E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/16.02.468

Research Article

Comparative Study of Lipid Profile in Treated and Untreated Multibacillary Leprosy Patients and Healthy Controls

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Received: 08.06.26, Revised: 18.07.26, Accepted: 25.08.26

ABSTRACT
Leprosy, a chronic infectious disease caused by Mycobacterium leprae, can impact various metabolic processes, including lipid metabolism. Changes in the serum lipid profile have been documented in individuals with Multibacillary (MB) leprosy, and these changes may differ based on treatment status. To assess and contrast the lipid profiles of treated and untreated Multibacillary leprosy patients with those of healthy controls. This comparative study involved untreated MB leprosy patients (n=76), treated MB leprosy patients (n=73), and healthy controls (n=76). The parameters of the serum lipid profile, including total cholesterol, triglycerides, high-density lipoprotein (HDL) cholesterol, and low-density lipoprotein (LDL) cholesterol, were analyzed and compared across the groups. Statistical tests were applied to assess significance, with a p-value of less than 0.01 deemed significant. Untreated patients with MB leprosy exhibited significantly lower mean levels of total cholesterol (117.0 ± 16.39 mg%), triglycerides (105.8 ± 37.62 mg%), and LDL cholesterol (98.4 ± 12.01 mg%) compared to controls (140.0 ± 15.72 mg%, 124.3 ± 19.51 mg%, and 113.4 ± 27.5 mg%, respectively; p=0.001). Nonetheless, the levels of HDL cholesterol in untreated patients (48.2 ± 5.08 mg%) were significantly greater than those in the control group (40.2 ± 4.94 mg%). Treated MB leprosy patients also showed significantly lower levels of total cholesterol (129 ± 10.0 mg%), triglycerides (97.3 ± 12.26 mg%), and LDL cholesterol (90.7 ± 7.79 mg%) compared to controls, while HDL cholesterol levels were significantly higher (45.9 ± 3.70 mg%) (p=0.001). The comparison of treated and untreated MB leprosy patients showed that total cholesterol levels were significantly higher in treated patients, while triglycerides, HDL cholesterol, and LDL cholesterol levels were lower in treated cases compared to untreated cases (p=0.001). Multibacillary leprosy is linked to considerable changes in lipid metabolism. Both treated and untreated MB leprosy patients showed lower levels of total cholesterol, triglycerides, and LDL cholesterol, along with higher HDL cholesterol, when compared to healthy controls. The therapy seemed to enhance total cholesterol levels, suggesting a partial restoration of lipid metabolism after treatment.

INTRODUCTION

Even after 150 years since M. leprae was discovered, leprosy continues to be a concern for the medical community and public health in developing nations [1–3]. These acid-fast bacilli extend beyond Schwann cells and macrophages, infecting various other cell types throughout the body's tissues and organs [4]. As per the Ridley and Jopling (R&J) classification, leprosy displays a broad immunopathological spectrum, from a strong cellular immune response (Th1 pattern) in

tuberculoid leprosy (TT) to a dominance of Th2 response with heightened humoral pathogenesis in lepromatous leprosy (LL) [3, 5]. On the other hand, the operational classification used by the WHO simplifies this into two categories: paucibacillary (PB) and multibacillary (MB) leprosy [6–8]. As a result, patients are treated with the same three-drug MDT, which includes rifampicin, dapsone, and clofazimine, with a fixed treatment duration of six months for PB leprosy and 12 months for MB leprosy [9]. There have been discussions and concerns within the scientific community about using the WHO classification for treatment selection, as it could result in PB regimens being improperly assigned to MB leprosy patients [10–12]. Therefore, the adoption of the R&J spectral classification could help in choosing more suitable treatments, which could ultimately reduce the rates of therapeutic insufficiency, TF, and leprosy relapse [13–15]. Leprosy, or Hansen's disease, is a long-lasting and debilitating condition resulting from the Mycobacterium leprae bacterium. It impacts the skin, peripheral nerves, mucosal surfaces of the upper respiratory tract, and the eyes, resulting in progressive and permanent disabilities if not treated [1]. Although leprosy was considered to have been eliminated as a public health problem worldwide in 2000 (with a disease burden of less than 1 case per 10,000 persons), it remains a global public health issue [16]

MATERIAL AND METHOD

Sample Collection

Leprosy patients, both treated and untreated, were gathered from the leprosy center (National Training Centre) in Karachi. This study included a total of 220 leprosy cases, comprising 110 untreated newly diagnosed patients and 110 treated leprosy patients. Skin smear tests for diagnostic purposes were conducted, both clinically and based on bacterial analysis. Control samples were collected from the general population for comparison.

