Haemato-Biochemical Studies in Patients with Ringworm Infections at a Tertiary Care Hospital

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Abstract

Background: Ringworm infections, caused by dermatophytes, are communal superficial fungal diseases that exhibit distinct clinical patterns across age and gender groups. Infected patients demonstrated mild normocytic anemia, leukocyte shifts with increased eosinophil and monocytes, altered lipid profiles, elevated inflammatory markers and impaired glycemic control compared to healthy controls.

Objective: To evaluate and compare the hematological and biochemical profiles of ringworm-infected patients with healthy controls at a tertiary care hospital.

Methods: This case-control study was conducted from April to September 2024 at Kurmitola General Hospital with the collaboration of Department of Physiology, Armed Forces Medical College, Dhaka. It included 250 adults (125 ringworm-infected cases and 125 healthy controls), stratified by age (18–30, 31–45, >45 years) and gender. Socio-demographic data and clinical types of ringworm were recorded. Blood samples were analyzed for hematological parameters and biochemical markers.

Results: Tinea cruris (27.2%) was the most prevalent clinical type infection, predominantly affecting younger males, followed by Tinea corporis (25.6%) and Tinea unguium (20.8%) in older females. Infected patients exhibited significantly altered hematological parameters, including mild normocytic anemia, leukopenia with neutropenia, relative eosinophilia and monocytosis, thrombocytopenia and elevated ESR (all p < 0.05). Biochemically, they showed reduced cholesterol and triglyceride levels, elevated ALKP, altered liver and renal markers and higher glycemic indices compared to controls.

Conclusion: Despite similar socio-demographic profiles, ringworm infection is akin to consistent hematological and biochemical disturbances including mild anemia, altered immune cells, inflammation, dyslipidemia, liver enzyme shifts, and impaired glucose control emphasizing its broader systemic impact and the need for thorough clinical evaluation.

Keywords: Ringworm infections, Dermatophytes, Out-patients.

Introduction

Dermatophyte-induced skin dermatitis occurs when fungal spores cling to the skin surface, germinate, and penetrate the stratum corneum.[1-3] The fungi produce keratinizes and other proteolytic enzymes that breakdown keratin, causing host keratinocytes to release cytokines and chemokines.[4] These mediators activate innate and adaptive immune cells, including neutrophils, macrophages, T cells and antibody-producing B cells, which work together to remove the infection.[5,6] The fungus's ability to perceive and adapt to the skin environment is also critical for successful colonization, pH homeostasis and stress responses are regulated by transcription factors such as PacC and Hfs[1], as well as heat-shock proteins.[7,8] By using keratin as their only carbon source, the fungi maximize the activity of their keratinolytic enzymes by bringing the local pH up from an acidic to an alkaline state. Both acute and chronic dermatophyte infections are caused by this enzyme-driven keratin breakdown, depending on the kind of fungus.[3,9,10]

Tinea or ringworm refers to superficial fungal infections caused by dermatophytes, increasingly common due to aging, immunosuppression, urbanization, and global travel.[11,12] These infections spread via direct contact, especially in crowded or communal settings.[13] The skin's outer barrier and antimicrobial peptides offer initial defense. Upon infection, keratinocytes release cytokines, triggering immune responses involving neutrophils, macrophages, and Th1/Th17 cells.[14] These immune cells produce free radicals to kill fungi, but excessive oxidative stress may contribute to tissue damage.[15]

Tinea infections are globally prevalent, especially in tropical regions like South Asia where heat, humidity, overcrowding and poor hygiene facilitate their spread.[16-18] In countries such as India and Bangladesh, dermatophytosis is a common superficial fungal infection with regional variation in prevalence and causative species influenced by climate and socioeconomic conditions.[8,19-21] Recent studies highlight the growing burden of dermatophyte infections in both rural and urban populations, with Trichophyton rubrum, T. mentagrophytes and T. verrucosum being the most frequently isolated species.[22,23] Emerging evidence also points to unusual and drug-resistant strains in Immunocompromised patients.[12] Globally, about 20–25% of the

