried out and patients with known viral hepatitis or pre-existing liver illness were excluded, subclinical liver diseases or undetected hepatic dysfunction could not be completely ruled out, potentially influencing the results. Furthermore, genetic factors that influence drug metabolism, such as acetylator status, were not evaluated. Fourth, several risk factors, such as alcohol intake and smoking, were relied on self-reported data, which could be prone to recall bias or underreporting, especially in sociocultural contexts where alcohol use is stigmatized. Finally, the small

sample size and low number of hepatotoxicity events may have limited the statistical power to find relationships with less common risk variables. Despite these limitations, the study sheds light on the local prevalence and factors of anti-tuberculosis drug-induced hepatotoxicity, emphasizing the need for bigger, multicenter prospective studies.

5. CONCLUSIONS AND RECOMMENDATIONS

The results of this study show that anti-TB drug-induced hepatotoxicity is still a clinically important adverse effect, even with standard treatment regimens. Significant variables included female gender, unemployment, smoking, and having a new tuberculosis case. Early identification of high-risk patients and regular liver function monitoring, especially during the intensive phase of therapy, are critical strategies for reducing treatment interruptions and improving patient outcomes.

Conflict of intertest

The authors of this study report no conflicts of interest.

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