Grouping of Subjects

Subjects included for study were divided into three groups:

Group A: Control group.

For control group 76 samples were collected which include male 55 (72.4%) female 21 (27.6%), taken from general population.

Group B: (Untreated Multiibacillary Leprosy Cases) Test Group

This group was comprised of untreated multiibacillary leprosy patients. Total number of patients in this group was 76 among them male 55 (72.4%) and female 21 (27.6%).

Group C: (Treated Multibacillary Leprosy Cases) Test Group

This group was comprised of untreated multiibacillary leprosy patients. Total number of patients in this group was 73 which comprised of male 55 (75.3%) and female 18 (24.7%).

.2.5 Collection of Blood Samples

The blood samples of patients who fulfilled the inclusion criteria were collected after an overnight fasting of 14 hours. About 5 ml of blood drawn from antecubital vein after all aseptic measures and collected into gel tubes for, lipid profile. Serum was taken after centrifugation at 3000 rpm for 10 minutes and stored at -80°C till analyzed.

2.8.3 Estimation of Lipid Profile

Serum of leprosy patients were taken for estimation of used for lipid profile, LFTs by kits method Cholesterol was analyzed by CHOD-PAP method. HDL-c also estimated. LDL-c was analyzed by *Fried Wald formula* (1972). TG was calculated by GPO- PAP method by using automated hematology analyzer [17-23].

Statistical Analysis

Data analysis was on SPSS version 19. Clinical characteristics were summarized as mean ± S.D. for biochemical (total cholesterol, triglyceride, HDL, LDL, Student t-test/ANOVA were used for comparison between cases Multibacillary Vs. controls. In statistical evaluation only p-value <0.05 will be considered significant.

RESULT

Table 1: Comparison of Sex distribution of Untreated Multibacillary Leprosy and Controls

Sex distribution	Untreated Leprosy Multibacillary (MB) (n=76)	Controls (n=76)	P-value
	Mean ± S.D	Mean ± S.D	
Gender			
Male	55 (72.4%)	55 (72.4%)	1.000

Female	21 (27.6%)	21 (27.6%)	

No significant difference was observed in between groups (p>0.05)

Table 1 presents a comparison of the sex distribution between untreated Multibacillary (MB) leprosy patients and healthy controls. Of the untreated MB leprosy cases (n=76), 55 (72.4%) were male and 21 (27.6%) were female. In the same way, the control group was made up of 55 males (72.4%) and 21 females (27.6%). The statistical analysis showed that there was no significant difference in the distribution of gender between the two groups (p=1.000; p>0.05). This suggests that the sex distribution in both groups was similar, which reduced the potential for gender-related bias in the study.

Table 2: Comparison of Sex distribution of Treated Multibacillary Leprosy and Controls

Sex distribution	**Treated Leprosy Multibacillary (MB) (n=73)**	**Controls (n=76)**	**P-value**
	Mean ± S.D	**Mean ± S.D**	
Gender			
Male	55 (75.3%)	55 (72.4%)	0.679
Female	18 (24.7%)	21 (27.6%)	

No significant difference was observed in between groups (p>0.05).

Table 2 shows the comparison of sex distribution between treated Multibacillary (MB) leprosy patients and healthy controls. In the group of treated MB leprosy patients (n=73), there were 55 males (75.3%) and 18 females (24.7%). Of the 76 individuals in the control group, 55 (72.4%) were male and 21 (27.6%) were female. Gender distribution analysis revealed no significant difference between the two groups (p=0.679; p>0.05). This suggests that the sex distribution was similar in both groups, thus ensuring that gender did not serve as a confounding variable in the comparative analysis.

Table 3: Comparison of Lipid profile of untreated Multibacillary Leprosy and Controls

Biochemical Parameters	**Untreated Leprosy multibacillary (MB)(n=76)**	**Controls (n=76)**	**P-Value**
	Mean ± S.D	**Mean ± S.D**	
Total Cholesterol (mg %)	117.0 ± 16.39 **	140.0 ± 15.72	0.001
Triglycerides (mg %)	105.8 ± 37.62 **	124.3 ± 19.51	0.001
HDL Cholesterol (mg %)	48.2 ± 5.08 **	40.2 ± 4.94	0.001
LDL Cholesterol (mg %)	98.4 ± 12.01 **	113.4 ± 27.5	0.001

** Statistically Significant (p<0.01).

As shown in Table 3, the lipid profile parameters of untreated Multibacillary (MB) leprosy patients were compared with those of healthy controls. The research comprised 76 control subjects and 76 untreated MB leprosy patients. The findings show that the lipid profile of untreated MB leprosy patients differs significantly from that of the control group, with these changes being statistically significant. In untreated MB leprosy patients, the average total cholesterol level (117.0 ± 16.39 mg %) was significantly lower than that of the control group (140.0 ± 15.72 mg %), with a p-value of 0.001 indicating high significance. Likewise, the levels of triglycerides in untreated MB patients (105.8 ± 37.62 mg %) were significantly lower than those of the controls (124.3 ± 19.51 mg %).