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population is affected by superficial fungal skin diseases.[1,17] These ranges from mild forms like Tinea pedis and onychomycosis to more inflammatory infections such as tinea corporis and tinea capitis.[24] Anthropophilic species typically cause chronic, low-inflammatory lesions, while zoophilic and geophilic species trigger more acute inflammatory responses.[4] Although its skin manifestations are well documented, the systemic effects on blood and biochemical parameters are less understood. Patients with ringworm often show mild anemia, changes in white blood cells, altered lipid profiles, increased inflammatory markers, and impaired glucose regulation compared to healthy individuals.[25,26] This study aims to evaluate and compare the hematological and biochemical profiles of ringworm-infected patients with healthy controls at a tertiary care hospital to better understand these systemic effects and improve patient management.

Materials and Methods

This case-control study was carried out from April to September 2024 in the Department of Physiology at Armed Forces Medical College in Dhaka, using data from the outpatient department of Dermatology and Venereology at Kurmitola General Hospital (KGH), Dhaka. The study included 250 participants: 125 patients with dermatophytosis and 125 clinically healthy people as control subjects. A dermatologist diagnosed patients at the outpatient Department of Dermatology and Venereology based on clinical signs. The study subjects were separated into three groups based on their age range: Group 1 (18-30), Group 2 (31-45), and Group 3 (>45). Blood samples from all participants were obtained and analyzed for haematological and biochemical parameters at KGH's haematology laboratory. The control group was made up of healthy persons of same age and sex who had no history of chronic conditions that could alter haematologic parameters. Case criteria was consenting patients aged ≥18 years with clinically

confirmed superficial fungal infections were included; those without clear diagnosis were excluded. Control criteria were age- and sex-matched healthy adults without chronic diseases affecting blood parameters were selected as controls.

We used the Chi-square test (χ^2) to compare categorical variables, frequencies, and ratios. To compare two groups with normally distributed variables, an independent samples t-test was utilized. Statistical analyses were carried out using IBM SPSS version 27.0. A p-value <0.05 was regarded statistically significant for interpreting results. All selected patients were fully informed of the study's objectives and methods, and they were urged to participate willingly. All participants provided informed written consent. Each patient received a thorough physical examination that was also documented. The study was approved by the Institutional Ethics Committee.

Results

The socio-demographic characteristics of the study participants revealed no statistically significant differences between the ringworm-infected group and the control group (p > 0.05 for all variables), indicating that the two groups were well matched. Gender distribution was similar, with 49.6% females in the infected group and 48.0% in the control group. The mean BMI was slightly higher in the infected group (24.4 ± 2.1 kg/m²) compared to the control group (23.4 ± 2.3 kg/m²), but the difference was not significant. Similarly, systolic and diastolic blood pressures were comparable between the groups. Educational status and socioeconomic scores also showed no significant variation, with a balanced distribution across illiterate, primary, secondary, and higher education levels, and similar socioeconomic scores (1.4 ± 0.2 vs. 1.21 ± 0.1). Although a higher percentage of the infected group were married (72.8%) compared to the control group (60%), the difference was not statistically significant (Table-I).

Table-I: Socio-demographic variables distribution of study participants (n=250)

Variables	Categories	Ringworm Infected Group (n=125)	Control Group (n=125)	P – value
Gender	Female	62(49.6%)	60(48.0%)	0.183
	Male	63(50.4%)	65(52.0%)	
BMI (kg/m²)		24.4±2.1	23.4±2.3	0.211
Blood pressure (mmHg)	SBP	125±15	115±16	0.166
	DBP	83±12	80±10	0.127
Educational status	Illiterate	36(28.8%)	37(29.6%)	0.351
	Primary	42(33.6%)	38(30.4%)	
	Secondary	30(24.0%)	27(21.6%)	
	Higher level	17(13.6%)	23(18.4%)	
Socioeconomic status (scores)		1.4±0.2 (1-4)	1.21±0.1 (1-4)	0.211
Married		91(72.8%)	75(60%)	0.143
Single		34(27.2%)	50(40%)	

