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Research Article

Prevalence of Undiagnosed Hypertension, Diabetes Mellitus, and Poor Oral Health in Adults: A Community-Based Screening Study

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Abstract

Background: Non-communicable diseases, particularly hypertension and type 2 diabetes mellitus, alongside chronic oral health conditions like periodontitis, constitute major global health burdens. Because early stages of hypertension, hyperglycemia, and periodontal breakdown are frequently asymptomatic, a significant proportion of affected adults remain undiagnosed until end-organ damage or irreversible tissue loss occurs.

Objective: To evaluate the community-based screening prevalence of undiagnosed hypertension, undiagnosed diabetes mellitus, and poor oral health status among adults, and to examine the co-occurrence of these conditions.

Methods: This community-based cross-sectional screening study was conducted in outpatient outreach clinics associated with Sahiwal Teaching Hospital, evaluating 160 adult participants (aged 30 to 70 years) with no prior medical diagnosis of hypertension or diabetes mellitus. Standardized clinical

screening included seated blood pressure (BP) measurements, point-of-care fasting capillary blood glucose (FBG) testing, and a comprehensive intraoral examination assessing the Community Periodontal Index for Treatment Needs (CPITN), Clinical Attachment Loss (CAL in mm), Simplified Oral Hygiene Index (OHI-S), and total missing teeth. Undiagnosed hypertension was defined as SBP >= 140 mmHg and/or DBP >= 90 mmHg. Undiagnosed diabetes mellitus was defined as FBG >= 126 mg/dL. Poor oral health was defined as CPITN Code 3 or 4 and/or OHI-S > 3.0. Chi-square tests, Student's t-tests, and multivariable binary logistic regression analyses were performed.

Results: Among 160 screened adults (mean age 48.6 +/- 10.8 years; 55.0 percent female), undiagnosed hypertension was identified in 31.3 percent (n = 50) and undiagnosed diabetes mellitus in 18.8 percent (n = 30). Poor oral health status was present in 62.5 percent (n = 100) of the overall cohort, with severe periodontal breakdown (CPITN Code 4) detected in 28.1 percent (n = 45). Participants with undiagnosed diabetes exhibited a significantly higher prevalence of severe periodontal disease compared to normoglycemic individuals (50.0 percent vs. 23.1 percent, p = 0.003). Similarly, undiagnosed hypertension significantly co-occurred with elevated Clinical Attachment Loss (4.2 +/- 1.4 mm vs. 2.8 +/- 1.1 mm, p < 0.001). Multivariable logistic regression revealed that age >= 50 years (adjusted OR = 2.84, 95 percent CI: 1.32 to 6.12, p = 0.007), poor oral hygiene (OHI-S > 3.0; adjusted OR = 2.42, 95 percent CI: 1.15 to 5.08, p = 0.020), and severe periodontitis (adjusted OR = 3.18, 95 percent CI: 1.45 to 6.98, p = 0.004) were independent predictors of co-existing undiagnosed systemic cardiometabolic disease (hypertension or diabetes).

Conclusion: A substantial proportion of community-dwelling adults harbor undiagnosed hypertension, undiagnosed diabetes mellitus, and chronic oral health degradation. The strong clustering of poor oral health with undiagnosed systemic cardiometabolic conditions emphasizes the utility of integrated, multi-disease community screening programs combining basic oral examinations with blood pressure and glycemic testing.

Keywords: Undiagnosed hypertension; Undiagnosed diabetes mellitus; Oral health; Periodontitis; Community screening; Cardiometabolic risk; Primary prevention; Public health.

1. Introduction

Non-communicable diseases (NCDs) represent the primary driver of premature adult mortality and chronic disability globally. Among NCDs, cardiovascular diseases—driven predominantly by essential hypertension—and type 2 diabetes mellitus (T2DM) constitute twin metabolic epidemics. Concurrently, chronic oral diseases, particularly periodontitis and dental caries, affect over 3.5 billion people worldwide, representing the most prevalent non-communicable condition identified in global burden of disease surveys.[1-3]

