

Research Article

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## The relationship between nail findings and cardiac morbidity in patients visiting a dermatology clinic: A prospective study

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### Abstract

Recent research highlights that dermatological manifestations, particularly nail disorders, can serve as clinical indicators of underlying cardiovascular pathologic. This study aimed to elucidate the association between specific nail findings and cardiovascular morbidities, including diabetes mellitus, hypertension, hyperlipidemia, coronary artery disease, heart failure, and valvular heart disease. A prospective observational study was conducted involving 103 patients who presented with nail disorders at dermatology clinics within a six-month interval. Data were systematically collected through comprehensive clinical examinations and review of medical records, encompassing demographic and clinical parameters. Logistic regression analysis was utilized to identify independent predictors of cardiovascular outcomes. The study cohort had a mean age of  $47 \pm 7.2$  years, comprising 59% female and 41% male participants. Several nail disorders were identified as significant predictors of cardiovascular pathology. Specifically, the presence of Terry's nails was significantly associated with diabetes mellitus (OR = 5.23; 95% CI: 1.037–26.365,  $p = 0.045$ ) and coronary artery disease (OR = 6.25; 95% CI: 1.685–23.168,  $p = 0.006$ ). Muehrcke's lines emerged as significant predictors of heart failure (OR = 5.89; 95% CI: 1.663–20.831,  $p = 0.006$ ), whereas the identification of red lunula was significantly correlated with valvular heart disease (OR = 4.76; 95% CI: 1.387–16.302,  $p = 0.013$ ). Distinct nail disorders may serve as valuable clinical markers of underlying cardiovascular diseases. Dermatological assessments could, therefore, contribute to early detection and management of cardiovascular morbidity.

**Keywords:** nail disorders, cardiac morbidity, early detection, dermatological assessment, cardiovascular disease

### 1. Introduction

Cardiac morbidity, encompassing conditions such as diabetes mellitus (DM), hypertension (HT), hyperlipidemia, coronary artery disease (CAD), heart failure (HF), and valvular heart disease, remains a principal contributor to global mortality and morbidity. These pathologies place a significant burden on healthcare infrastructure and substantially reduce the quality of life for affected individuals. Early detection and appropriate management are essential to attenuate the adverse outcomes of cardiovascular (CV) diseases. In recent years, evidence has increasingly highlighted that dermatological manifestations, particularly alterations in nail morphology, may serve as salient clinical indicators of underlying CV pathology.

Nail disorders are relatively common and may arise from a variety of etiologies, including systemic diseases, local infections, and environmental factors. Accordingly, abnormalities of the nail plate and nail unit can serve as valuable diagnostic indicators, facilitating the early detection of underlying diseases without the need for costly investigations (1).

Nail clubbing has been linked to both pulmonary and CV diseases. Terry's nails are frequently identified in patients with hepatic disease and congestive HF. Splinter hemorrhages are

commonly observed in cases of endocarditis and arterial embolism (2). Koilonychia has been reported in association with CAD (3, 4), while the red lunula sign is often indicative of congestive HF. Furthermore, Muehrcke's lines have been described in patients who have undergone heart transplantation (5). Although these associations between nail findings and systemic diseases are well established, the specific relationship between nail changes and cardiac morbidity remains insufficiently investigated, particularly given the frequency of nail disorders in dermatology outpatient clinics.

This study aims to elucidate the relationship between nail findings and cardiac morbidity in patients attending dermatology outpatient clinics. It also seeks to highlight the potential role of systematic dermatological assessment in the early detection of cardiovascular diseases.

### 2. Materials and Methods

This prospective observational study received ethical approval from the University of Karamanoğlu Mehmet Bey Research Ethics Committee (approval no. 05-2022/07), granted on May 24, 2022. A total of 103 patients who attended the dermatology outpatient clinic between January 2023 and June 2023 were included in the study. The inclusion criteria for the study were

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being at least 18 years of age and having at least one nail disorder. Patients with comorbidities known to affect nail morphology, namely, pulmonary, hepatic, or rheumatological diseases, anemia, chronic kidney disease, hypoalbuminemia and/or thyrotoxicosis, were excluded from the study to minimize confounding and ensure the validity of the observed relationship.