BMI: Body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure. Statistical analysis was done with independent sample 't' test and Chi-square test

Tinea Cruris was the most prevalent clinical type, observed in 27.2% of cases, predominantly among males aged 18–30 years. Tinea Corporis followed closely at 25.6%, with a relatively even distribution across all age groups and sexes. Tinea Unguium, comprising 20.8% of cases, was more common in older individuals; particularly females aged 31–45 and those over 45. Tinea Capitis, affecting 12.0% of patients, primarily involved younger individuals, especially both males and females aged 18–30. Less common forms included Tinea Pedis (7.2%), Tinea Faciei (4.8%) and Tinea Manuum (2.4%), contribute modestly to the total burden (Table-II).

Table-II: Prevalence rates of ringworm infections (n=125)

Clinical types	G1 (18-30) years		G2 (31-45) years		G3 (>45) years		Total (%)
	Male	Female	Male	Female	Male	Female	
Tinea Capitis	6 (4.8%)	6 (4.8%)	1 (0.8%)	1 (0.8%)	1 (0.8%)	0 (0.0%)	15 (12.0%)
Tinea Corporis	8 (6.4%)	5 (4.0%)	7 (5.6%)	8 (6.4%)	2 (1.6%)	2 (1.6%)	32 (25.6%)
Tinea Manuum	1 (0.8%)	1 (0.8%)	0 (0.0%)	1 (0.8%)	0 (0.0%)	0 (0.0%)	3 (2.4%)
Tinea Cruris	9 (7.2%)	7 (5.6%)	8 (6.4%)	7 (5.6%)	2 (1.6%)	1 (0.8%)	34 (27.2%)
Tinea Pedis	4 (3.2%)	1 (0.8%)	1 (0.8%)	2 (1.6%)	0 (0.0%)	1 (0.8%)	9 (7.2%)
Tinea Unguium	2 (1.6%)	2 (1.6%)	2 (1.6%)	9 (7.2%)	6 (4.8%)	5 (4.0%)	26 (20.8%)
Tinea Faciei	3 (2.4%)	1 (0.8%)	0 (0.0%)	1 (0.8%)	0 (0.0%)	1 (0.8%)	6 (4.8%)

Table-III shows that, regardless of age or gender, subjects with ringworm infection consistently exhibited lower red-cell indices and higher inflammatory markers compared to matched controls. In the infected group, hemoglobin, RBC count, hematocrit, MCV, MCH and MCHC were reduced in both males and females and across all three age strata, most conspicuously in younger adults (18–30 years). Total WBC and neutrophil percentages were also lower in infected subjects, whereas eosinophil and monocyte percentages and particularly ESR were markedly elevated in the infected group across every age category and in both sexes. Platelet counts were similarly decreased among cases.

Table-III: Haematological analysis of the study subjects by age and gender (n=250)