A major challenge in public health and primary care management is the silent nature of early-stage cardiometabolic and oral diseases. Essential hypertension earned the moniker "the silent killer" because vascular structural remodeling and elevated systemic peripheral resistance develop insidiously without overt clinical symptoms. Similarly, chronic hyperglycemia in early T2DM induces microvascular and macrovascular damage for years prior to formal clinical diagnosis. In oral pathology, chronic periodontitis progresses with minimal acute pain, leading to gradual alveolar bone destruction, tooth mobility, and ultimate tooth loss before affected individuals seek professional dental care.[4-6]

Consequently, a vast reservoir of undiagnosed hypertension, undiagnosed diabetes, and unmanaged periodontal breakdown exists within community populations, particularly in low- and middle-income regions where routine health check-ups are underutilized. Delaying diagnosis until clinical complications manifest—such as stroke, ischemic heart disease, diabetic retinopathy, nephropathy, or extensive tooth loss—greatly increases healthcare costs and reduces quality of life.

Growing pathophysiological evidence demonstrates that oral health is inextricably linked to systemic cardiometabolic status. Chronic periodontitis acts as a low-grade systemic inflammatory burden. Subgingival bacterial pathogens (such as Porphyromonas gingivalis) and locally produced pro-inflammatory cytokines (IL-1 beta, IL-6, TNF-alpha) enter the systemic circulation, driving acute-phase hepatic protein synthesis (such as C-reactive protein), exacerbating systemic insulin resistance, and impairing vascular endothelial nitric oxide bioavailability. Conversely, systemic hyperglycemia impairs neutrophil function

and microvascular repair, accelerating periodontal tissue degradation. [7-8]

Despite these established physiological links, community screening programs often operate in silos: cardiovascular drives focus exclusively on blood pressure, diabetes camps evaluate capillary glucose alone, and dental outreach events assess oral cavities without measuring basic vital signs. Evaluating the simultaneous community prevalence of undiagnosed hypertension, undiagnosed diabetes, and poor oral health within a single, integrated screening framework provides critical evidence for public health policy. [9-10]

Therefore, this community-based screening study was undertaken to evaluate the prevalence of undiagnosed hypertension, undiagnosed diabetes mellitus, and poor oral health status in an adult population, and to analyze their clinical co-occurrence.

2. Rationale of the Study

Community outreach programs offer an ideal opportunity to detect early, asymptomatic non-communicable diseases before irreversible systemic or oral organ damage occurs. Because hypertension, diabetes mellitus, and periodontitis share common socio-demographic risk factors and chronic inflammatory pathways, screening for a single condition in isolation misses valuable opportunities for early secondary prevention. Quantifying the co-occurrence of undiagnosed cardiometabolic conditions and oral health degradation provides an empirical foundation for designing integrated, multi-disease screening protocols in primary care and community outreach settings.

3. Objectives

Primary Objective

To determine the community-based screening prevalence of undiagnosed hypertension, undiagnosed diabetes mellitus, and poor oral health status in an adult population.

Secondary Objectives

1. To assess oral health metrics (Community Periodontal Index for Treatment Needs, Clinical Attachment Loss, Simplified Oral Hygiene Index, missing teeth) across screened participants.

2. To evaluate the co-occurrence and clustering of poor oral health status with undiagnosed hypertension and undiagnosed diabetes.

3. To compare clinical cardiometabolic variables (systolic/diastolic blood pressure, fasting capillary glucose) between participants with good versus poor oral health status.

4. To identify independent socio-demographic and oral health predictors of co-existing undiagnosed systemic cardiometabolic disease using multivariable logistic regression.

4. Materials and Methods

4.1 Study Design and Setting

A hospital-affiliated, community-based cross-sectional screening study was conducted at Sahiwal Teaching Hospital.

4.2 Study Duration

The study was conducted over an eight-month period, encompassing community mobilization, outreach clinic execution, standardized clinical screening, laboratory point-of-care testing, intraoral examinations, data processing, and statistical modeling.

4.3 Study Population

Adult men and women aged 30 to 70 years residing in surrounding community catchment areas who voluntarily attended mobile health screening camps.

4.4 Sample Size

A sample size of 160 adult participants was enrolled. The sample size was calculated using G-Power software based on estimating a population prevalence of undiagnosed hypertension of 25 to 30 percent, with a 95 percent confidence interval, a 5 percent margin of error, and an alpha level of 0.05.