In untreated MB leprosy patients, HDL cholesterol levels (48.2 ± 5.08 mg %) were significantly higher than those of the controls (40.2 ± 4.94 mg %), suggesting a change in lipid metabolism linked to the disease. Moreover, untreated MB leprosy patients exhibited significantly lower LDL cholesterol levels (98.4 ± 12.01 mg %) compared to healthy controls (113.4 ± 27.5 mg %). In summary, the results suggest that untreated multibacillary leprosy is linked to considerable disruptions in lipid metabolism, primarily marked by decreases in total cholesterol, triglycerides, and LDL cholesterol levels,

alongside an increase in HDL cholesterol levels. All biochemical parameters exhibited differences that were statistically highly significant, with p-values under 0.001.

Table 4: Comparison of Lipid profile of treated Multibacillary Leprosy and Controls

Biochemical Parameters	Treated Leprosy multibacillary (MB) (n=73)	Controls (n=76)	
	Mean ± S.D	Mean ± S.D	P-value
Total Cholesterol (mg %)	129 ± 10.0 **	140 ± 15.7	0.001
Triglycerides (mg %)	97.3 ± 12.26 **	124.3 ± 19.51	0.001
HDL Cholesterol (mg %)	45.9 ± 3.70 **	40.2 ± 4.94	0.001
LDL Cholesterol (mg %)	90.7 ± 7.79 **	113.4 ± 27.5	0.001

** Statistically Significant (p<0.01)

The comparison of lipid profile parameters between treated Multibacillary (MB) leprosy patients and healthy controls is shown in Table 4. The study comprised 73 patients with treated MB leprosy and 76 control subjects. The results showed that all parameters of the lipid profile differed significantly between the two groups. In treated MB leprosy patients, the average total cholesterol level was significantly lower (129 ± 10.0 mg %) than that of the control group (140 ± 15.7 mg %), with a p-value of 0.001 indicating high significance. In treated MB patients, triglyceride levels were significantly lower (97.3 ± 12.26 mg %) than in controls (124.3 ± 19.51 mg %). Treated MB leprosy patients exhibited significantly higher HDL cholesterol levels (45.9 ± 3.70 mg %) compared to controls (40.2 ± 4.94 mg %). Im Gegensatz dazu lagen die LDL-Cholesterinwerte bei behandelten MB-Patienten (90,7 ± 7,79 mg %) signifikant niedriger als bei gesunden Kontrollen (113,4 ± 27,5 mg %). The results indicate that even post-treatment, patients with multibacillary leprosy who have undergone treatment still show considerable changes in lipid metabolism. The pattern of the lipid profile was marked by reductions in total cholesterol, triglycerides, and LDL cholesterol, alongside increases in HDL cholesterol levels. Every difference noted was statistically very significant ($p < 0.01$).

Table 5: Comparison of Biochemical parameters of treated and untreated Multibacillary Leprosy Cases

Biochemical parameters	Multibacillary Leprosy cases		
	Treated (n=73)	Untreated (n=76)	
	Mean ± S.D	Mean ± S.D	P-value
Total Cholesterol (mg %)	129 ± 10.0 **	117.0 ± 16.39	0.001
Triglycerides (mg %)	97.3 ± 12.26 **	105.8 ± 37.62	0.001
HDL Cholesterol (mg %)	45.9 ± 3.70 **	48.2 ± 5.08	0.001
LDL Cholesterol (mg %)	90.7 ± 7.79 **	98.4 ± 12.01	0.001