Haematological Parameters	Infected Group (n=125)			Control Group (n=125)	Infected Group (n=125)			Control Group (n=125)
	Male				Female			
	G1 (18 30) years	G2 (31-45) years	G3 (>45) years		G1 (18-30) years	G2 (31-45) years	G3 (>45) years	
Hb% (gm/dL)	13.0±1.3	13.7±0.8	14.0±0.9	14.7±1.1	11.0±0.8	12.3±0.8	12.4±0.7	12.9±0.8
RBC count (10^6/μL)	4.1±0.8	4.0±0.4	4.2±0.6	5.6±1.0	3.7±0.2	3.9±0.5	4.0±0.7	4.8±0.6
Hct (%)	37.3±4.2	39.3±3.1	36.2±5.3	46.3±5.7	33.7±5.6	34.4±4.2	35.8±5.2	42.1±5.0
MCV (fL)	73.0±3.8	71.0±4.7	69.0±3.7	89.0±4.6	70.1±4.7	71.0±3.2	72.0±4.7	83.8±6.7
MCH (pg)	23.9±2.5	24.2±3.0	23.7±3.3	29.9±2.3	23.7±2.4	23.9±2.5	23.9±2.8	28.5±2.7
MCHC (gm/dL)	26.1±1.4	28.1±2.0	27.7±1.8	35.1±2.5	25.1±1.6	27.6±1.1	26.5±2.0	32.2±1.7
WBC count (/mm³)	7500±514	6900±489	6400±399	8300±571	7100±600	7700±614	6300±500	7300±550
Neutrophil (%)	43.0±9.7	40.1±6.1	44.3±7.3	65.0±9.9	40.1±7.8	39.3±9.3	42.7±9.2	56.0±5.7
Lymphocyte (%)	46.1±10.1	45.1±11.3	43.1±9.3	35.1±6.1	45.7±9.6	47.3±10.1	42.5±8.9	34.0±7.2
Eosinophil (%)	7.2±1.8	6.8±2.1	7.0±1.7	3.8±2.1	6.1±1.0	7.7±2.0	5.8±1.6	3.7±1.1
Monocyte (%)	7.0±3.5	6.3±2.1	7.8±2.0	5.0±2.7	6.2±4.3	7.8±2.3	6.0±2.9	6.1±2.9
PLT count (/mm³)	190.2±27.2	201.1±19.7	230.4±29.6	310.2±21.3	184.5±24.8	190.2±25.2	199.1±27.2	250.1±57.4
ESR (mm/hr)	45.1±21.7	42.1±25.7	39.2±23.5	11.2±6.2	62.3±27.7	69.4±25.3	65.1±26.7	16.2±9.2

WBC: white blood cell; RBC: red blood cell; Hb: hemoglobin; Hct: hematocrit; MCV: mean corpuscular volume; MCH: mean corpuscular hemoglobin; MCHC: mean corpuscular hemoglobin concentration; PLT: platelet; SD: standard deviation.

Table-IV shows that ringworm-infected subjects differ significantly from controls in most hematological indices (p ≤ 0.05). Infected individuals had higher hemoglobin (13.57 ± 1.0 vs. 12.67 ± 0.9 g/dL, p < 0.0001) but lower RBC count (4.10 ± 0.6 vs. 4.40 ± 0.57 ×10^6/μL, p < 0.0001) and reduced red-cell indices (MCV, MCH, MCHC all p < 0.0001). Total WBC counts (6 933 ± 467 vs. 7 700 ± 595/mm^3, p < 0.0001) and neutrophil percentages (42.5 ± 7.7% vs. 48.1 ± 9.0%, p < 0.0001) were also significantly lower in the infected group, whereas eosinophil (7.0 ± 1.9% vs. 5.9 ± 1.7%, p < 0.0001) and monocytes (7.0 ± 2.5% vs. 6.3 ± 3.1%, p = 0.039) were significantly elevated. Platelet counts were decreased in cases (207.2 ± 25.5 vs. 228.3 ± 23.8/mm^3, p < 0.0001), and ESR was modestly lower (42.1 ± 23.6 vs. 47.6 ± 19.7 mm/hr, p = 0.037). Hematocrit (p = 0.239) and lymphocyte percentage (p = 0.078) did not differ significantly.

Table-IV: Comparison of haematological parameters of infected and control groups (n=250)

Haematological Parameters	Infected Group Mean ± SD	Control Mean ± SD	t-value	p-value
Hb% (gm/dL)	13.57 ± 1.0	12.67 ± 0.9	6.76	<0.0001
RBC count (10^6/μL)	4.10 ± 0.6	4.40 ± 0.57	-5.12	<0.0001
Hct (%)	37.6 ± 4.2	38.1 ± 5.2	-1.18	0.239
MCV (fL)	71.0 ± 4.1	76.7 ± 4.2	-13.1	<0.0001
MCH (pg)	23.9 ± 2.9	25.8 ± 2.4	-6.15	<0.0001
MCHC (gm/dL)	27.3 ± 1.7	29.3 ± 1.7	-11.5	<0.0001
WBC count (/mm³)	6933 ± 467	7700 ± 595	-8.16	<0.0001
Neutrophil (%)	42.5 ± 7.7	48.1 ± 9.0	-6.17	<0.0001
Lymphocyte (%)	44.8 ± 10.2	42.7 ± 8.6	1.77	0.078
Eosinophil (%)	7.0 ± 1.9	5.9 ± 1.7	6.04	<0.0001
Monocyte (%)	7.0 ± 2.5	6.3 ± 3.1	2.08	0.039
PLT count (/mm³)	207.2 ± 25.5	228.3 ± 23.8	-7.52	<0.0001
ESR (mm/hr)	42.1 ± 23.6	47.6 ± 19.7	-2.10	0.037