4.5 Inclusion Criteria

1. Adults aged 30 to 70 years.

2. No prior formal medical diagnosis of hypertension or diabetes mellitus, and not currently receiving antihypertensive or anti-diabetic pharmacotherapy.

3. Ability to undergo seated blood pressure measurement, fasting capillary blood glucose sampling, and basic intraoral examination.

4. Provision of written informed consent.

4.6 Exclusion Criteria

1. Known, medically documented diagnosis of hypertension, type 1 or type 2 diabetes mellitus, or current use of blood pressure or glucose-lowering medications.

2. Self-reported history of major cardiovascular events (myocardial infarction, stroke, heart failure) or end-stage renal disease.

3. Active acute systemic infection, fever, or emergency medical condition requiring immediate hospital transfer.

4. Pregnancy or active lactation.

5. Completely edentulous individuals lacking scorable natural teeth for periodontal assessment.

4.7 Community Screening Protocol and Data Collection

Screening camps were established in accessible community community centers. Participants were requested to attend after an overnight fast (minimum 8 hours). A structured questionnaire recorded socio-demographic parameters (age, sex, education, household income), tobacco and alcohol consumption history, and personal/family medical history.

4.8 Clinical and Laboratory Screening

- Body Mass Index (BMI): Height was measured using a portable stadiometer (cm) and weight using a calibrated digital balance (kg). BMI was calculated as kg/m squared.

- Blood Pressure Measurement: Seated blood pressure was measured after 10 minutes of quiet rest using a validated digital sphygmomanometer with an appropriately sized cuff. Two readings were taken 5 minutes apart and averaged.

    - Undiagnosed Hypertension Definition: Systolic Blood

Pressure (SBP) >= 140 mmHg and/or Diastolic Blood Pressure (DBP) >= 90 mmHg (based on Seventh Report of the Joint National Committee / WHO screening criteria).

- Fasting Capillary Blood Glucose (FBG): Measured using a calibrated point-of-care glucometer utilizing enzymatic glucose oxidase test strips from capillary fingerstick blood after an 8-hour fast.
    - Undiagnosed Diabetes Mellitus Definition: Fasting capillary glucose >= 126 mg/dL (7.0 mmol/L). Impaired Fasting Glucose (IFG) was defined as FBG 100 to 125 mg/dL.

4.9 Intraoral Examination

Intraoral evaluations were performed by calibrated dental examiners under headlamp illumination using a WHO periodontal probe and mouth mirror. Recorded metrics included:

- Community Periodontal Index for Treatment Needs (CPITN): Scored 0 to 4 (0 = Healthy; 1 = Bleeding on probing; 2 = Calculus; 3 = Shallow pockets 4–5 mm; 4 = Deep pockets >= 6 mm).
- Clinical Attachment Loss (CAL in mm): Measured from the cemento-enamel junction to the pocket base across index teeth.
- Simplified Oral Hygiene Index (OHI-S): Sum of Debris Index (DI-S) and Calculus Index (CI-S), scored 0 to 6.
- Missing Teeth: Count of missing natural teeth (excluding third molars).
- Poor Oral Health Definition: Operationalized as presence of CPITN Code 3 or 4 (moderate-to-severe periodontitis) and/or OHI-S > 3.0 (poor oral hygiene).

4.10 Statistical Analysis

Data were analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY). Continuous variables were assessed for normality using the Kolmogorov-Smirnov test and expressed as mean +/- standard deviation. Categorical

variables were presented as absolute numbers and percentages.

Proportions of undiagnosed hypertension, undiagnosed diabetes, and poor oral health were calculated. Comparisons between sub-groups (e.g., normoglycemic vs. undiagnosed diabetes; normotensive vs. undiagnosed hypertension) were conducted using Student's t-test for continuous parameters and Pearson's Chi-square test or Fisher's exact test for categorical parameters. Bivariate correlations evaluated relationships between SBP, FBG, CAL, and OHI-S. Multivariable binary logistic regression was performed to identify independent factors associated with the presence of at least one undiagnosed cardiometabolic condition (hypertension or diabetes). Statistical significance was defined as a two-sided $p < 0.05$.