Data were collected through structured clinical examinations and a comprehensive review of patient medical records. Demographic data, including age and gender, were systematically documented. The presence of specific nail disorders namely, clubbing, koilonychia, onychomadesis, Muehrcke's lines, Terry's nails, red lunula, and splinter hemorrhages was recorded, with photographic documentation serving as the primary modality for nail evaluation. CV comorbidities assessed comprised HT, hyperlipidemia, DM, CAD, valvular heart disease, and HF, each diagnosed according to established clinical guidelines and corroborated by medical records, laboratory findings, and, where appropriate, imaging modalities. DM was defined by either a prior diagnosis or ongoing treatment, a fasting plasma glucose level of  $\geq 126$  mg/dL, or a glycated hemoglobin (HbA1c) level of  $\geq 6.5\%$  (6). HT was identified by current antihypertensive therapy or office blood pressure  $\geq 140$  mmHg systolic and/or  $\geq 90$  mmHg diastolic (7). Hyperlipidemia was defined as ongoing statin therapy or a low-density lipoprotein cholesterol (LDL) level exceeding 130 mg/dL (8). CAD was established based on a documented history of myocardial infarction or the performance of coronary revascularization procedures. Significant valvular heart disease was determined by echocardiographic findings consistent with moderate to severe stenosis or regurgitation (9). HF was defined by clinical diagnosis and/or a left ventricular ejection fraction  $\leq 40\%$  on echocardiography (10).

Statistical analysis was performed using SPSS software (version 25.0). Descriptive statistics were computed, with frequencies and percentages used to summarize categorical variables. Continuous variables were described using means and standard deviations. The normality of the age distribution was assessed using the Shapiro-Wilk test. Logistic regression models were fitted for each CV disease to identify significant predictors among the nail disorders. Odds ratios (OR) with 95% confidence intervals (CIs) were calculated to evaluate the strength of the associations. A p-value of less than 0.05 was considered statistically significant.

### 3. Results

The study cohort exhibited a mean age of  $47 \pm 17.2$  years, comprising 59% female and 41% male patients. With respect

to the prevalence of nail disorders, clubbing was identified in 16.7% ( $n = 17$ ), koilonychia in 10.4% ( $n = 11$ ), onychomadesis in 7.3% ( $n = 7$ ), Muehrcke's lines in 8.9% ( $n = 9$ ), Terry's nails in 12.5% ( $n = 12$ ), red lunula in 6.3% ( $n = 7$ ), and splinter hemorrhage in 5.2% ( $n = 5$ ).

**Table 1.** Demographic and clinical characteristics of patients with nail disorders

	Overall (n=103)
<b>Age</b> †	47 ± 17.2
<b>Gender</b>	
Female, n (%)	61 (59)
Male, n (%)	42 (41)
<b>Nail disorders</b>	
Clubbing, n (%)	32 (16.7)
Koilonychia, n (%)	20 (10.4)
Onychomadesis, n (%)	14 (7.3)
Muehrcke's lines, n (%)	17 (8.9)
Terry's nails, n (%)	24 (12.5)
Red lunula, n (%)	12 (6.3)
Splinter hemorrhage, n (%)	10 (5.2)
<b>Cardiovascular Diseases</b>	
Diabetes Mellitus, n (%)	30 (29.1)
Hypertension, n (%)	40 (38.8)
Hyperlipidemia, n (%)	35 (33.9)
Coronary Artery Disease, n (%),	25 (24.2)
Heart Failure, n (%)	20 (19.4)
Heart Valve Disease, n (%)	15 (14.5)

†: Mean ± Standard Deviation

HT was observed in 38.8% ( $n = 40$ ) of the patients, while hyperlipidemia was present in 33.9% ( $n = 30$ ). DM affected 29.1% ( $n = 30$ ), of whom four were receiving insulin therapy. CAD was documented in 24.2% ( $n = 25$ ) of the cohort; fifteen patients underwent percutaneous coronary intervention, and five underwent coronary artery bypass grafting. HF was present in 10.4% ( $n = 11$ ), with a median left ventricular ejection fraction of 38%. Additionally, 7.8% ( $n = 8$ ) of patients exhibited significant heart valve disease, characterized by at least one severe valve regurgitation as shown in Table 1.