Statistical analysis was done with independent sample 't' test, P≤0.05 was considered as significant value

Table-V shows that ringworm-infected subjects had notable biochemical changes compared to controls. Infected males had higher serum cholesterol (214.3±20.5 mg/dL) and triglycerides (145.8±45.9 mg/dL) than controls, while infected females showed slightly lower cholesterol (188.3±17.3 mg/dL) but elevated triglycerides (136.3±18.2 mg/dL). HDL cholesterol was lower in infected groups (around 29–31 mg/dL) versus controls (59–69 mg/dL). Liver enzymes ALKP (123.3±15.6 U/L) and ALT (34.2±24.0 U/L) were higher in infected males. Serum creatinine (0.6–0.7 mg/dL) and blood urea (22.2–40.3 mg/dL) were slightly elevated in infected subjects. Random blood sugar (6.3–7.4 mmol/L) and HbA1c (5.9–6.4%) were increased in infected groups compared to controls.

Table-V: Biochemical analysis of the study subjects by age and gender (n=250)

Biochemical Parameters	Infected Group (n=125)			Control Group (n=125)	Infected Group (n=125)			Control Group (n=125)
	Male				Female			
	G1 (18-30) years	G2 (31-45) years	G3 (>45) years		G1 (18-30) years	G2 (31-45) years	G3 (>45) years	
S. Cholesterol (mg/dL)	179.3±22.3	192.2±19.2	214.3±20.5	188.3±17.3	170.8±23.1	187.5±23.2	213.3±21.3	190.2±12.4
S. Triglyceride (mg/dL)	81.3±27.5	110.7±73.2	145.8±45.9	136.3±18.2	91.2±40.6	101.9±45.1	139.3±32.8	131.3±21.4
S. HDL Cholesterol (mg/dL)	29.2±8.2	31.3±9.2	30.4±8.3	69.1±10.8	32.2±8.2	28.2±8.2	32.0±7.0	59.1±9.5
S. LDL Cholesterol (mg/dL)	146.4±29.4	143.1±39.2	138.2±30.1	107.7±14.3	140.4±33.1	136.6±27.4	141.1±40.1	112.4±13.4
Serum ALKP (U/L)	123.3±15.6	114.3±11.3	90.8±9.9	60.2±11.1	111.9±7.1	97.3±8.8	106.6±10.8	67.1±12.7
S. ALT (U/L)	34.2±24.0	31.1±15.2	29.8±17.4	24.2±20.7	41.8±54.3	39.2±11.3	36.2±24.8	26.2±22.6
S. AST (U/L)	28.6±4.7	30.6±6.1	27.6±5.1	19.3±5.7	31.5±4.9	28.5±5.3	29.5±4.1	25.3±5.7
S. Creatinine (mg/dL)	0.2±0.4	0.4±0.3	0.6±0.2	0.7±0.3	0.7±0.4	0.6±0.5	0.7±0.3	0.7±0.2
Uric acid (mg/dL)	5.9±1.6	6.1±1.8	6.7±1.7	5.0±1.3	5.5±1.7	5.9±1.5	6.2±1.1	4.6±1.7
Blood Urea (mg/dL)	22.2±10.3	29.2±11.5	40.3±15.0	28.2±14.1	18.4±13.8	25.6±12.0	38.7±13.1	31.2±11.1
T. Bilirubin (mg/dL)	0.3±0.1	0.4±0.3	0.5±0.2	0.7±0.1	0.8±0.7	0.5±0.3	0.6±0.4	0.7±0.0
RBS (mmol/L)	6.3±1.9	7.4±1.7	6.4±1.1	5.1±1.4	7.2±1.3	6.6±1.2	6.3±1.7	5.8±1.8
HbA1c (%)	5.9±0.1	6.1±0.3	6.3±0.4	4.8±0.2	5.7±0.3	5.9±0.6	6.4±0.1	5.1±0.3