5. Results

5.1 Demographic Characteristics of the Screened Cohort

The total screened sample comprised 160 adults (mean age 48.6 +/- 10.8 years; 88 females [55.0 percent], 72 males [45.0 percent]). Overall, 42.5 percent of participants were overweight or obese (BMI >= 25 kg/m squared), and 38.8 percent reported current tobacco use (smoked or smokeless).

Demographic / Clinical Variable	Total Screened Cohort (n = 160)
Age (years)	48.6 +/- 10.8
Age Category, n (%)	
- 30 to 49 years	86 (53.8)
- 50 to 70 years	74 (46.2)
Female Sex, n (%)	88 (55.0)
Male Sex, n (%)	72 (45.0)

Demographic / Clinical Variable	Total Screened Cohort (n = 160)
Body Mass Index (kg/m squared)	25.4 +/- 4.2
Overweight / Obese (BMI >= 25 kg/m squared), n (%)	68 (42.5)
Current Tobacco User, n (%)	62 (38.8)
Formal Education (< Primary Level), n (%)	58 (36.3)

Table 1: Baseline demographic characteristics of the community-screened population.

5.2 Screening Prevalence of Undiagnosed Conditions

Screening identified undiagnosed hypertension in 31.3 percent (n = 50) of participants. Undiagnosed diabetes mellitus was identified in 18.8 percent (n = 30), while an additional 25.0 percent (n = 40) presented with impaired fasting glucose (IFG). Poor oral health status was detected in 62.5 percent (n = 100) of screened adults, with severe periodontitis (CPITN Code 4) present in 28.1 percent (n = 45).

Condition Screened	Screening Outcome Category	Prevalence, n (%)	95% Confidence Interval
Blood Pressure Status	Normotensive (BP < 120/80 mmHg)	62 (38.8)	31.2–46.7
	Prehypertension (BP 120–139 / 80–89)	48 (30.0)	23.0–37.7
	Undiagnosed Hypertension (BP >= 140/90)	**50 (31.3)**	**24.2–39.0**

Condition Screened	Screening Outcome Category	Prevalence, n (%)	95% Confidence Interval
Glycemic Status	Normal Fasting Glucose (FBG < 100 mg/dL)	90 (56.3)	48.2–64.1
	Impaired Fasting Glucose (FBG 100–125)	40 (25.0)	18.5–32.5
	Undiagnosed Diabetes (FBG >= 126 mg/dL)	**30 (18.8)**	**13.0–25.7**
Oral Health Status	Good / Moderate Oral Health	60 (37.5)	30.0–45.4
	Poor Oral Health Status (Overall)	**100 (62.5)**	**54.6–70.0**
	- CPITN Code 3 (Shallow Pockets 4–5 mm)	55 (34.4)	27.1–42.2
	- CPITN Code 4 (Deep Pockets >= 6 mm)	45 (28.1)	21.3–35.8
	- Poor Oral Hygiene (OHI-S > 3.0)	68 (42.5)	34.8–50.5

Table 2: Screening prevalence of undiagnosed hypertension, undiagnosed diabetes, and poor oral health.

5.3 Co-occurrence of Oral Health Status with Undiagnosed Cardiometabolic Conditions

Participants with undiagnosed diabetes exhibited a significantly higher prevalence of severe periodontal disease (CPITN Code 4) compared to normoglycemic participants (50.0 percent vs. 23.1 percent, p = 0.003). Similarly, participants with undiagnosed hypertension displayed significantly higher Clinical Attachment Loss (4.2 +/- 1.4 mm vs. 2.8 +/- 1.1 mm, p < 0.001) and greater tooth loss (5.2 +/- 2.4 vs. 2.6 +/- 1.5 teeth, p < 0.001) than normotensive adults.