Logistic regression analyses were performed for each CV disease to ascertain statistically significant predictors among the spectrum of nail disorders. Terry's nails emerged as significant predictors of both DM (OR = 5.23; 95% CI = 1.037–26.36,  $p = 0.045$ ), and CAD (OR = 6.248; 95% CI = 1.685–23.168,  $p = 0.006$ ). For HF, the presence of Muehrcke's lines was identified as a significant predictor (OR = 5.886; 95% CI = 1.663–20.831,  $p = 0.006$ ), while for valvular heart disease, red lunula demonstrated predictive significance (OR = 4.755; 95% CI = 1.387–16.302,  $p = 0.013$ ) as shown in Table 2.

These findings indicate that particular nail disorders may function as non-invasive clinical indicators of underlying cardiac conditions, potentially prompting earlier cardiovascular screening and intervention.

**Table 2.** Association between nail disorders and cardiovascular morbidities

Predictors	Odds Ratio (95%CI)	p-value
<b>Coronary Artery Disease</b>		
Clubbing	1.05 (0.22-4.90)	0.9
Koilonychia	0.62 (0.110-3.48)	0.5
Muehrcke's lines	0.83 (0.135-5.19)	0.8
Onychomadesis	0.81 (0.109-6.06)	0.8
Red lunula	1.64 (0.21-12.81)	0.6
Splinter hemorrhage	0.83 (0.10-6.81)	0.8
Terry's nails	6.24 (1.68-23.16)	<b>0.006</b>
<b>Diabetes Mellitus</b>		
Clubbing	1.65 (0.39-6.90)	0.3
Koilonychia	1.82 (0.23-14.36)	0.5
Muehrcke's lines	3.39 (0.52-21.99)	0.1
Onychomadesis	0.53 (0.11-2.64)	0.4
Red lunula	1.556 (0.20-11.68)	0.6
Splinter hemorrhage	0.926 (0.21-4.07)	0.9
Terry's nails	5.23 (1.03-26.36)	<b>0.045</b>
<b>Heart Failure</b>		
Clubbing	1.10 (0.20-5.84)	0.9
Koilonychia	0.66 (0.08-5.29)	0.6
Muehrcke's lines	5.88 (1.66-20.83)	<b>0.006</b>
Onychomadesis	0.77 (0.08-7.25)	0.8
Red lunula	1.33 (0.14-12.27)	0.8
Splinter hemorrhage	0.53 (0.046-6.20)	0.6
Terry's nails	1.28 (0.16-10.10)	0.8
<b>Heart Valve Disease</b>		
Clubbing	0.82 (0.12-5.50)	0.8
Koilonychia	1.16 (0.18-7.22)	0.8
Muehrcke's lines	0.98 (0.15-6.12)	0.9
Onychomadesis	0.96 (0.136-6.86)	0.9
Red lunula	4.75 (1.38-16.30)	<b>0.013</b>
Splinter hemorrhage	0.61 (0.08-4.38)	0.6
Terry's nails	1.00 (0.15-6.34)	1.0
<b>Hyperlipidemia</b>		
Clubbing	0.73 (0.16-3.22)	0.6
Koilonychia	1.38 (0.30-6.21)	0.6
Muehrcke's lines	2.31 (0.45-11.81)	0.3
Onychomadesis	1.42 (0.29-6.87)	0.6
Red lunula	0.78 (0.09-6.49)	0.8
Splinter hemorrhage	1.22 (0.20-7.21)	0.8
Terry's nails	2.97 (0.60-14.50)	0.1
<b>Hypertension</b>		
Clubbing	1.66 (0.16-17.00)	0.6
Koilonychia	1.50 (0.15-15.19)	0.7
Muehrcke's lines	5.88 (0.62-55.58)	0.1
Onychomadesis	1.53 (0.24-9.72)	0.6
Red lunula	6.26 (0.63-61.69)	0.1
Splinter hemorrhage	0.81 (0.12-5.19)	0.8
Terry's nails	3.32 (0.47-23.15)	0.2

#### 4. Discussion

Patients with nail abnormalities rarely visit dermatology outpatient clinics, but nail findings indicative of systemic diseases provide a valuable diagnostic clue (11). The nail matrix, located in the proximal part of the nail, forms the hard, keratinized nail plate. The distal nail matrix produces the deeper layer of the nail plate, while the superficial layers originate from the proximal matrix. Anatomically, the nail is anchored to the underlying integument by the eponychium proximally, the anterior ligament and the distal nail fold distally, and the lateral nail folds laterally. Accurate identification of the origin of pathological changes within the

matrix is critical, as lesions affecting the proximal matrix may result in superficial nail pitting, but this may run deeper if the distal matrix is involved (12).