** Statistically Significant (p<0.01)

The biochemical lipid profile parameters of treated versus untreated Multibacillary (MB) leprosy cases are compared in Table 5. The comparison included a total of 73 MB patients who were treated and 76 MB patients who were untreated. The results show that all lipid profile parameters differ significantly between the two groups. Treated MB leprosy patients exhibited a significantly higher mean total cholesterol level (129 ± 10.0 mg %) compared to untreated patients (117.0 ± 16.39 mg %), with a p-value of 0.001. This finding indicates that there may be a partial improvement in cholesterol levels after treatment. In treated MB patients, the levels of triglycerides were significantly lower (97.3 ± 12.26 mg %) compared to those in untreated patients (105.8 ± 37.62 mg %). Likewise, the levels of HDL cholesterol in treated cases (45.9 ± 3.70 mg %) were lower than those in untreated cases (48.2 ± 5.08 mg %). Treated MB patients exhibited a notable decrease in LDL cholesterol levels (90.7 ± 7.79 mg %) compared to their untreated counterparts (98.4 ± 12.01 mg %). Every difference noted between the treated and untreated groups was statistically significant,

with p-values of 0.001. In summary, the results suggest that there are considerable alterations in lipid profile parameters connected to treatment of multibacillary leprosy. Patients who received treatment exhibited enhanced total cholesterol levels, while triglycerides, HDL cholesterol, and LDL cholesterol levels were lower in comparison to those in untreated patients. Alle Abweichungen wiesen eine statistische Signifikanz auf ($p < 0,01$).

DISCUSSION

This study assessed changes in the lipid profile of treated and untreated Multibacillary (MB) leprosy patients, comparing these changes to those of healthy controls. The results showed considerable disruptions in the lipid metabolism of MB leprosy patients, indicating a potential impact of Mycobacterium leprae infection on serum lipid levels. Comparable metabolic changes in leprosy have been documented as well [24, 25]. Untreated MB leprosy patients in the present study exhibited significantly lower levels of total cholesterol, triglycerides, and LDL cholesterol compared to healthy controls. The chronic infectious nature of leprosy, in which M. leprae uses host lipids to survive and multiply within macrophages and Schwann cells [25], may account for these findings. Lipid catabolism may be enhanced and hepatic lipid synthesis diminished due to chronic infection and inflammation, resulting in hypolipidemia. Similar findings were noted in [26], which identified lower serum cholesterol and LDL levels in leprosy patients experiencing metabolic stress from infection. It is noteworthy that, in untreated MB leprosy patients, HDL cholesterol levels were significantly higher than those of the control group. The rise in HDL could signify a compensatory reaction to chronic inflammation or changes in immune regulation associated with leprosy. HDL has anti-inflammatory and antioxidant characteristics that could play a role in host defense mechanisms during infections [24]. In the comparison of treated MB leprosy patients with controls, total cholesterol, triglycerides, and LDL cholesterol levels were found to be significantly lower, while HDL cholesterol levels were significantly higher. The results suggest that lipid abnormalities continue to exist post-treatment, even if some improvement may take place. Residual inflammatory activity, tissue damage, or the disease's long-term effects on lipid metabolism may lead to persistent metabolic changes [27]. In a comparison of treated and untreated MB leprosy patients, those who had received treatment showed significantly higher total cholesterol levels than their untreated counterparts. This implies that after the reduction of bacterial load and inflammatory activity, cholesterol metabolism may partially normalize due to the effects of multidrug therapy. However, triglycerides, HDL cholesterol, and LDL cholesterol levels in treated patients remained altered, indicating that lipid metabolism did not fully recover even after treatment. There are records of similar findings concerning persistent biochemical changes post-therapy [28]. Overall, the current research backs the idea that leprosy has a significant impact on lipid metabolism, especially in multibacillary cases. It may thus be beneficial to keep track of the lipid profile parameters of leprosy patients to evaluate metabolic disturbances and the advancement of the disease. To gain a better understanding of the mechanisms behind lipid changes in leprosy and the effects of treatment on metabolic recovery, further research involving larger samples and long-term follow-up is advised [29].

CONCLUSION

The current research concludes that there are significant disturbances in serum lipid metabolism associated with Multibacillary (MB) leprosy. When compared to healthy controls, both treated and untreated MB leprosy patients showed reduced levels of total cholesterol, triglycerides, and LDL cholesterol, as well as increased HDL cholesterol levels. These changes imply that chronic infection with Mycobacterium leprae might affect lipid use and metabolic processes in those affected. Moreover, the treatment correlated with enhancements in total cholesterol levels, suggesting a partial normalization of lipid metabolism after anti-leprosy therapy. Nonetheless, the ongoing changes in triglyceride, HDL, and LDL levels in patients receiving treatment indicate that metabolic changes may persist post-treatment. It may thus be beneficial to monitor the lipid profile parameters of MB leprosy patients in order to evaluate their metabolic health, therapeutic response, and disease status. It is advisable to conduct additional extensive studies to gain a better understanding of the mechanisms that underlie lipid abnormalities in leprosy and their clinical significance.

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