Oral Metric / Condition	**Normotensive (n = 62)**	**Prehypertension (n = 48)**	**Undiagnosed HTN (n = 50)**	**p-value**
Clinical Attachment Loss (mm)	2.8 +/- 1.1	3.4 +/- 1.2	4.2 +/- 1.4	<0.001
Simplified Oral Hygiene Index (OHI-S)	2.1 +/- 0.8	2.8 +/- 0.9	3.5 +/- 1.1	<0.001
Total Missing Teeth (n)	2.6 +/- 1.5	3.8 +/- 1.8	5.2 +/- 2.4	<0.001
Oral Metric / Glycemic Status	**Normal Glucose (n = 90)**	**IFG (n = 40)**	**Undiagnosed DM (n = 30)**	**p-value**
CPITN Code 4 (Severe Periodontitis), n (%)	21 (23.3)	9 (22.5)	15 (50.0)	0.003
Clinical Attachment Loss (mm)	2.9 +/- 1.2	3.2 +/- 1.1	4.6 +/- 1.5	<0.001

Oral Metric / Condition	Normotensive (n = 62)	Prehypertension (n = 48)	Undiagnosed HTN (n = 50)	p-value
Total Missing Teeth (n)	3.0 +/- 1.6	3.6 +/- 1.9	5.8 +/- 2.6	<0.001

Table 3: Oral health metrics stratified by blood pressure and glycemic screening categories.

5.4 Clustering of Undiagnosed Systemic and Oral Conditions

Overall, 41.3 percent (n = 66) of screened adults presented with at least one undiagnosed systemic cardiometabolic condition (hypertension or diabetes). Among participants with poor oral health (n = 100), 52.0 percent (n = 52) had co-existing undiagnosed hypertension or diabetes, compared to only 23.3 percent (n = 14) among those with good oral health (p = 0.001).

Disease Clustering Category	Number of Participants (n = 160)	Percentage (%)
No Undiagnosed Systemic or Oral Condition	38	23.8
Poor Oral Health Alone (No Systemic Disease)	48	30.0
Undiagnosed Systemic Disease Alone (HTN or DM)	14	8.8
Combined Poor Oral Health + Undiagnosed Systemic Disease	**52**	**32.5**
- Poor Oral Health + Undiagnosed Hypertension	32	20.0

Disease Clustering Category	Number of Participants (n = 160)	Percentage (%)
- Poor Oral Health + Undiagnosed Diabetes	12	7.5
- Poor Oral Health + BOTH Undiagnosed HTN and DM	8	5.0

Table 4: Clustering of undiagnosed systemic cardiometabolic diseases and poor oral health status.

5.5 Multivariable Logistic Regression Analysis

In multivariable binary logistic regression modeling for the presence of at least one undiagnosed systemic cardiometabolic condition (hypertension or diabetes), age >= 50 years (adjusted OR = 2.84, 95 percent CI: 1.32 to 6.12, p = 0.007), severe periodontitis (CPITN Code 4; adjusted OR = 3.18, 95 percent CI: 1.45 to 6.98, p = 0.004), poor oral hygiene (OHI-S > 3.0; adjusted OR = 2.42, 95 percent CI: 1.15 to 5.08, p = 0.020), and overweight/obesity (BMI >= 25 kg/m squared; adjusted OR = 2.26, 95 percent CI: 1.08 to 4.72, p = 0.031) were confirmed as independent predictors.

Predictor Variable	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Age >= 50 Years (vs. < 50 Years)	3.42 (1.75–6.68)	<0.001	2.84 (1.32–6.12)	0.007
Severe Periodontitis (CPITN Code 4)	4.12 (1.98–8.58)	<0.001	3.18 (1.45–6.98)	0.004
Poor Oral Hygiene (OHI-S > 3.0)	3.28 (1.65–6.52)	0.001	2.42 (1.15–5.08)	0.020

Predictor Variable	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Overweight / Obese (BMI >= 25 kg/m squared)	2.88 (1.45–5.72)	0.002	2.26 (1.08–4.72)	0.031
Current Tobacco User	2.14 (1.10–4.18)	0.025	1.48 (0.71–3.08)	0.294
Male Sex	1.38 (0.72–2.64)	0.328	1.12 (0.54–2.32)	0.762

Table 5: Multivariable logistic regression predicting presence of undiagnosed cardiometabolic disease.

6. Discussion

This community-based screening study evaluated the prevalence of undiagnosed hypertension, undiagnosed diabetes mellitus, and poor oral health status among adults, revealing high burden rates for all three conditions. Nearly one-third (31.3 percent) of screened adults harbored undiagnosed hypertension, nearly one-fifth (18.8 percent) had undiagnosed diabetes, and nearly two-thirds (62.5 percent) presented with poor oral health. Crucially, severe oral health degradation strongly clustered with undiagnosed systemic cardiometabolic conditions.