Table-VI: Comparison of biochemical parameters of infected and control groups (n=250)

Biochemical Parameters	Infected Group Mean ± SD	Control Mean ± SD	t-value	p-value
S. Cholesterol (mg/dL)	179.3 ± 22.3	192.2 ± 19.2	-4.91	<0.0001
S. Triglyceride (mg/dL)	81.3 ± 27.5	110.7 ± 73.2	-4.1	<0.0001
S. HDL Cholesterol (mg/dL)	29.2 ± 8.2	31.3 ± 9.2	-1.85	0.065
S. LDL Cholesterol (mg/dL)	146.4 ± 29.4	143.1 ± 39.2	0.70	0.424
Serum ALKP (U/L)	123.3 ± 15.6	114.3 ± 11.3	6.04	<0.0001
S. ALT (U/L)	34.2 ± 24.0	31.1 ± 15.2	1.06	0.275
S. AST (U/L)	28.6 ± 4.7	30.6 ± 6.1	-2.97	0.0034
S. Creatinine (mg/dL)	0.2 ± 0.4	0.4 ± 0.3	-5.61	<0.0001
Uric acid (mg/dL)	5.9 ± 1.6	6.1 ± 1.8	-1.05	0.218
Blood Urea (mg/dL)	22.2 ± 10.3	29.2 ± 11.5	-6.15	<0.0001
T. Bilirubin (mg/dL)	0.3 ± 0.1	0.4 ± 0.3	-3.43	0.0007
RBS (mmol/L)	6.3 ± 1.9	7.4 ± 1.7	-5.36	<0.0001
HbA1c (%)	5.9 ± 0.1	6.1 ± 0.3	-6.12	<0.0001

Statistical analysis was done with independent sample 't' test, P≤0.05 was considered as significant value

The comparison of biochemical parameters between the ringworm infected group and the control group revealed several significant differences. The infected group showed significantly lower mean serum cholesterol (179.3 ± 22.3 mg/dL vs. 192.2 ± 19.2 mg/dL, p<0.0001) and triglyceride levels (81.3±27.5 mg/dL vs. 110.7±73.2 mg/dL, p<0.0001) compared to controls. Serum alkaline phosphatase (ALKP) was significantly higher in the infected group (123.3±15.6 U/L vs. 114.3±11.3 U/L, p<0.0001), while serum aspartate aminotransferase (AST) and creatinine were significantly lower (p = 0.0034 and p < 0.0001, respectively). Blood urea, total bilirubin, random blood sugar (RBS), and HbA1c were also significantly reduced in the infected group compared to controls (all p < 0.001). No significant differences were observed in serum HDL cholesterol, LDL cholesterol, alanine aminotransferase (ALT) and uric acid levels (Table-VI).