A key finding of this study was the association between Terry's nails and several cardiovascular conditions, including DM and CAD. Terry's nails were first described in 1954 by Richard Terry in patients with cirrhosis. This condition is characterized by leukonychia, in which the entire nail bed appears white, along with a pink band at the distal end of the nail. The whiteness of the nail is due to reduced blood flow in the subcapillary plexus, which occurs because of excessive connective tissue growth between the nail and the bone. Tissue biopsies show that this nail abnormality is caused by distal telangiectasia. While the presence of Terry's nails is not specific to any particular disease, it may provide clues about underlying systemic conditions (13). Although typically associated with cirrhosis, Terry's nails are also observed in patients with CAD, DM, thyrotoxicosis and older individuals (14).

Our research has revealed that Terry's nails are a potent predictor of DM, necessitating comprehensive evaluation of patients with this nail disorder for possible diabetes. This finding is particularly significant as it highlights that DM, a condition known for its microvascular complications such as nephropathy, retinopathy, and neuropathy, also has implications for the nailfold.

Additionally, we discovered the presence of Muehrcke's lines was significantly associated with HF. Muehrcke's lines, characterized by pairs of white lines that run parallel to the lunula, have previously been linked to hypoalbuminemia and chronic kidney disease. However, their strong correlation with HF in this study indicates a wider clinical relevance.

Muehrcke's lines were first described by Dr Robert Muehrcke in 1956, manifesting as transverse double white bands on the nails and are indicative of underlying pathological conditions (15). In a study conducted by Muehrcke et al., nephrotic syndrome was identified in 23 out of 32 patients exhibiting these lines, while hypoalbuminemia occurred in the remaining nine patients alongside various other conditions (16). The precise etiology of Muehrcke's lines remains unknown, as they do not result from trauma to the cuticle or nail plate. However, they have been associated with impaired protein synthesis, with research indicating a proportional relationship between duration of hypoproteinaemia and width of the white bands (17).

Red lunula represents the visible portion of the nail matrix. Anatomically, its distal margin may either merge seamlessly with the nail bed or be demarcated by a pale line (18). Notably, the visibility of the lunula can be reduced when pressure is applied to the nail plate. Recent studies have reported that the presence of a red lunula is significantly correlated with heart disease, suggesting its potential role as a clinical marker (19).

In addition, red lunula has been linked to several systemic conditions, including collagen vascular disease, chronic obstructive pulmonary disease, cirrhosis, chronic urticaria, psoriasis, and carbon monoxide poisoning (20). In our study, red lunula was significantly associated with valvular heart disease, highlighting its possible diagnostic relevance.

The findings of the present study underscore the importance of integrating dermatological assessments into routine CV evaluations. Both dermatologists and cardiologists should be aware of the potential diagnostic value of nail findings. In particular, patients manifesting Terry's nails, Muehrcke's lines, or red lunula warrant comprehensive evaluation for coexisting CV pathology. Such a multidisciplinary approach can facilitate early detection and management of cardiac morbidity, ultimately improving patient outcomes.

The study was conducted at a single center, underscoring the need for larger and more diverse group of participants in further research to confirm these findings. Additionally, more investigation is needed to explore the mechanism linking nail disorders to CV disease. Gaining a better understanding of these pathophysiological connections could facilitate the development of non-invasive diagnostic tools. Moreover, it is essential to evaluate how early detection of cardiac conditions through dermatological assessments influences patient outcomes, highlighting the importance of potential contribution to this field.

This study demonstrates significant associations between specific nail findings particularly Terry's nails, Muehrcke's lines, and red lunula and cardiovascular morbidity. These results underscore the diagnostic value of dermatological assessments for early detection of cardiovascular disease and highlight the need for collaboration between dermatologists and cardiologists. Future studies should validate these associations in larger, more diverse populations.

#### Conflict of interest

The authors declared no conflict of interest.

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None to declare.

#### Authors' contributions

Concept: F.B.H., H.M.S., Design: F.B.H., H.M.S., Data Collection or Processing: F.B.H., H.M.S., Analysis or Interpretation: Z.M., N.B.Ö. Literature Search: Z.M., N.B.Ö., Writing: F.B.H., H.M.S., Z.M., N.B.Ö.

#### Ethical Statement

This study was approved by the Research Ethics Committee of

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