6.1 Public Health Significance of Undiagnosed Disease Burden

The high prevalence of undiagnosed hypertension and diabetes reflects broader regional challenges in primary healthcare utilization, health literacy, and opportunistic screening. In many community settings, adults do not seek medical care unless severe, debilitating symptoms develop. Because hypertension and early hyperglycemia cause minimal overt discomfort, affected individuals remain unaware of their condition, allowing vascular remodeling,

arterial stiffening, and microvascular end-organ damage to progress unchecked.

Similarly, chronic oral health degradation—manifested as CPITN Code 3/4 periodontitis and poor oral hygiene—was identified in 62.5 percent of participants. Periodontitis is frequently ignored by patients in its early stages due to lack of pain, being perceived merely as occasional "gum bleeding" until severe mobility or tooth loss occurs.

Concurrently, severe periodontitis serves as a systemic inflammatory reservoir. Chronic bacterial translocation and systemic entry of endotoxins maintain elevated systemic levels of CRP, IL-6, and TNF-alpha. This low-grade inflammatory state induces vascular endothelial dysfunction—reducing nitric oxide availability—and impairs insulin receptor signaling in skeletal muscle and adipose tissue, fostering both elevated blood pressure and impaired glycemic control.

6.2 The Oral-Cardiometabolic Clustering Dynamic

A central finding of this study is the marked co-occurrence of poor oral health with undiagnosed hypertension and diabetes. Participants with undiagnosed diabetes had double the prevalence of severe periodontitis (50.0 percent) compared to normoglycemic individuals. Hyperglycemia induces non-enzymatic glycation of proteins, forming advanced glycation end-products (AGEs). Binding of AGEs to their cell-surface receptors (RAGE) on endothelial cells and macrophages upregulates pro-inflammatory cytokine production, impairs capillary basement membrane permeability, and compromises periodontal ligament repair.

6.3 Rationale for Integrated Community Screening Models

Currently, public health screening campaigns operate in disciplinary silos: medical camps screen blood pressure and glucose, while dental camps evaluate teeth in isolation. Our findings provide strong empirical justification for integrated, multi-disease screening models. Incorporating a 2-minute seated blood pressure measurement and capillary fingerstick glucose test into routine dental outreach events—or conversely, adding a basic 1-minute intraoral visual inspection for gum bleeding, calculus, and tooth loss into primary care medical screening—would dramatically improve early case detection for both cardiometabolic and oral diseases at minimal additional cost.

6.4 Limitations

Several limitations of this study should be noted. First, as a cross-sectional screening study, diagnostic confirmation of hypertension and diabetes relied on single-visit screening cutoffs (seated BP and fasting capillary glucose); definitive clinical diagnosis requires follow-up diagnostic testing on a separate day. Second, HbA1c testing was not universally available in this field outreach setting. Third, radiograph-based alveolar bone loss measurements were not performed during field intraoral screening, relying instead on clinical probing metrics (CPITN, CAL).

7. Conclusion

Undiagnosed hypertension, undiagnosed diabetes mellitus, and chronic oral health degradation represent highly prevalent, co-existing health challenges among community-dwelling adults. Poor oral health status and severe periodontitis independently correlate with undiagnosed systemic cardiometabolic disease. Implementing integrated, multi-disease community screening programs that combine cardiovascular vital sign checks, point-of-care glycemic testing, and basic oral health evaluations offers a highly efficient strategy for early disease detection and primary prevention.

8. Recommendations

1. Establish integrated community screening protocols combining blood pressure measurement, point-of-care fasting glucose testing, and basic intraoral screening in outreach health camps.

2. Train community health workers and primary care nurses to perform basic oral health inspections alongside routine vital sign measurements.

3. Incorporate opportunistic screening for hypertension and diabetes in dental outpatient clinics for adult patients presenting with severe periodontitis or high oral hygiene index scores.

4. Enhance public health education campaigns emphasizing the bidirectional connection linking gum health to heart disease and diabetes management.

5. Conduct prospective longitudinal studies to evaluate whether community-based

identification and early joint management of periodontal disease and cardiometabolic risk factors improve long-term cardiovascular outcomes.

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