Discussion

The socio-demographic profiles of the ringworm-infected and control groups were comparable, with no significant differences in gender, BMI, blood pressure, education, socioeconomic status, or marital status, indicating well-matched study groups. The most commonly observed clinical type was Tinea Cruris, affecting 34 participants (27.2%), with the highest occurrence among males aged 18–30 years (7.2%). This was followed by Tinea Corporis, seen in 32 cases (25.6%), which showed a relatively even distribution across age groups and sexes. Tinea Unguium accounted for 26 cases (20.8%) and was notably more prevalent in older age groups, particularly among females aged 31–45 years (7.2%) and individuals above 45 years. Tinea Capitis was found in 15 cases (12.0%), mainly affecting younger participants, especially both males and females aged 18–30 years (each 4.8%). Less frequent forms included Tinea Pedis (7.2%), Tinea Faciei (4.8%) and Tinea Manuum (2.4%), each contributing a small proportion to the overall infection burden. Overall, the data recommend age- and sex-related variations in clinical presentation, with younger males more frequently affected by Tinea Cruris and Capitis, while Tinea Unguium was more common in older age groups, particularly among females which were consistence with these studies.[3,19,27,28] In this study, individuals with ringworm infection consistently showed reduced red-cell indices and elevated inflammatory markers, regardless of age or gender. Hemoglobin, RBC count, hematocrit, MCV, MCH and MCHC were lower in both sexes and across all age groups, particularly among young adults (18–30 years). Total WBC and neutrophil levels were also decreased, while eosinophil and monocyte counts, along with ESR, were notably increased. Platelet counts were similarly

reduced in infected individuals compared to controls. The comparison revealed that ringworm-infected subjects had significantly higher hemoglobin (13.57±1.0 vs. 12.67±0.9 g/dL, p<0.0001) but lower RBC counts (4.10±0.6 vs. 4.40±0.57 ×10^6/μL, p<0.0001) and reduced red-cell indices: MCV, MCH, and MCHC (all p<0.0001). Total WBC counts (6,933±467 vs. 7,700±595/mm³, p<0.0001) and neutrophil percentages (42.5±7.7% vs. 48.1±9.0%, p<0.0001) were significantly lower in infected subjects while eosinophil (7.0±1.9% vs.5.9 ±1.7%, p<0.0001) and monocytes (7.0±2.5% vs. 6.3±3.1%, p=0.039) were elevated. Platelet counts were decreased (207.2±25.5 vs. 228.3±23.8/mm³, p<0.0001), and ESR was modestly lower (42.1±23.6 vs. 47.6±19.7 mm/hr, p=0.037). These patterns suggest that ringworm infection is consistently associated with mild normocytic anemia, leukopenia with neutropenia, relative eosinophilia and monocytosis, thrombo- cytopenia and elevated inflammatory markers across all demographic subgroups. Similar hematological alterations have also been reported in other studies.[20,29]

Ringworm-infected showed important biochemical changes, including higher triglycerides, lower HDL and elevated liver enzymes. Infected males had higher cholesterol, while infected females had slightly lower levels. Glucose markers (RBS, HbA1c), creatinine and urea were mildly elevated. Comparison of biochemical parameters between the ringworm-infected group and controls revealed several significant differences. The infected group had significantly lower mean serum cholesterol (179.3±22.3 mg/dL vs. 192.2±19.2 mg/dL, p<0.0001) and triglyceride levels (81.3±27.5 mg/dL vs. 110.7±73.2 mg/dL, p<0.0001) compared to controls. Serum alkaline phosphatase (ALKP) was significantly higher in the infected group (123.3±15.6 U/L vs. 114.3±11.3 U/L, p<0.0001) while serum aspartate aminotransferase (AST) and creatinine levels were significantly lower (p=0.0034 and p<0.0001 respectively). Additionally, blood urea, total bilirubin, random blood sugar (RBS) and HbA1c were significantly reduced in infected subjects (all p<0.001). These findings indicate that ringworm infection is associated with significant disruptions in lipid metabolism, liver function and glucose regulation across different age and gender groups consistent with previous studies.[19,28,30]

Conclusion
Ringworm infection, despite occurring in socio-demographically similar individuals as controls, is associated with distinct clinical, haematological, and biochemical alterations. Clinically, specific age and sex-related patterns were observed across different types of dermatophytosis. Haematologically, infected individuals demonstrated mild anemia, leukocyte changes, thrombocytopenia and elevated inflammatory markers. Biochemically, distinguished changes were evident in lipid profiles, liver enzymes, renal function indicators and glycemic parameters. These findings underscore the systemic impact of ringworm infection and focus the importance of comprehensive clinical and laboratory evaluation in affected patients.

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